# Asymmetric Information and Learning:
# Evidence from the Automobile Insurance Market

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## Abstract

This paper tests the predictions of adverse selection models using data from the automobile insurance market. In contrast to what recent research has suggested, I find that the evidence is consistent with the presence of informational asymmetries in this market: higher insurance coverage is correlated with more accidents. Consistent with the presence of learning by policyholders about their risk type, such a coverage correlation exists only for policyholders who have had three or more years of driving experience prior to joining their insurer. Consistent with the presence of learning by insurers about repeat customers, I find that, as the experience of the insurer with a group of policyholders increases, the coverage-accidents correlation declines in magnitude and eventually disappears. Finally, consistent with insurers' having more information about their repeat customers than would be available to other insurers, I find that policyholders under-report their past claims when joining the insurer and that policyholders that leave the insurer are disproportionately ones with a poor claims history with the insurer.

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# 1  Introduction

Ever since the seminal works of Akerlof (1970) and Rothschild and Stiglitz (1976), economic theorists have devoted much effort to developing models of adverse selection. This paper seeks to test the predictions of these models using data from the market for automobile insurance.

The paper uses a unique and rich data set that I obtained from an insurer operating in the automobile insurance market in Israel. Because the data includes *all* the information known by the insurer about its policyholders, it is especially fitting for studying adverse selection. The data includes the insurer's information about more than 200,000 policies issued during a five-year period. In particular, the data contains (i) all the characteristics (including past claims history) of policyholders known to the insurer, (ii) the price-deductible menus offered to policyholders and the choices made by them, and (iii) the claims and payments resulting from each policy.

When policyholders have private information about their risk type, adverse selection models predict that high-risk types will purchase higher insurance coverage. Examining the pool of all policies, I find, consistent with this prediction, that policyholders with low deductibles are associated with more accidents and higher total losses to the insurer. I also find that subsets of the pool of all policies differ systematically in how strong the correlation is (or even in whether it exists). These identified differences are consistent with the presence of learning over time by policyholders and by insurers.

The above findings concerning a coverage-accidents correlation address questions raised by recent research. Chiappori and Salanie (2000) suggest that the evidence is inconsistent with a coverage-accidents correlation in the market for automobile insurance. Also studying this market, Dionne, Gouriéroux and Vanasse (2001) suggest that the evidence is inconsistent with residual adverse selection in each of the risk classes formed on the basis of parameters known to the insurer. The findings of these studies have already had a significant impact. Among other things, the materials accompanying the recent award of the Nobel Prize for work on asymmetric information (Swedish Royal Academy of Science (2001)) cite the Chiappori - Salanie findings as a reason for viewing the evidence on the presence of asymmetric information in markets as "mixed." [1]

In contrast to this recent empirical work, using a data set that is more complete than the data used in prior work, I obtain robust results that are overall consistent

with the coverage-correlation prediction of classic adverse selection theory. My findings confirm that such correlation does not exist for the subset of policies on which the Chiappori-Salanie study focused – those sold to policyholders with less than three years of driving experience. My findings, however, also indicate that this result does not carry over to policyholders with three or more years of driving experience who account for a substantial majority of all policyholders.

While prior empirical work has paid significant attention to examining whether a coverage-correlation exists, it has devoted little attention to examining how this correlation change with respect to learning over time. The richness of my data, however, enables me to study how the presence of such correlation depends on the relevant experience of policyholders and insurers. As to the learning by policyholders, I find that, for policyholders with little or no driving experience, low deductibles are not associated with more accidents. Such policyholders might have had relatively little opportunity to obtain private information about their risk type and thereby to gain an informational advantage over the insurer. However, such an association does exist for policyholders that have sufficient driving experience. Furthermore, driving experience prior to joining the insurer might be especially helpful in providing policyholders with an informational advantage over the insurer; consistent with this possibility, I find that the coverage-accidents correlation exists only for policyholders who had three or more years of driving experience prior to joining the insurer.

As to the learning by the insurer, I find evidence that the correlation between low deductibles and more accidents is especially strong for new customers or ones who have been with the insurer for a relatively short period. For repeat customers, this correlation diminishes in magnitude over time and eventually disappears. When a policyholder has stayed with the insurer for a sufficiently long period, the insurer's experience with the policyholder might erode whatever informational advantage the policyholder might have had when joining the insurer.

I also find evidence consistent with the possibility that the learning by insurers about their repeat customers provides them with an informational advantage over potential rivals to which the policyholders might turn. In the insurance market that I study, as is the case in the US, when a policyholder switches to a new insurer, the new insurer would not receive from the current insurer information about the priori insurer's experience. The information that the new insurer would have – from the customer's own reporting, from inferences drawn from the customer's making a switch, or from public sources – can be expected to be less complete than the claim

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[1] These findings also provided motivation for the work of De Meza and Webb (2001), who develop a model of insurance markets with asymmetric information that does not predict correlation between insurance coverage and accidents.

history information possessed by the current insurer. I find that the evidence is indeed consistent with such differences in information among insurers.

In particular, I find that the performance of switchers is worse than what would be predicted if their self-reports of past claims were assumed to be as reliable as the insurer's records about its own repeat customers. Also, I find that policyholders who leave the insurer are disproportionately ones who had a bad record with the insurer and who thus could benefit from switching to an insurer that would know less about them. Policyholders who remain with the insurer, in turn, are disproportionately ones with a good past claims record and ones that subsequently perform better than new customers.

It should be noted that, while a coverage-accidents correlation is consistent with adverse selection models, it is also consistent with moral hazard models. Under a moral hazard story, a correlation between low deductibles and more accidents can be expected because policyholders with higher insurance coverage will have lower incentive to take precautions. Thus, my findings concerning the existence of coverage-accidents correlation indicate only that the presence of adverse selection cannot be rejected. Because adverse selection and moral hazard both produce a correlation between coverage and accidents, disentangling them empirically is widely viewed as difficult (Royal Academy of Science (2001)). Putting aside the coverage-accidents correlation, which can be easily explained under both adverse selection and moral hazard stories, some of my other findings concerning the dynamics of behavior over time do not appear readily explainable by a standard moral hazard story. Disentangling adverse selection and moral hazard, however, is beyond the scope of the present study.

