Information Updating and Insurance Dropout: Evidence from Dental Insurance*

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Abstract

Micro data from a dental insurance natural experiment is used to analyze why agents opt out of insurance. The purpose is to relate the dropout decision to new information on risk, acquired by the policy holder and the insurer. The results show that agents tend to leave the insurance when reclassified into higher premium classes, or when experiencing unexpectedly low dental care utilization within the insurance. They are more responsive to higher premiums than to lower expected utilization. The results show updating on dental risk to be asymmetric, giving agents and insurer partly different information sets. Higher premiums are viewed as higher prices of insurance rather than fair risk reassessments. Agents do not take the insurer's information fully into account, even though it is public. The decision is also based on old information.

Keywords: Asymmetric information, Adverse Selection, Learning, Health Insurance.
JEL codes: D82, D83, G22, I11.

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1 Introduction

Asymmetric information in insurance markets may reduce the extent of insurance coverage and thereby induce welfare costs. In a survey of the empirical literature, Chiappori and Salanié (2003) find the extent of asymmetric information to vary across different types of insurance markets. Testing the extent of asymmetric information in health insurances, and whether agents act on informational advantages, is therefore important in order to determine the viability of health insurance markets. Already Akerlof (1970) noted that adverse selection can motivate public intervention in health insurance markets.

The evidence of adverse selection in health insurance is mixed. Most empirical studies on health insurance markets use cross-sectional data to observe whether the market equilibrium has properties consistent with adverse selection; see, for example, Savage and Wright (2003), Sapelli and Vial (2003), Thomasson (2002), and Cardon and Hendel (2001). Little is however learned about the dynamics of adverse selection.

Testing how agents react to exogenous shocks can be one strategy for capturing the evolution of an adverse selection externality. Changes in the incentive structure can be one such shock. Bauchmeuller and DiNardo (2002) study the dynamics of the health insurance market in New York State when mandatory community rating was implemented in some segments. They find that healthier agents are more prone to switch into less generous policies, i.e. HMO plans. In a similar way, Cutler and Reber (1998) study the evolution of selection in health plans offered to Harvard employees following a price reform, where the marginal price of coverage was increased. They observe that younger and healthier agents tend to switch from more generous to less generous insurance policies, rather than older and less healthy agents switching in the opposite direction. One remarkable result is the potential speed of an adverse selection death spiral as the most generous health plan collapsed only three years after the price reform. In a similar vein, Nicholson, Bundorf, Stein and Polsky (2003) study health care spending among individuals switching between HMO and non-HMO plans. They find that individuals switching from a non-HMO to a HMO plan used 11 percent less resources prior to switching, than those remaining in the non-HMO plan. Individuals switching from an HMO to a non-HMO plan, on the other hand, used 18 percent more resources prior to switching than those staying within the HMO.

The way that the contracting parties are updating their information on risk has consequences for the persistence of information asymmetries. If updating is asymmetric, either one party may gain an informational advantage over time, or the existing asymmetries will be reduced. There is some indirect evidence about the learning process on health risks. Hendel and Lizzeri (2003) find the premium profiles on the US life insurance market to be consistent with a model of symmetric learning and commitment from the insurer on reclassification risk. Crocker and Moran (2003), in turn, find evidence that the coverage in employer-based health plans is consistent with a model of symmetric learning and friction in the mobility between jobs. The empirical research on how insurers and policy holders update their information on health risks is limited, however.

In this study, micro data is used to analyze why agents opt out of insurance, in a setting where the premium can be changed due to risk reclassification. The purpose is to analyze how the decision to leave insurance coverage is related to new information on risk acquired by the policy holder and the insurer.

The data comes from a dental insurance natural experiment provided by the National Dental Service[1] in the county of Värmland, Sweden. The insurance was introduced in 1999, and offers full-coverage during a two-year contract period. After the initial contract period, 9.6 percent of the policyholders decided not to renew their insurance. This decision is here related to new information on dental health. The results indicate that the updating of information is asymmetric. Policy holders tend to view a higher premium, due to reclassification of risk, as a price increase, rather than a signal of worse dental health. They also tend to be more responsive to higher premiums than to private signals of changed dental risk.

The next section gives a description of the institutional setting and the data. Section three presents a simple theoretical framework for insurance lapsation when information is asymmetrically updated. The empirical results are presented in section four, and the final section contains the concluding remarks.

[1] Folktandvården.

2 Empirical Setting

Dental care in Sweden is provided by both private, mainly self-employed, dentists and the National Dental Service. From the year an individual turns 20, he is covered by a public dental insurance scheme, to which both private and public dentists are affiliated.[2] The public dental insurance was initially designed as a progressive subsidy, with a coverage up to 80 percent of dental costs. Over time, the generosity of the scheme has gradually been reduced in an effort to cut public spending on dental care, making individuals more exposed to the risk of high dental costs. Since 1999, the subsidy is linear, covering around 30 percent of all dental costs (Olsson, 1999).

2.1 Dental Insurance with Risk Reassessment

To counteract the increased risk exposure, the National Dental Service in Värmland, Sweden, introduced a voluntary insurance, in January 1999, where dental patients were offered to subscribe to dental care.[3] The term insurance is not explicitly used by the National Dental Service, but the subscription is in effect a full-coverage voluntary dental insurance provided by a public monopolist. At a fixed annual fee, the subscription provides free dental services during a two-year contract period. It is important to note that dentists within the National Dental Service are employed with a fixed salary and have no direct private interest in the insurance.

The subscription fee is set after an oral examination of the patient. The oral examination evaluates dental risk in four dimensions (general risk, technical risk, caries risk, and parodental risk) and for each dimension there are 6 to 8 risk indicators, where each indicator is rated on a four-graded scale. The risk indicators for each dimension are summed up, and patients are clustered into one of 16 risk classes based on this sum. Contracts are then priced according to risk class. The risk classification is assessing patients' dental health. Dental health never improves, so a patient being upgraded to a higher risk class has experienced a deterioration in his dental health and is viewed as a higher risk. Any downgrading of a patient to a lower risk class follows from new information indicating that the initial classification was erroneous. The National

[2] Dental care is provided free of charge for individuals below the age of 20.

[3] For patients aged 20, the insurance was offered from September 1998.

Dental Service only uses these risk indicators when assessing risk, and does not take realized dental costs explicitly into account.

In 1999, around 60 percent of all patients registered with the National Dental Service in Värmland had a valid risk classification, and were thus given the opportunity to purchase insurance. About 23 percent of these patients—roughly 7,000 individuals—purchased a dental subscription in 1999. The introduction of the dental insurance in 1999 constitutes an ideal situation for studying adverse selection, as no private insurance was available to these individuals before 1999. It was also unanticipated from the patients' perspective, making dental care utilization exogenous to the insurance decision. The launch of the dental plan thus constitutes a natural experiment. The initial decision of whether to purchase insurance is analyzed by Grönqvist (2004), and results differ across risk classes. The estimated evidence of adverse selection is concentrated to high risk classes. Within low risk classes, however, there is evidence consistent with advantageous selection; here, the probability of purchasing dental insurance is increasing with lower expected dental consumption. This latter finding is consistent with findings of Cawley and Philipson (1999) and Finkelstein and McGarry (2003). The results can be explained by heterogeneity in both risk aversion and the effectiveness of prevention, in a model similar to that of de Meza and Webb (2001), where the level of self-protection increases with risk aversion. The overall evidence from the initial decision to purchase insurance, or not, suggests that adverse selection may not be a problem at the aggregate level.

The introduction of the dental insurance in 1999 also creates a setting for studying selection in terms of insurance lapsation. After the two-year contract period, agents must decide whether to continue their subscription for another contract period. Before the insurance can be renewed, patients have their dental risk, and thus their premium, reassessed by the dental service. It turns out that about 10 percent of those agents who found the insurance worth purchasing in 1999 choose not to renew it in 2001.[4] Thus, there must be some new circumstance that makes these agents reconsider their initial decision. Within this dental insurance setting, it is possible to link the decision to lapse from the insurance to proxies of new information. The new information on

[4] This number is net of agents who die or leave the county during the period.

risk, received by the insurer, cannot be directly observed but can be inferred through the up-grading, or down-grading, of agents into new risk classes.

For agents, dental care consumed within the insurance is used as a proxy for new private information. Consumption of dental care and dental cost has a high correlation over time (see, for example, Powell 1998). A person with a history of prior caries has a higher probability of getting new problems. Bacteria will easily grow if the enamel has been coarsened by prior caries, or will grow in the seam between a prior filling and the tooth. A filled tooth will also need future maintenance or replacement, and will be more fragile. Past dental consumption is thus a good predictor of dental risk and future dental consumption. Consequently, if agents have private information, this could be proxied with past costs, since the National Dental Service in Värmland does not explicitly use realized dental costs in their risk assessment. So, if an agent has an unexpectedly high (low) dental consumption within the insurance, he can be viewed as receiving a signal of the dental risk being higher (lower) than his prior expectations.

The risk classification is assessing the long run risk level, not explicitly the expected expenditures during the upcoming two-year contract period. Asymmetric information in this setting may also result from dental consumption potentially following cyclical patterns longer than the two-year contract period. The idea being that high dental consumption, e.g. from investing in a denture, would be followed by a period of low expenditures before the denture needs to be repaired or replaced.