The analysis of this paper is organized as follows. Section 2 describes the predictions of adverse selection models that I will test. Section 3 discusses prior empirical work. Section 4 describes the data used for the study. Section 5 conducts tests concerning the prediction of coverage-accidents correlation. Section 6 tests various predictions concerning learning and behavior over time. Finally, Section 7 concludes.

## 2   Coverage-Accidents Correlation

### 2.1   Differences Between Insurers and new customers

As is common, the insurer whose data I use offers a menu with different levels of deductible (and associated levels of premium). Policyholders that choose different

deductibles must be different. They might differ in their risk-aversion,[2] and such differences would not affect the costs of their policies to the insurer. They also might differ in the risks that they face; such differences in risk, of course, would affect the costs of their policies to the insurer.

The coverage choices made by individuals that have private information about their risk type have been studied by the seminal work of Rothschild-Stiglitz (1976) and subsequent work (e.g., Riley (1979), Spence (1978), Miyazaki (1977), Wilson (1977), and Grossman (1979)).[3] One basic prediction of these models is that, in the presence of such private information, a menu of different deductibles will result in sorting, with high-risk policyholders more likely to choose low deductibles.[4] I therefore will test the hypothesis that policyholders who choose lower deductibles are associated with more accidents.

## 2.2 Learning and Policyholders' Informational Advantage over the Insurer

The prediction of a coverage-accidents correlation arises from models that assume that policyholders have an informational advantage over the insurer with respect to the policyholders' risk type. Whether and to what extent such informational asymmetries exist might well depend on the learning of information by the policyholder and by the insurer over time.

One type of possible learning is by policyholders. While nature accurately knows any individual's risk-type, the individual might well be imperfectly informed about this risk-type when getting a driving license. It is plausible to assume that there is a limit to how much an individual can learn about the individual's risk-type by mere introspection, i.e., without actual experience with driving. Thus, the more driving experience a policyholder has, the more information the policyholder is likely to obtain about the policyholder's risk type. Thus, other things equal (including how long policyholders have been with the insurer), the more driving experience a group

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[2] One possible reason for having deductibles is to eliminate coverage for small claims that would produce administrative costs (which are ultimately borne by policyholders) but would provide only minimal benefit in terms of saving risk-bearing costs to the policyholder. Focusing solely on considerations of risk-bearing costs and administrative costs, the greater an individual's degree of risk-aversion, the lower the optimal deductible for this individual.

[3] For excellent recent surveys of adverse selection models, see Riley (2001), who surveys such models in general, and Dionne, Doherty, and Fombaron (2000), who focus on adverse selection models of insurance markets.

[4] These models also analyze the optimal choices of menus that insurers will make in equilibrium. The prediction that a menu will result in high-risk types choosing more coverage will arise, however, even if the menus offered are not optimally set.

of policyholders has, the more likely it is that the group will exhibit a coverage-accidents correlation.

I just discussed the potential effect of the policyholder's driving experience holding constant other variables including the experience of the insurer with the policyholder. This suggests that it is useful to distinguish, as is done in the diagram below, between two periods: (i) the period (if any) during which a policyholder was driving prior to joining the insurer – i.e., during which the policyholder gained experience with driving but without the insurer gaining experience with the policyholder, and (ii) the period (if any) during which the policyholder has been with the insurer – i.e., during which both the policyholder has been gaining driving experience and the insurer has been obtaining experience with the policyholder.
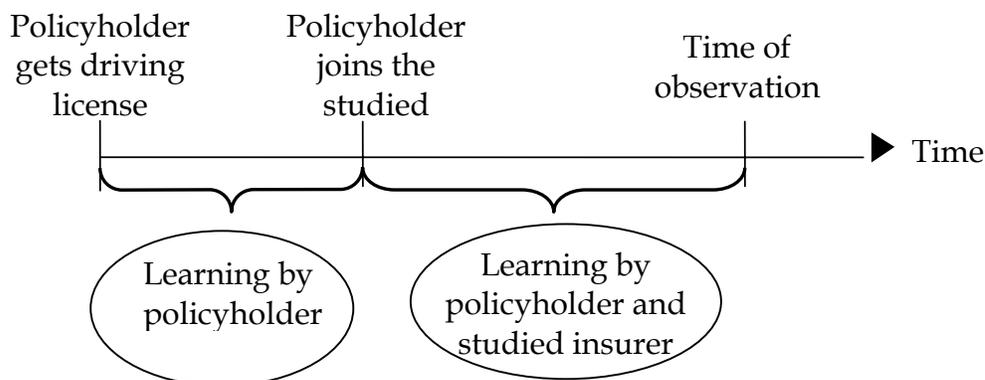


During the first period (i) in which the policyholder drove prior to joining the insurer, the realization of risks produced by the policyholder's driving was observed by the policyholder – and often also by the policyholder's insurer at the time (as will be presently discussed) – but not by the studied insurer. As will be discussed below, in the market I study (and often in other insurance markets as well), insurers generally do not get – either from prior insurers of new customers or from self-reporting by such customers – a complete and accurate picture of the past claims history of these customers. Thus, driving experience during the period prior to joining the insurer might provide the policyholder with an informational advantage over the insurer. The more driving experience a new policyholder had before joining the insurer, the greater the likely asymmetry of information between the policyholder and the insurer. Accordingly, the hypothesis that I will test is that, the more experience a group of policyholders had prior to joining the insurer, the stronger (or more likely to exist) the correlation in this group between low deductibles and more accidents.