An important question at this stage is whether past dental consumption contains any private information on dental risk, as oral examinations are used by the National Dental Service in Värmland to assess dental risk. To this end, a validity test of the proxy for private information, and whether it is due to a cyclical pattern in dental consumption, is performed. Dental cost for the two years 2000 to 2001 is regressed on dental costs during the two preceding years (1998-1999) and on dummy variables for each of the 16 risk classes. Dental costs for the additional preceding two-year period, 1996 to 1997, are also added to the analysis to capture the long run patterns of dental consumption. If the proxy contains private information, dental consumption during the preceding two years should explain costs in the upcoming two-year period, in excess of the risk classification system. The test is performed on the agents not buying the insurance within the period 1999 to 2001 (n=36 241). The reason for using this group is that dental care within the insurance may be guided by clinical guidelines related to risk classes, thus generating a spurious relation.

[Table 1 about here]

Table 1 reports that past dental costs, 1998 to 1999, alone explain 9 percent of future costs, whereas the risk classification system alone explains 11 percent of the variation[5]. The risk classes are better predictors of future dental costs and contain more information on dental risk than do past costs. When both past dental costs, 1998 to 1999, and the risk classes are used as regressors, 14 percent of the variation in costs in 2000 to 2001 is explained. Hence, a large part, but not all, of the information contained in past dental consumption is also captured by the risk classification system. There is still scope for private information to act on. Past dental consumption captures an additional 27 percent (3 percentage points) of the variation in future dental costs not captured by the risk classification system. The coefficient on *Cost 98-99* is positive, demonstrating that high dental consumption during the previous two-year period indicates higher dental care expenditures in the next two years. This rejects the notion that any private information would be due to cyclical patterns in dental consumption not captured by the risk classification system. Instead the predictive power would be due to the anatomy of dental problems giving a positive correlation over time. Next, when dental consumption for the period 1996 to 1997 is added to the analysis the explanatory power increases; 16 percent of the variation in dental costs 2000 to 2001 is explained. The predictive power of *Cost 96-97*, in excess of *Cost 98-99* and the risk classification, indicates that there is a cyclical component in dental care, even if this component does not explain predictive power of the chosen proxy for private information.

[5] For risk classes 14 to 16 the coefficients do not follow the increasing pattern expected for higher risk classes. This is due to the low number of patients, 229 out of the 36 241 (0.64 percent), belonging to any of the top three risk classes in the chosen sample. Chance thus has a larger scope.

2.2 Data

Data comes from an administrative database on dental care. The sample consists of those patients who started to subscribe to dental care in 1999, and who were registered with the dental service in Värmland during the period 1997 to 2001.[6] Patients need to be registered until 2001, so that they can be observed throughout the contract period. They also need to be registered from 1997, so that their dental consumption can be tracked during the two-year period before the insurance purchase.

The sample consists of 5998 patients, of whom 9.6 percent, or 575 individuals, choose to drop out after the initial two-year contract period. Policy holders are mainly clustered in the low- and middle-risk classes, with over 90 percent of the individuals in the sample belonging to the eight lowest risk classes. None of the policy holders in the sample belong to any of the three top risk classes (14-16). The decision to opt-out is slightly increasing with higher risk classes.

[Table 2 about here]

Private information on risk is proxied with past dental costs. The variable *pre-cost* contains the cost of dental care during the two-year period prior to the insurance purchase[7] and gives a measure of agents' private information at the time when the initial decision to sign-up was made. *diff-cost*, in turn, captures the signal received by the agent during the insurance period and it is defined as the cost of dental care within the insurance minus pre-cost.[8] A high value of diff-cost indicates an unexpectedly high dental consumption, as compared to the prior period. Pre-cost and diff-cost are

[6] Patients aged 20 in 1998 were given the offer already in September 1998, as part of a pilot project. These patients are included in the sample, even if they bought the insurance at the end of 1998. In this case, however, they need to have been registered with the National Dental Service since 1996, but need not be registered in 2001.

[7] *Pre-cost* is the amount charged by the National Service in Värmland, and calculated by applying the gross price list to procedures chargeable to patients.

[8] Dental care within the insurance is not registered as specific procedures. Instead, it is registered within broader groups of procedures and as the time used by the relevant staff category (dentist, hygienist, nurse). To calculate dental cost, the time usage is summed up using the time tariff. From 1999, there are, however, no explicit time tariffs for hygienist and nurse services. These are calculated as fractions of the time tariff for dentists, using the price list in 1995 to 1998 as a key.

measured in SEK (1 SEK = 0.128 USD in January 1999)

The signal received by the dental service can be inferred from the risk reclassification and is measured as premium changes in SEK, so *diff-prem* is measured in the same units as diff-cost and is directly comparable in numbers. The variable diff-prem only includes premium changes due to patients being reclassified into higher or lower risk classes, and does not capture the general price increase over all risk classes. Between January 1999 and May 2001, all premiums increased by 11 percent. Consumer prices increased by 5 percent during the same period, while the general price level for medical and dental services increased by 16 percent (Statistics Sweden).

The data also includes information on patients' age and gender. The decision to opt out may be influenced by the attitudes of the treating dentist. To capture this influence, a dummy variable for each of the 43 clinics is used. Descriptive statistics of the variables are displayed in table 2.

3 Dropout under Asymmetric Updating

If agents lapse in their insurance coverage, there must be some new circumstance that makes the insurance no longer worth buying. There may be a number of reasons for opting out; premiums may have increased due to higher loading or higher dental consumption due to moral hazard. Also, policy-holders' wealth circumstances or their degree of risk aversion may have changed. The focus here, however, is how the decision to opt out is related to new information on risk and whether updating of information is asymmetric. The decision to opt out is viewed as a response to new information on risk obtained by the insurer and the policyholder, in a setting that captures the dental insurance in Värmland.

3.1 Dropout Decision

Agents are assumed to live in a world where they face the risk of a financial loss, and where an insurer offers a full coverage insurance. Neither the agent nor the insurer have perfect knowledge of the risk level, but make an assessment of the risk. The policy is priced based on the insurer's inference of the agent's risk level.

For an agent to find a full coverage insurance worth buying, it must give him an assured wealth level, Z_i, at least as high as the certainty equivalence, CE_i. Hence, if the agent initially bought the insurance in the beginning of period 0 then $CE_{i0} < Z_{i0}$.

During period 0 both the agent and the insurer receive new information, making them reassess the agent's risk level. If the agent decides to opt out at the beginning of period 1, at least one part—the agent or the insurer—must have obtained new information on the agent's risk level. If the learning process is symmetric the agent adjusts his willingness to pay for the insurance by the same amount as the insurer changes the premium, and there is no lapsation due to updating. If signals are asymmetric, on the other hand, agents may in fact discontinue their insurances; either (i) when the agent lowers the assessed risk level more than the insurer does, or (ii) when the insurer receives a signal to raise the assessed risk level and it is not matched by the signal received by the agent. In both cases the insurance becomes relatively more expensive from the agent's perspective.

In the first situation, the agent gets a signal indicating that his risk is lower than expected, reducing his assessed risk level at the beginning of period 1. With a lower perceived risk, his cost of being uninsured is reduced, implying that $CE_{i1} > CE_{i0}$. If the insurer also gets a signal indicating the agent having lower risk, the updated risk assessment will make him reduce the insurance premium, thereby increasing the wealth level assured by the insurance $Z_{i1} > Z_{i0}$. Whether the agent will continue to purchase insurance in period 1 depends on the size of these signals. If the signal received by the agent is sufficiently large relative that of the insurer, the certainty equivalent will become larger than the wealth assured by insurance, $CE_{i1} > Z_{i1}$. Thus, even if the premium has been reduced, the agent will no longer find the insurance worth its price, and will opt out.

In the second situation, the insurer receives a signal to raise the assessed risk level not matched by the agent. The updated risk assessment will make the insurer raise the insurance premium for period 1, which implies that the wealth assured by having insurance is reduced, $Z_{i1} < Z_{i0}$. If the agent also gets a signal during period 0 indicating that the risk level is higher than anticipated he will be willing to purchase a more expensive insurance in period 1, $CE_{i1} < CE_{i0}$. When the signal received by the insurer is sufficiently large relative to that received by the agent, the income with insurance will become lower than the certainty equivalent, $CE_{i1} > Z_{i1}$. The price of the insurance has increased more than what the agent is willing to accept, so he drops out.

If the responsiveness to signals is not sufficiently large, however, or if asymmetric updating makes the policy relatively cheaper from the agent's perspective, he will not opt out.

3.2 Dropout consequences

Insurance lapsation due to updating follows from signals of new information being asymmetric in a certain way. The consequences of insurance dropout depend on the quality of new information.

At signals indicating better than expected health, agents only lapse their contract if they reduce the assessed risk level more than the insurer. The agents opting out are those believing that they have lower risk than previously expected. If this belief is correct, lapsation will lead to problems of adverse selection, since the risks opting out are the good ones. If the signal is false—and the insurer's assessment is more correct—there will be no problems of adverse selection.

When new information indicates higher risk, on the other hand, there is only lapsation if the insurer increases the assessed risk level more than the agent does. If the insurer's reassessment is correct, the self-selection out of insurance occurs because the insurer has improved on its risk classification, which can be viewed as reducing the problems of adverse selection. If, however, the insurer's signal is erroneous—and the agent's assessment is more correct—the risks opting out are the good ones, thereby aggravating the problem of adverse selection.

Hence, lapsation will lead to adverse selection, if agents' risk reassessment is more accurate than that of the insurer, irrespective of whether lapsation follows from good or bad news. Adverse selection has negative welfare consequences as the scope of coverage provided by the market is reduced, potentially eliminating the insurance in a death spiral.

Now, even if the insurer's reassessment is more correct, agents lapsing their contract imply an inefficiency as risk averse agents always take a fair insurance. Agents here opt out even though the policy becomes more fair, and also fairer than their preferred policy.