During the second period – the period if any between the time in which the policyholder joined the insurer and the time of observation – information about the realization of risks has flown to both the policyholder and the insurer. Although there might be some private information received by the policyholder even during this period, existing models have assumed that new information arriving during this period has been by and large observed by both the policyholder and the existing insurer (see, e.g., Kunreuther and Pauly (1985), Watt and Vazquez (1997)). Under this assumption, the Bayesian updating that each side will do will work to reduce whatever informational asymmetry the policyholder had when joining the insurer. The reason for this is that, when a policyholder has an informational advantage when joining the insurer, the informational benefit from observing the subsequent realization of risks will be greater for the insurer than for the policyholder. Indeed, assuming that after a policyholder joins an insurer they both observe all realization of risks, Watt and Vazquez (1997) prove that, for any given informational asymmetry that the policyholder has when joining, the asymmetry will go to zero after a sufficiently long period with the insurer.

Thus, under the considered story, the longer the period that a group of policyholders has been with the insurer, the less likely it is that policyholders will have an informational advantage over the insurer even if they had such an advantage when joining the insurer. Accordingly, the hypothesis that I will test is that, the more experience the insurer has had with a group of policyholders, the weaker (or less likely to exist) the correlation in this group between low deductibles and more accidents.

## 2.3 Learning and Differences in Information among Insurers

The information that an insurer learns about its repeat customers might create a difference in information between the insurer and other insurers to which these customers might subsequently turn. Of course, if the repeat customer does turn to another insurer, this other insurer will ask the customer to report past claim history. However, there is evidence that such self-reporting is often substantially incomplete or inaccurate (Insurance Research Council (1991)). Furthermore, there is evidence that most of the accidents for which claims are submitted do not appear in public records and new insurers thus cannot learn about them from inspecting public records (Insurance Research Council (1991)). Finally, in the Israeli market I study, as in the US market, insurers do not provide information about their experience with

policyholders to other insurers.[5] Therefore, a new insurer would likely have an informational disadvantage compared with a repeated customer's incumbent insurer.

To be sure, a new insurer could draw inferences from the fact that a new customer has decided to switch from the customer's prior insurer. If all switchers were ones with a bad record, the insurer could have inferred that such a switcher must have such a record. But in a world in which some policyholders change insurers for other reasons (say, relocation or dissatisfaction with some services of the insurer or the intermediating insurance agent), an insurer generally would not be able to infer fully a new customer's past claims record from the customer's decision to switch. In particular, when a customer who in fact has a bad past record switches to another insurer, this other insurer would not be able to tell for sure whether the switch has been motivated by the customer's bad past record or by other reason.

This adverse selection story with informational differences among insurers yields several testable hypotheses. To start, this story implies that reports of past claims provided by policyholders switching to the insurer from other insurers will be less complete than the records that the insurer has about the past claims of its repeat customers. Accordingly, I will test the hypothesis that new customers who report a given past claims history will perform in the future less well than repeat customers for whom the insurer has observed such a past claims history.

Furthermore, although some policyholders will leave the insurer each year for reasons that have nothing to do with their record with the insurer, some will leave because of the poor record they have with the insurer. Because new insurers will be unable to tell that a switch was motivated by such a poor record, customers with a bad record with an insurer might have something to gain from switching to a new insurer. Accordingly, I will test below the hypothesis that policyholders that leave the insurer will be disproportionately ones with a poor past claims record.

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[5] Fombaron (1997b) and de Garidel (1997) study the difference between the cases in which insurers are and are not required to provide a new insurer with all the information that they have with respect to departing customers, and they also examine the desirability of requiring insurers to do so. In the market under consideration, such a requirement is not established by law or by agreement among insurers, and insurers do not share information about customers.

# 3   Prior Empirical Work

## 3.1   Existence of Asymmetric Information

Evidence consistent with adverse selection and coverage-risk correlation has been found in some studies of insurance markets. Surveying the evidence on the health insurance market, Cutler and Zeckhauser (2000) conclude that, in this market, adverse selection is present and quantitatively large.[6] Furthermore, Friedman and Warshawsky (1990), Bruggiavini (1993) and, most recently, Finkelstein and Poterba (2000) have found evidence consistent with adverse selection in the annuity market. However, with respect to the market for automobile insurance, recent work has argued that the evidence is inconsistent with the presence of adverse selection.[7]

A main focus of prior work about the automobile insurance market has been on testing the prediction that higher insurance coverage is correlated with more accidents. Three initial studies suggested the presence of adverse selection, but their findings were criticized by subsequent research as unreliable. Dahlby (1983) and Dahlby (1992), the first two studies on the subject, did not have individual data on coverage. Puelz and Snow (1994) did use individual data obtained from a Georgia insurer, but subsequent work questioned their results. Although Puelz and Snow had individual data, they did not have some of the variables affecting risk type – such as the policyholder's years of driving experience and the policyholder's past claim history – that the insurer had. In contrast, my data includes all the information about individual policyholders known to the insurer.

Dionne, Gouriéroux, and Vanasse (2001) recently raised another objection to the Puelz-Snow study. They suggest that the insurer's risk classification is sufficient (in the sense that there is no residual adverse selection in each risk class in the insurer's portfolio) once nonlinear effects, not considered by Puelz and Snow, are taken into account. To address the problem suggested by these authors, I checked the robustness of my results by controlling for the suggested non-linearity bias in unreported regressions, and I obtained the same robust results throughout.

Chiappori and Salanie (1997, 2000) suggest that the correlation between deductible choice and risk type should be tested using bivariate probit. Chiappori and Salanie (2000) apply this test to French data. Two kinds of insurance coverage are offered in France, and the authors tested whether individuals who bought

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[6] One notable exception in this area is Cardon and Hendel (2001), who find no evidence of adverse selection in their study of the health insurance market.

[7] Recent work (Cawley and Philipson (1999)) has also questioned whether adverse selection exists in the market for life insurance.

higher coverage turned out to be riskier. Finding no such correlation, they inferred that the existence of adverse selection in this market can be rejected.

The testing done by this study, however, was limited to policyholders with no more than two years of driving experience. Thus, the study tested the existence of coverage-accidents correlation only among beginning drivers who constitute a small subset of all policyholders. The absence of such correlation in the case of such drivers, who have had little opportunity to develop through driving experience an informational advantage over the insurer, does not necessarily imply that such correlation does not exist among other drivers.