3.3 Empirical Strategy

If a patient gains from not renewing the contract, $U^I < U^{NI}$, there is some new information that makes him reconsider his initial decision. The decision on whether to opt out is related to signals on risk and analyzed with a binary choice model.

With symmetric learning, the decision to opt out of insurance is not related to signals of new information; that is, if the insurer gets a signal indicating the risk level of an agent to be higher than expected, he will raise the agent's premium accordingly. The agent, in turn, will regard the increase in the premium as fair and will not opt out, as he receives an equivalent signal. Likewise, if the agent receives a signal indicating lower risk, his willingness to pay for insurance is reduced. The agent will still not opt out as the insurance premium is accordingly reduced, while the insurer receives an equivalent signal. The hypothesis of symmetric updating can be tested by estimating the following model

$$Prob(y_{i1} = 1) = Prob(U_{i1}^{NI} > U_{i1}^{I}) = g(S_{i0}^{j}, P_{i0}^{A}, P_{i0}^{I}, X_i, \varepsilon_{i1}), \tag{1}$$

and testing for $g_1 = 0$, where S_{i0}^j for $j = I, A$ is the signal of new information received during period 0 by the insurer and the agent, respectively. Positive (negative) values on the signal implies that new information indicate the risk to be larger (smaller) than expected. P_{i0}^j for $j = I, A$ is the prior on risk in the beginning of period 0 for the insurer and the agent, respectively, and ε_{i1} is the error term in the econometric model. Individual specific reasons for opting out—other than asymmetric updating—are captured by the error term, assuming them to be independent of the signals of new information. The general tendency to opt out is captured by the constant term in the regression model. The covariate vector X_i contains age and gender to capture socioeconomic and behavioral differences, and a dummy variable for each clinic to capture potential differences in praxis style. If $g_1 = 0$ cannot be rejected agents lapse their coverage for reasons other than asymmetric updating.

If the hypothesis of symmetric learning is rejected, asymmetric updating is studied by estimating the following model

$$Prob(y_{i1} = 1) = Prob(U_{i1}^{NI} > U_{i1}^{I}) = f(S_{i0}^{A}, S_{i0}^{I}, P_{i0}^{A}, P_{i0}^{I}, X_i, \varepsilon_{i1}). \tag{2}$$

In the dental insurance setting, the signal received by the insurer is not really private. It can be inferred by observing the premium changes due to risk reclassification. These signals are thus public and available to the agents. If an agent believes the insurer to be guided by new and valid information, he should incorporate this information and only act on his private information. That is, the decision on whether to opt out should not be influenced by premium change, as this change reflects new information on risk obtained by the insurer. If agents incorporate the insurer's signal in addition to their private signals, the marginal effects will be $f_1 < 0$ and $f_2 = 0$.

Now, if the agent does not—or only partly—incorporate information obtained by the insurer, the contracting parts will have disjoint information sets if updating is asymmetric, and the marginal effects will be $f_1 < 0$ and $f_2 > 0$. The two situations where asymmetric updating lead to lapsation generate the same reduced-form predictions. In both cases the insurance policy becomes relatively more expensive from the agent's perspective. (i) When the new information indicates that the agent has a higher risk than expected, he will opt out if the premium increase is higher than the increase in his willingness-to-pay. That is, the higher the insurer's signal, conditional on the agent's signal, the greater is the likelihood of the agent opting out. (ii) When new information reveals that the agent has lower risk than expected, the agent opts out if his willingness-to-pay is reduced more than the premium. That is, the lower the agent's signal, conditional on the insurers signal, the greater is the likelihood of the agent opting out.

To analyze whether the response to asymmetric updating is the same when premiums are not reduced sufficiently as when premiums are raised too much, dropout behavior is analyzed separately for premium decreases and increases.

From the reduced form model it is not possible to determine who has the informational advantage, only whether updating is asymmetric or not.

4 Results

A first conclusion from the empirical results is that the hypothesis of symmetric updating is not supported by the data. In model 1, table 3, the decision to opt out of insurance is regressed only on the proxy for the insurer's signal, i.e. diff-prem, and not on the signal received by agents, i.e. diff-cost. Dummy variables for each risk group and previous dental costs are included to control for the information available at the time of the initial decision to enter the insurance. In addition, the effect of age, gender, and variation across clinics (fe clinics) are controlled for. The results show diff-prem to be positive and highly significant. Agents are more likely to drop out when the insurer increases its assessment of the risk level. Replacing diff-prem by diff-cost in model 2 gives similar results; diff-cost is negative and significant. Agents receiving a signal of risk being lower than expected are more likely to drop out, indicating that the premium is not accordingly reduced. Had learning on risk been symmetric, these signals would not have been significant.