In my analysis I conduct tests with respect to the whole pool of policies as well as separately for beginning and more experienced drivers. As will be discussed in detail later, my analysis confirms the Chiappori-Salanie finding that correlation between coverage and accidents does not exist for beginning drivers. The analysis indicates, however, that such correlation does exist with respect to policyholders with more than two years of driving experience and, because such policyholders constitute a very large majority, also for the pool of all policies.

## 3.2  Learning

There has been relatively little empirical work on learning over time about policyholders' risk type.[8] The studies that conducted testing for the presence of coverage-accidents correlation in a large pool of policies have commonly not broken the pool into subsets based on the experience of the insurer with the customer or on the driving experience of the insurer. For example, Puelz and Snow (1994) and Dionne, Gouriéroux, and Vanasse (2001), which have reached opposite results concerning the existence of correlation in a general pool of policies, have not examined how their results hold for subsets of the pool defined by insurer or policyholder experience. As will be seen, in the data that I examine, such subsets differ in whether and to what extent a coverage-accidents correlation exists.

As discussed, one of the elements that I will study is the possibility that during the period in which a policyholder stays with an insurer, the insurer and the policyholder will by and large receive the same information about accidents occurring in that period. It is worth noting in this connection the recent work by Hendel and Lizzeri (2001) about the market for life insurance. They find evidence

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[8] Because my focus is on asymmetric information about policyholders' risk type, the learning on which I focus concerns information about customers' risk type. Another type of learning that might go on when policyholders stay with the same insurer concerns learning by policyholders about the quality of the insurer's services (Israel (2001)).

that is consistent with symmetric learning taking place after a policyholder joins an insurer. [9]

## 4  The Data

### 4.1  The Insurer and its Records

The paper is based on data that I received from an insurer that operates in the market for automobile insurance in Israel. This data  covers five years of the insurer's operation, 1995 through 1999. The data contains information about 216,524 policies and about 111,138 different policyholders (some policyholders bought policies in two or more years).

The data includes all the information that the insurer had about each of these policies. Each observation has the following variables with respect to the policyholder: (the list of all variables appears in Appendix I):

(1) *Policyholder's demographic characteristics*: age, education, gender, family status, place of birth, immigration year, and place of residence;

(2) *Policyholder's car characteristics*: size of engine, model year, value of the car, value of the radio, commercial vehicle or not, main vehicle or not, type of protection against theft;

(3) *Policyholder's driving characteristics*: years since getting driving license, number of claims in the past three years, young driver or not, age of young driver, gender of young driver, license years of young driver, whether the policyholder had insurance in the past, additional drivers (if any);

(4) *Menu of contract terms offered:* the company offered four deductible-premium alternatives – low-deductible, regular-deductible, high-deductible, and very-high-deductible contracts -- which will be described in detail in subsection 4.2 below;

(5) *Deductible choice*: what deductible (and accompanying premium) was chosen by the policyholder;

(6) *Period covered:* the length of the period covered by the purchased policy (which was usually one year); and

(7) *Realization of risks covered by the policy*: the number of claims submitted by the policyholder and a description of each submitted claim, including the amount of

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[9] In contrast to the automobile insurance market that I study, the life insurance market commonly involves one-sided commitment by insurers, which commit to the level of premia in the event that the policyholder will elect to stay in future periods. Hendel and Lizzeri find evidence that actual contract have front loading, which is what is predicted for contracts with one-sided commitment and learning over time. Because the market I study involves one-period contracts with no commitment, learning in this market has different implications.

damages reported and the amount that the insurer paid or was expected to pay. Table 1 displays descriptive statistics of the variables.

I also received from the insurer the estimate that, when calculating its costs, the insurer used for the average administrative costs involved in processing a claim. Because these processing costs were estimates and not "hard" number like the other variables, I checked in all relevant cases whether the reported results hold ignoring these estimated costs and I found that they do.

It is worth noting that the policies offered by the insurer, as are all policies offered in the Israeli automobile insurance market, are one-period policies with no commitment on the part of either the insurer or the policyholder. There is substantial literature that studies the optimal design of policies commit customers to a multi-period contract (e.g., Dionne (1983), Dionne and Lasserre (1985), Cooper and Hayes (1987)) or that include a one-sided commitment of the insurer to offer the policyholder certain terms in subsequent periods (Dionne and Doherty (1994), De Garidel (1997)). Although such policies are observed in certain countries (see, e.g., Dionne and Vanasse (1992)), many insurance markets, including the one I study, use only one-period, no-commitment policies (Kunreuther and Pauly (1985)).

## 4.2. The Deductible-Premium Menu

Israeli insurers are allowed to develop their own formula for determining insurance premia, provided that they submit them for approval by the insurance regulator. The factors that the regulator does not allow insurers to use in setting the premium are place of birth, place of residence, occupation, and education. The insurer under study attempted to take into account in its pricing decisions all the information that it was permitted to use.

The insurer offered its potential customers a menu of contract choices after first obtaining from them all the information described in subsection 4.1. The potential customer was then given a menu of four premium-deductible contracts. One option, which was labeled "regular" by the company, offered a "regular" deductible and a "regular" premium. The term "regular" was used for this deductible level both because it was relatively similar to the deductible levels offered by other insurers and because most policyholders chose it. The regular premium was a function of all the characteristics of the policyholder used in the insurer's formula. The regular deductible was set at the level of 50% of the (regular) premium that was associated with the regular deductible, except that the regular deductible was capped at 1400 New Israeli Shekels (NIS) (about $350 during the considered period).

The three other price-deductible contracts included in the menu offered to potential customers were: 1) a "low" deductible, set at 60% of the level of the regular

deductible, coming with a premium equal to 1.3 times the level of the regular premium; 2) a "high" deductible, set at a level equal to 1.8 times the level of the regular deductible, coming with a premium equal to 0.7 times the regular premium; and 3) a "very high" deductible, set a level equal to 2.6 times the level of the regular deductible, and coming with a premium equal to 0.685 times the regular premium.

Because I did not have an access to the company's formula for determining premia, I regressed the regular premium quoted to each customer on all the customer's characteristics that the company was allowed to use in its formula to test how well a linear regression can explain the premium. The regression, which appears in Table 2, has an $R^2$ of 0.71, which indicates that a linear model can be used instead of the actual formula.[10]

## 4.3  Summary Statistics

Table 3 provides summary statistics for the whole period covered by the data. The table indicates that, compared with regular-deductible policyholders, low-deductible policyholders have higher claim frequency and loss ratio, and policyholders with high or very high deductibles have lower claim frequency and loss ratio.

Since only a very small fraction of the customers chose high or very high deductibles (apparently the company did not price them low enough to make them attractive), my focus below will be on differences between low-deductible and regular-deductible policyholders. Policyholders who chose low deductibles had a larger incidence of one or more claims during the life of the policy. For example, 28% of low-deductible policyholders had at least one claim, whereas only 21% percentage of regular-deductible policyholders had at least one claim.

Note that low-deductible policyholders were able to file claims also for accidents whose damages were too small to claim under policies with a regular, high, or very high level of deductible. Thus, it is useful to compare low-deductible and regular-deductible policyholders in terms of the number of claims of a type that can be submitted by both groups of policyholders. The data indicates that, counting only claims for damages exceeding the level of the regular deductible (claims that could be submitted by both low-deductible and regular-deductible policyholders), the percentage of policyholders filing such claims is significantly higher for low-deductible policyholders than for regular-deductible policyholders. Similarly,

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[10] Most of the regressions below use all the characteristics of the policy as covariants. For robustness check, in unreported regressions I used the regular premium instead of the characteristics of the policy, and I obtained results that were similar in terms of both significance and magnitude throughout.

counting only claims for damages exceeding 1.5 and 2 times the level of the regular deductible, the percentage of policyholders filing such claims is also significantly higher for low-deductible policyholders than for regular-deductible policyholders.

# 5 Are Lower Deductibles Correlated with Higher Risks?

The summary statistics just presented are consistent with the prediction that low-deductible policyholders are associated with higher claim frequencies and higher losses for the insurer (see section 2.1). This section tests this prediction. I continue to focus on differences between low-deductible and regular-deductible policyholders because, as noted, the overwhelming majority of policyholders in the data belong to these two groups, with less than 2% choosing high or very high deductibles.

## 5.1 Testing for Coverage-Accidents Correlation

I start by comparing low-deductible and regular-deductible policyholders in terms of the number of claims submitted. As noted earlier, this comparison should focus on claims that can be submitted by both types of policyholders. If we were to count all claims reported by low-deductible policyholders, then we would expect to find more claims submitted by low-deductible policyholders even if the two groups did not at all differ in their risk type; this would happen because low-deductible policyholders can submit claims with respect to a larger range of accidents. Below I therefore compare these two groups in terms of claims that exceed the level of regular deductibles and thus can be submitted by policyholders in both groups. As will be noted below, the results hold also when making the comparisons in terms of claims exceeding certain higher thresholds.

I first tested for a correlation between low deductibles and more accidents using Order probit, Poisson and OLS specification. For the set of all the policyholders choosing either low or regular deductible, I regressed the number of claims exceeding the regular deductible on all the characteristics of the policyholder and the vehicle and on a dummy variable representing whether a regular or a low deductible was chosen. I ran these regressions for the whole pool of policies and also separately for the policies in each of the insurer's five years of operation.

The results, which are displayed in Table 4, indicate that the number of claims exceeding the regular deductible is higher (at the 1% confidence level) for low-deductible policyholders than for regular-deductible policyholders. This is the case (for all specifications used) both for the whole pool and for each of the five years of operations. For the whole pool, the probability of having an at least one accident

was higher by about 3% for low-deductible policyholders than for regular-deductible policyholders (at the 1% confidence level). This difference is significant relative to the average number of claims that exceeded the regular deductible for either low- or regular-deductible policies. The average number of claims exceeding the regular deductible was 0.23 for low-deductible policyholders and 0.18 for regular-deductible policyholders (see Table 1). Low-deductible policyholders have about 20% more such claims than regular-deductible policyholders in each of the five years included in the data.

The second test that I used is the bivariate probit recommended and used by Chiappori and Salanie (2000). The bivariate probit estimates the correlation $\rho$ between the error terms of two binary equations. These two equations are the choice of the deductible on the policyholder's characteristics and the occurrence of at least one claim on the policyholder's characteristics. If the error terms of the two equations are independent, then $\rho$ will be equal to 0. The resultof this regression provides an estimate for $\rho$ that is negative, statistically significant (at the 1% confidence level) and equal to –0.057. Thus, the hypothesis that the two equations are independent can be rejected.

Finally, it might be argued that regular-deductible policyholders might sometimes be reluctant to submit claims for accidents whose damage exceeds the regular deductible but just barely. They might elect not to submit such claims, so the argument goes, in order to avoid the transaction costs involved in submitting a claim and/or to avoid having a claim in their record that might lead to an increase in the premium in subsequent years (see Hosios and Peters (1989)). To ensure that the above results are not vulnerable to this problem, I did the tests discussed above also for claims exceeding 1.5 times the level of the regular deductible as well as for claims exceeding 2 times the level of the regular deductible. In both cases I obtained similar results, namely that the number of claims exceeding the used threshold is higher (at the 1% confidence level) for low-deductible policyholders than for high-deductible policyholders. It is worth noting that I followed a similar procedure of using alternative, higher thresholds also for all the other tests in this paper that involve the number of claims, and I obtained similar results throughout; all of the results reported below are thus robust to this potential problem.