[Table 3 about here]

To identify the determinants of selection out from insurance, both diff-prem and diff-cost are included as explanatory variables in model 3. Both variables are significant, and the responsiveness to diff-prem is more than three times as large as to diff-cost. This rejects the hypothesis that agents deduce the insurer's signal through the observed risk reclassification, and then append this additional information to their information sets. Instead, agents and insurer have, at least in part, different information sets. The higher responsiveness to diff-prem may be due to higher premium representing a loss with certainty, while a lower diff-cost represents uncertain gains in risk. Increases and decreases in premiums are included as separate variables in model 4, table 4. The parameter estimate for premium increases is considerably larger than the estimate for reductions, but the difference does not reach significance (p-value = 0.210). A premium increase, net of private signals, is at least partly regarded by agents as a price increase, rather than a fair risk reassessment. The risk reclassification by dentists is based on specific risk indicators within the scope of an oral examination, and the outcome is available to patients via their dentist. Therefore, it would have been natural if patients had seen this risk reassessment as legitimate and based on objective criteria.

[Table 4 about here]

The responsiveness of new information may differ across risk classes, as the relative impact of a Krona's worth of change in premium and dental consumption differs. Different slopes are therefore allowed for low, medium, and high risk classes, where the four lowest risk classes are defined as low, classes 5 to 8 as medium, and risk classes 9 to 13 as high. In model 5, table 4, where different slopes are allowed for diff-prem, the effect does not differ between high and low risk classes. Diff-prem is positive and significant throughout. The hypothesis of equal slopes cannot be rejected (p-value = 0.458); higher premiums are viewed as the same type of price increases, regardless of risk class. For diff-cost, on the other hand, the effect differs across risk classes (p-value = 0.031). In low risk classes, high values of diff-cost will reduce the probability of lapsation more than in high risk classes.

A noteworthy result is that pre-cost—agents' information at the time of the initial insurance decision—is negative and significant. Lower dental cost prior to purchasing insurance increases the probability of opting out. This information was available already in the decision to sign-up, and should therefore have no bearing on the decision to lapse the insurance.

Another remarkable result is that the constant term is increasing with higher risk classes; that is, controlling for the effect of both old and new information, agents in higher risk classes have higher probabilities of opting out. During the period, all risk classes were subject to a proportional price increase (11 percent between January 1999 and June 2001), which translates into larger out-of-pocket costs for higher risk groups. One interpretation would be that patients are more sensitive to larger nominal premium increases, being liquidity constrained.

The probability of opting out of insurance is reduced with higher age, the interpretation of which is ambiguous. It can be that age contains information on changes in risk that is neither captured in the risk classification nor in past dental consumption. It can also be the case that the propensity to insure risk increases with age. Moreover, men are less likely to opt out than women.

[Table 5 about here]

[Table 6 about here]

[Table 7 about here]

The results can also be captured by depicting the typical patient lapsing the insurance. Table 5 reports that the National Dental Service in Värmland makes larger profits on patients that opt out,[9] which implies that, on average, patients opting out have lower dental costs than their peers in the same risk class. Patients who opt out also receive higher average premium increases, as seen in table 6. However, considering all patients receiving higher premiums, in table 7, it is seen that the profit on these agents is negative. For patients remaining in the same risk class, the profit is positive, and positive and still higher for patients reclassified into a lower risk class. Hence, patients upgraded to a higher risk class are, on average, those having generated losses to the dental service, but there is a large variability.

The National Dental Service is reassessing patients' risk level on basis of certain risk indicators. These indicators do not only pick up information contained in dental cost, thus some patients receiving higher premiums actually have a lower dental cost relative to peers in the same risk class. The typical patient leaving the insurance is someone generating profits but still receiving a higher premium. Whether lapsation is due to an adverse selection process depends on who is making the best assessment on future risk. If the risk indicators go wrong for this group of patients, there is adverse selection, but if the indicators actually pick up new risk not contained within realized dental consumption, there is instead inefficiency due to a communication problem between dentist and patient.

[Table 8 about here]

[9] The profit for each patient is calculated by subtracting the cost of his dental care (within the contract) from the revenue he generates. The revenue consists of the premium paid by the patient, plus a lump-sum of 200 SEK from the Public Insurance Office (Försäkringskassan). This lump-sum corresponds to the average reimbursement from the public dental insurance scheme, covering all adults in Sweden (see section 2). It is paid out to induce neutrality towards patients outside the private dental insurance.

A next issue is whether insurance dropout due to asymmetric updating has an economic importance. To get an impression of the economic significance of the estimated effects in model 3, table 3, the probability of opting out is first evaluated at the sample mean of all included variables, and then compared to the probability when diff-prem is increased and diff-cost reduced with one standard deviation, respectively, see table 8. At the sample mean, the probability of dropping coverage is 6.9 percent. When diff-prem is increased with one standard deviation the probability of opting out increases with 55 percent—to 10.7 percent. A decrease in diff-cost with one standard deviation, in turn, raises the probability of dropping coverage with 39 percent—to 9.6 percent. Hence, the behavioral response to asymmetric learning on risk is substantial in the present setting.