## *5*.2   Losses from Accidents

I now turn to comparing low-deductible and regular-deductible policyholders in terms of the costs to the insurer produced by claims exceeding the regular deductible. I regressed the total insurance payments made by the insurer in

connection with such claims on all the characteristics of the policyholder and on a dummy variable reflecting whether a regular or low deductible was chosen.

The regressions, which are displayed in Table 4, indicate that such total insurance payments are higher (at the 1% confidence level) for low-deductible policyholders. This result holds for the whole pool and for each of the five years in the data. The regression indicates that the insurer's total insurance payments in connection with claims exceeding the regular deductible were higher (at the 1% confidence level) for low-deductible policyholders than for regular-deductible policyholders by 230-315 NIS (~$58-$78). This increase is roughly equal to 20% of the average level of total insurance payments among regular-deductible policyholders.

## 5.3  Beginning vs. Experienced Drivers

As discussed earlier, Chiappori and Salanie (2000), studying the performance of policyholders with less than three years of driving experience, found no coverage-accidents correlation for such policyholders. Below I explore the source for the difference between this result and the results obtained above for the pool of all policyholders. In particular, I examine whether in my data the results are different for the relatively small subset of policyholders with little driving experience.

To examine this possibility, I first regressed (in unreported regressions) the number of claims on the deductible level controlling for all the other variables *separately* for policyholders with less than three years of driving experience and for policyholders with three or more years of such experience. I found that the coefficient of the deductible was not significant for the first group of beginning drivers but was negative and significant (at the 1% confidence level) for the second group of more experienced drivers.

I also ran the bivariate probit test used by Chiappori and Salanie (2000) separately for policyholders with less than three years of driving experience and for policyholders with three or more years of such experience. For policyholders with less than three years of driving experience, I found that the correlation between the error terms of the two binary equations, $\rho$, has a positive value of 0.023 that is not statistically significant (with a standard error of 0.059). The non-existence of statistically significant correlation for this subset of my data is consistent, of course, with the findings of Chiappori and Salanie who studied policyholders with less than three years of driving experience.[11]

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[11] Note that the results reported above are ones that do not exclude the information I have in my data on past claims history, whereas the Chiappori-Salanie findings were reached using data

However, for the group of policyholders with three or more years of driving experience, a correlation between low deductibles and more accidents does exist. For this group, the results indicate that ρ has a negative value of  -0.06 that is statistically significant (at the 1% confidence level). This enables rejecting the independence of the two equations.

Thus, although the Chiappori-Salanie findings of statistical insignificance of ρ are confirmed for policyholders with less than three years of driving experience in my data, they do not carry over to policies purchased by policyholders with more driving experience. The latter policies purchased by drivers with such experience account for a very substantial majority of the policies sold by the considered insurer and in the Israeli automobile insurance market in general (as well as in the French market considered by Chiappori and Salanie). Because of the numerical dominance of policies purchased by experienced drivers, the pool of all policies is also characterized (as identified earlier) by a correlation between low deductibles and more accidents.

The identified difference between young and experienced drivers highlights the possible importance of learning of information in this market. The next section will study the subject of learning more systematically.

# 6    Learning

## 6.1  Learning by Policyholders

I start by testing the prediction concerning learning by policyholders and, in particular, concerning the effects of driving experience that policyholders had before joining the insurer. . According to this hypothesis (see section 2.2), a coverage-accidents correlation is more likely to exist for groups of policyholders with more driving experience prior to joining the insurer.

To test this hypothesis, I divided all the policies in the data into 5 sub-groups – made of the policyholders that have respectively 0, 1, 2, 3, or 4 or more years of driving experience prior to joining the insurer. I then tested the presence of coverage-accidents correlation for each sub-group separately. In testing this

that did not include information on past claims history which they did not have. To duplicate with my data exactly what these authors did, I excluded the information that I have on the past claims history of policyholders and then did the bivariate probit test on policyholders with less than three years of experience. Again, I found that ρ, the correlation between of the error terms of the two equation, is very close to zero (0.0023) and the 95 percent interval is equal to [-0.111, 0.116]. This is similar to the Chiappori-Salanie finding that zero falls within the 95 percent confidence interval for ρ.

prediction I am looking only at new customers. In concentrating on this specific group I am able to isolate the effect of policyholders' learning prior to joining the insurer from any learning that takes place after the policyholder joins the insurer.

The results, which are reported in Table5, indicate that a coverage-accidents correlation does not exist for the groups of new customers with only 0,1, or 2 years of driving experience prior to joining the insurer. Such correlation does exist, however, for the new customers who obtained 3 years or 4 or more years of driving experience prior to joining the insurer. Thus, the results are consistent with the story that, the longer the driving experience prior to joining the insurer of a group of policyholders, the more likely its members to have an informational advantage over the insurer, and thus the more likely to exist a coverage-accidents correlation.

Interestingly, finding that a coverage-accidents correlation does not exist for policyholders with no or little driving experience enable me to reject the possibility that policyholders can obtain significant private information about their risk type in connection with automobile accidents from mere introspection or from observing their performance in other dimensions of life. The data is consistent with significant private information about this risk type coming only from actual experience with one's own driving.

## 6.2 Learning by Insurers

I now turn to testing the prediction that, as the experience of the insurer with a policyholder increases, the policyholder's initial informational advantage over the insurer (if any) will diminish and ultimately disappear (see section 2.2). To examine this issue, I test whether the coverage-accidents correlation declines or disappears for groups of policyholders with whom the insurer has had long experience.

To this end, I divided all the policies in the data into 5 sub-groups – those in which the insurer has had respectively 0, 1, 2, 3, or 4 years of prior experience with the policyholder. For each group, I regressed the number of claims exceeding the regular deductible on the choice of the deductible and all of the policyholder's characteristics using 3 different specifications: Order Probit, Poisson and OLS specification. As Table 8 shows, the coefficient on the deductible choice decreases with the length of the insurer's experience with the policyholder.

For example, for the group of policyholders with zero years of company experience, the coefficient on the deductible choice is equal to –0.10 (and equal to – 0.037 in the OLS specification) and is statistically significant (at the 1% confidence level). In contrast, for the group of policyholders with four years of company experience, the coefficient on the deductible choice decreases to –0.07 (and equal to – 0.008 in the OLS specification) and (with a standard error of 0.05 (and 0.008 for the

OLS specification)) is no longer statistically significant. Thus, the coverage-accidents correlation no longer exists for the group of policyholders with more than three years of experience with the insurer.

Because my data covers the first five years in which the insurer sold automobile insurance, it is worth distinguishing between learning by the insurer about particular policyholders and learning by the insurer about the general pool of policyholders it faces. Looking back at the results that Table 4 displays for each of the five years of the insurer's operations in the data, these results indicate that the coefficients on the deductible choice are all essentially the same both in magnitude and in significance. Thus, the evidence is consistent only with the possibility that the coverage-accidents correlation can be eliminated through policyholder-specific learning by the insurer about its repeat customers – and not with the possibility that such correlation can be eliminated by some general learning of the insurer about the general pool of policyholders in the market.

Finally, if insurers can over time learn enough about repeat customers to eliminate whatever informational advantage the customers had when joining the insurer, does that imply that informational asymmetries between policyholders and their insurer can be at most a short-run phenomenon in this market?[12]  The answer is no, because insurers in this market keep getting new customers. New drivers constantly join the pool of policyholders and, furthermore, policyholders change insurers (as will be presently documented). Therefore, since the market cannot be expected to reach a situation in which all the purchasers of insurance are repeat customers with long experience with the insurer, a coverage-accidents correlation cannot be expected to vanish completely in the long run.

## 6.3  The Combined Effects of Policyholder and Insurer Learning

Of course, the extent to which an informational asymmetry is present in any given case depends *both* on (i) the driving experience (if any) of the policyholder had prior to joining the insurer *and* on (ii) the experience (if any) that the insurer has had with the policyholder since then. As we have found, other things equal (including the insurer's experience with the policyholder), the more driving experience the policyholder had before joining the insurer, the more likely a coverage-accidents correlation to exist; and, other things equal, the longer the experience that the insurer has had with the policyholder since the policyholder joined, the less likely such a correlation to exist. Combining these two predicted relationships, if we draw

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[12] For a work stressing differences between short-run and long run effects in another insurance market, see Cutler and Reber (1998).

two axis representing the driving experience of policyholders prior to joining the insurer and the insurer's experience with policyholders, we can expect the presence of coverage-accidents correlation to depend on these two parameters as depicted in the following diagram.

**Correlation Between Low Deductibles and High Risks**
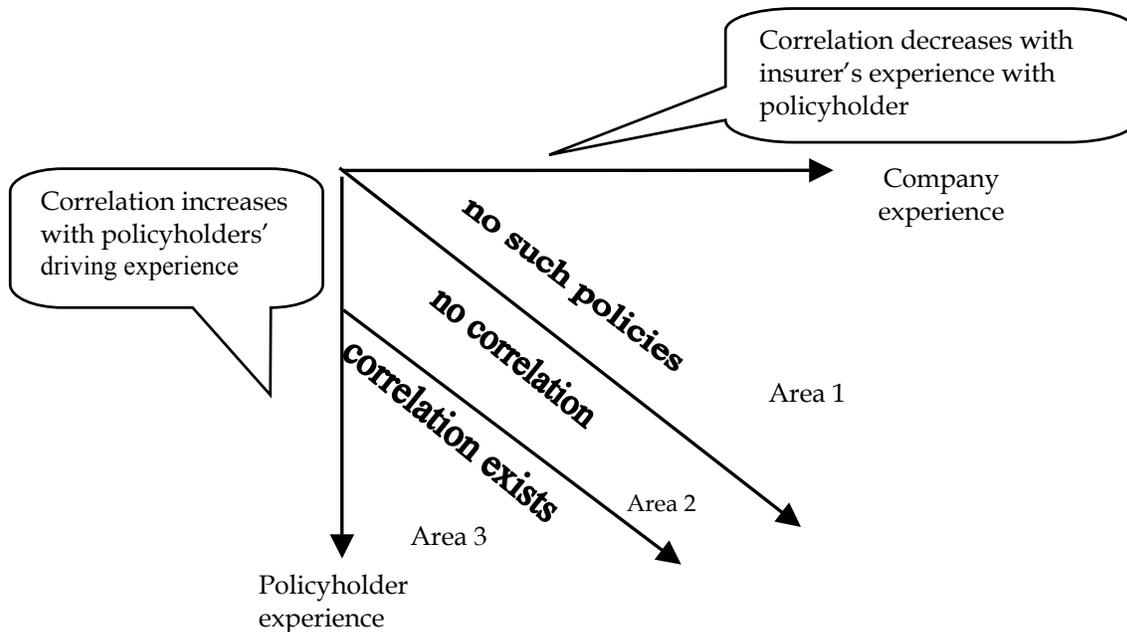


By definition, there are no cases in which the policyholder has been driving for fewer years than the policyholder has been with the insurer (Area 1). When the policyholder has spent all or close to all of the policyholder's driving years with the insurer (Area 2), a coverage-accidents correlation is not expected. However, when the policyholder's driving experience prior to joining the insurer is relatively substantial (Area 3), a coverage-accidents correlation is expected.

To test this prediction, which essentially combines the predictions concerning the effects of learning by policyholders and by insurers, I divided all policies in the data into 25 sub-groups, with each sub-group including all the policies with a given number of years of driving experience by the policyholder and a given number of years of experience with the policyholder by the insurer. I then tested the presence of coverage-accidents correlation for each group separately.

The results of these regressions, which are reported in Table 9, are largely consistent with the tested prediction. To illustrate, the column with sub-groups of

customers that just joined the insurer (and thus have zero years of experience with the insurer) indicates that a correlation appears only for the sub-groups of such customers that have three or more years of driving experience; in contrast, the column with sub-groups of customers that have four years of experience with the insurer indicates that a correlation appears only for customers that have six or more years of driving experience (and thus two or more years of driving experience prior to joining the insurer).