5 Discussion

There are many reasons why agents may fail to renew an insurance. The aim here is to analyze how the decision is affected by new information on risk. Asymmetric updating of information may lead agents' to terminate their insurance. In the context of a voluntary dental insurance, proxies for new information are related to the decision to opt out. Past dental costs can be used as a proxy for private information due to the set up of the insurance. A potential problem of using dental costs within the insurance, to capture new information, is that agents with a skill to extract services would be more likely to stay insured. These agents would have an unexpectedly high dental consumption, without necessarily having a higher risk. Still, it is a signal of higher future dental care consumption.

The results show that patients respond to economic circumstances in the decision whether to leave the insurance. Patients are more prone to opt out when reclassified into higher premium classes, or when they have an unexpectedly low dental consumption. They are more responsive to higher premiums than to reduced expected costs.

If updating were symmetric, patients would not respond to a higher premium since it would be regarded as a fair assessment of increased risk. The results indicate updating on dental risk to be asymmetric, leading to partly different information sets. New information obtained by the insurer can be inferred by observing premium changes, but patients do not fully incorporate this public information. A higher premium is viewed as a higher price on insurance contracts, rather than as a fair risk reassessment. The results may follow from the insurer making an erroneous updating of the patients' risk. However, if the insurer's updating does contain valid new information on risk, the results are consistent with the literature on loss aversion and fairness of pricing, where the outcomes of transactions are evaluated against a reference point. Kahneman, Knetsch and Thaler (1986) find that price increases deviating from the reference price, and not justified by increasing costs, are perceived as unfair by agents. Increased risk is an abstract notion, and dentists may to have problems in communicating why a contract has a higher expected cost. Higher premiums may therefore be viewed as breaking the reference price of an insurance contract.

The cyclical pattern of dental care is not responsible for the asymmetric updating. If this was the case a high consumption within the insurance would increase the probability of lapsing dental coverage; a pattern not observed in the data.

The fact that pre-cost is significant indicates that the impact of new information to the agent accumulates over time. This result may, however, be due to the cyclical pattern, giving pre-cost predictive power of the dental care needs in the upcoming contract period. Indeed in table 1 it was seen that dental consumption four years back has predictive power on current consumption. Naturally, agents not taking full account of new signals can also be due to the cognitive process of updating information being slow.

The consequences of asymmetric updating depend on which of the contracting parts who has the advantage in updating. Within the present data, the question of whether lapsation is due to a process of adverse selection cannot be determined. It can only be noted that the risk assessment system used by the National Dental Service in Värmland does about 30 percent better in predicting future dental cost, than do past dental costs. Nonetheless, past dental consumption captures some parts of the variation in future dental cost not captured by the risk classification.

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Tables

Table 1: Regression of Dental Costs 2000 to 2001

	Model 1		Model 2		Model 3		Model 4	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Cost 00-01								
Const.	1478	93.2	740	8.11	615	6.86	521	5.87
Cost 98-99	0.308	58.3			0.200	36.1	0.175	31.4
Cost 96-97							0.163	27.1
D gr2			97.5	0.87	78.6	0.71	75.4	0.69
D gr3			208	1.92	170	1.59	162	1.53
D gr4			394	3.98	325	3.34	290	3.01
D gr5			636	6.48	515	5.34	453	4.74
D gr6			907	9.32	737	7.7	648	6.84
D gr7			1247	12.9	995	10.5	850	9.0
D gr8			1626	17.0	1306	13.9	1124	12.0
D gr9			2040	20.9	1626	16.9	1391	14.5
D gr10			2262	22.6	1787	18.0	1505	15.2
D gr11			2495	24.1	1935	18.8	1648	16.1
D gr12			2920	25.2	2272	19.7	1933	16.8
D gr13			3421	24.6	2705	19.6	2291	16.7
D gr14			2869	14.8	2093	10.9	1669	8.8
D gr15			2900	8.8	2318	7.2	1893	5.9
D gr16			-306	-0.5	-886	-1.3	-1247	-1.9
N	36241		36241		36241		36241	
Adj. R^2	0.086		0.114		0.144		0.161	

Table 2: Descriptive Statistics

Variable	N	Mean	Stdv.	Min	Max
Opt-out	5998	0.096	0.294	0	1
Pre-cost	5998	652	920	0	22999
Gender	5998	0.506	0.500	0	1
Age	5998	37.6	13.4	20	85
Diff-prem	5998	77.1	382	-3801	3570
Diff-cost	5998	454	1031	-22419	10642

Table 3: Probit Estimates of Failure to Renew Insurance, I

	Model 1		Model 2		Model 3	
	Coef	t-value	Coef	t-value	Coef	t-value
D gr2	0.237	1.38	0.244	1.43	0.254	1.48
D gr3	0.508	3.04	0.506	3.05	0.543	3.24
D gr4	0.549	3.37	0.573	3.54	0.598	3.66
D gr5	0.578	3.52	0.612	3.74	0.656	3.96
D gr6	0.598	3.57	0.622	3.71	0.705	4.15
D gr7	0.554	3.17	0.621	3.52	0.713	3.98
D gr8	0.858	4.74	0.868	4.72	1.052	5.60
D gr9	0.908	4.52	0.932	4.54	1.174	5.54
D gr10	1.241	5.47	1.185	5.10	1.554	6.47
D gr11	0.982	2.75	0.937	2.69	1.367	3.68
D gr12	1.279	3.17	1.199	2.91	1.794	4.21
D gr13	2.506	3.50	1.748	2.29	3.251	4.41
age	-0.092	-9.29	-0.092	-9.42	-0.091	-9.11
age sqrt	9.50E-04	8.54	9.91E-04	9.15	9.30E-04	8.30
gender	-0.133	-2.68	-0.126	-2.58	-0.139	-2.81
pre. cost	-1.49E-04	-3.69	-2.04E-04	-3.83	-3.09E-04	-5.42
diff-prem	5.88E-04	9.87			6.27E-04	10.36
diff-cost			-1.03E-04	-2.53	-1.71E-04	-3.97
const.	-0.421	-1.34	-0.341	-1.12	-0.391	-1.24
fe clinics	Yes		Yes		Yes	
N	5998		5998		5998	
LRI	0.161		0.136		0.165	
Log L	-1590.63		-1636.54		-1582.21	

Table 4: Probit Estimates of Failure to Renew Insurance, II

	Model 4		Model 5		Model 6	
	Coef	t-value	Coef	t-value	Coef	t-value
D gr2	0.254	1.47	0.253	1.47	0.262	1.52
D gr3	0.542	3.24	0.542	3.24	0.555	3.31
D gr4	0.595	3.64	0.599	3.67	0.623	3.79
D gr5	0.650	3.92	0.647	3.87	0.607	3.62
D gr6	0.694	4.07	0.697	4.07	0.654	3.80
D gr7	0.696	3.87	0.703	3.88	0.661	3.63
D gr8	1.026	5.44	1.047	5.54	0.997	5.25
D gr9	1.142	5.35	1.197	5.61	1.053	4.84
D gr10	1.511	6.23	1.565	6.51	1.436	5.88
D gr11	1.291	3.44	1.398	3.80	1.234	3.28
D gr12	1.724	4.02	1.807	4.25	1.642	3.83
D gr13	2.970	3.82	3.138	4.20	2.995	3.95
age	-0.091	-9.12	-0.091	-9.13	-0.091	-9.05
age sqrt	9.32E-04	8.32	9.29E-04	8.29	9.25E-04	8.26
gender	-0.139	-2.81	-0.141	-2.84	-0.142	-2.87
pre. cost	-3.09E-04	-5.41	-3.11E-04	-5.45	-3.05E-04	-5.40
diff-prem					6.27E-04	10.33
l diff-prem			6.05E-04	3.38		
m diff-prem			6.83E-04	8.88		
h diff-prem			5.27E-04	5.11		
neg diff-prem	4.16E-04	2.37				
pos diff-prem	6.63E-04	9.89				
diff-cost	-1.73E-04	-4.00	-1.74E-04	-4.03		
l diff-cost					-3.77E-04	-3.99
m diff-cost					-1.72E-04	-3.47
h diff-cost					-1.01E-04	-1.67
const.	-0.398	-1.26	-0.368	-1.17	-0.365	-1.15
fe clinics	Yes		Yes		Yes	
N	5998		5998		5998	
LRI	0.165		0.165		0.167	
Log L	-1581.44		-1581.43		-1578.73	

Table 5: Mean Profit by Renewal Status

		Profit		P-values for differences	
		Mean	Stdv.	t-test	Mann-Whitney
Opt out	No	68	663	0.013	<0.000
	Yes	145	708		

Table 6: Mean Premium Change by Renewal Status

		Diff-prem		P-values for differences	
		Mean	Stdv.	t-test	Mann-Whitney
Opt out	No	60	348	<0.000	<0.000
	Yes	241	592		

Table 7: Mean Profit by Risk Reclassification

		Profit		P-values for differences	
		Mean	Stdv.	t-test	Mann-Whitney
Diff-prem	Neg	229	746	<0.000	<0.000
	0	132	603	<0.000	<0.000
	Pos	-109	725		

Note: The p-values tests for differences in profit against the group for which diff-prem is positive.

Table 8: Impact of Asymmetric Updating

	Probability at		Change	Perc. Change
	mean	1 stdv.		
Diff-prem	0.069	0.107	0.038	54.7
Diff-cost	0.069	0.096	0.027	38.6

Note: The probability of buying insurance is evaluated (i) at the sample mean of all variables, and (ii) when diff-prem is increased, and diff-cost is decreased, with one standard deviation, respectively.