Similarly, the row with sub-groups of policyholders that have three years of driving experience indicates that the correlation disappears for customers who have spent these three years with the insurer. In contrast, the row with sub-groups of policyholders with five or more years of driving experience indicates that the correlation disappears only for those customers who have spent at least four years with the insurer.

## 6.4   Learning and Differences in Information among Insurers

I now turn to investigating whether the information obtained by insurers about their repeat customers produces a difference in information among insurers with respect to these customers. To begin, note that some of the results obtained in the preceding sections 6.1-6.3 are already ones that are predicted by this story. These results indicate that the effect of driving experience on the presence of a coverage-risks correlation depends on whether this driving experience was acquired during (i) the period prior to the policyholder's joining the insurer (if any) in which the policyholder was insured by other insurers, or (ii) the period (if any) in which the policyholder has been insured by the current insurer. Driving experience during the latter period spent with the insurer reduces or even eliminates the correlation between low deductibles and more accidents but driving experience in the first period prior to joining the insurer does not (on the contrary). Such difference between driving experience with the current insurer and with prior insurers would not be expected if an insurer accepting new customers could obtain from prior insurers the complete and full information that they have about these customers. With this in mind, let us proceed to investigate the possibility of informational differences among insurers. .

### 6.4.1.  Inside vs. Outside Records as Predictors of Performance

The studied insurer requested that customers report to it the number of claims they submitted in the preceding three years. I now wish to test whether such reports by new customers systematically under-report past claims. On this story, the actual

past claim history of new customers is systematically worse than what is reported by such customers. According to hypothesis to be tested (see section 2.3), the number of accidents by new customers is expected to be higher than what would be predicted if the customers' self-reporting of past claims history were assumed to be accurate.

To test this hypothesis, I looked at a subset of all policies that were sold to either (i) new customers, or (ii) customers who have been with the insurer for at least three years. The number of claims in the past three years that appears in the insurer's data is based on self-reporting for the first group and on the insurer's own records for the second group.

I regressed the number of claims exceeding the regular deductible, as well as the total insurance payments and the total costs to the insurer from such claims on all the characteristics of the policyholder, including the number of past claims in the past three years, the policyholder's choice of deductible, and on whether the policyholder is a new customer or a repeat customer. The results, which are displayed in Table 10A, indicate that the number of claims, the total insurance payment, and the total cost to the insurer are all higher (at the 1% confidence level) for new customers. These results are consistent with the possibility that policyholders switching from other insurers to the insurer under-report past claims.

Although the insurer puts the self-reported claim history of new customers in its data, having no record of its own about these past claims, this does not mean that the insurer is not aware of the problem of under-reporting. In Cohen (2003), which studies the pricing decisions of the insurer over time, I find that, controlling for other characteristics, including past claims, new customers are charged higher prices than repeat customers.

### 6.4.2. Departing Customers

A related hypothesis that I now turn to test is the hypothesis (see section 2.3) that departing customers will be disproportionately ones with a poor past claims record with the insurer. Customers with such a record could gain from switching to a new insurer that would have less information about their past history.

To test this prediction, I created a dummy variable that was equal to 1 when a policyholder decided at the end of the policy period to stay with the insurer for another period and 0 otherwise. The decision whether to stay was regressed on whether the policyholder had claims during the period preceding the decision and on all the characteristics of the policyholder (including the deductible choice in the preceding period).

The results of this regression are displayed in Table 10B. They indicate that the probability of staying with the insurer for another year is smaller by 0.1 (at the 1% confidence level) for policyholders who had claims in the period preceding the decision than for policyholders who had no such claims. Overall, whereas policyholders in general have an average probability of 0.7 of staying with the insurer for another year, policyholders who have had claims in the year preceding the decision have a probability of only 0.6 of staying with the insurer for another year.

These results suggest that departing customers tend to be disproportionately ones whose record with the company included claims. One might still wonder whether such departing customers are indeed more likely to be high-risk types or simply policyholders who simply had claims due to bad luck. To examine this question, I looked at the realization of risks for policyholders who stayed and tested whether such policyholders tended to have subsequently good performance relative to the general pool of customers.

In particular, I ran a regression with respect to policies sold in the fifth year of the company's operations. For each of the three specifications (Order Probit, Poisson, and OLS) I regressed the number of claims on all the observable characteristics including the number of years of prior experience that the insurer has had with the customer (company experience). The results, which are reported in Table 10C, show that the coefficient on the company experience is negative and statistically significant. The longer the insurer's experience with the policyholder, the lower the likelihood that the policyholder will have claims. For example, for low-deductible policyholders, each year of experience reduces the number of claims by 0.009 (in the OLS specification at the 1% confidence level). This amounts to 6% of the number of claims that low-deductible policyholders have. Repeat customers, then, are correlated with less accidents.

## 6.5  Remark on Moral Hazard

As noted in the introduction, a correlation between coverage and accidents is consistent not only with the existence of adverse selection but also with the existence of moral hazard. Indeed, it might be suggested that the identified coverage-accidents correlation, although consistent with adverse selection, could be produced wholly by moral hazard and that the considered market thus could involve no adverse selection.

Although disentangling moral hazard and adverse selection in this market is beyond the scope of this paper, it might be worth noting that some of the findings in this section 6 concerning learning over time do not seem readily explainable by a

standard moral hazard story. For example, if the coverage-accidents correlation were produced by pure moral hazard and no adverse selection existed, why would policyholders who leave their insurer tend to be ones with a poor past claims record? If the correlation is only a result of pure moral hazard and policyholders have no informational advantage over any insurers, then policyholders will have no incentive to flee bad past records and to switch to new insurer once they had an accident. Such tendency to leave the insurer, however, can be explained if there are differences in information among insurers – as there are in a model of adverse selection with learning. When insurers have less information about new customers than about repeat customers, policyholders with poor past claims record have something to gain from switching to a new insurer.

Furthermore, the finding that the coverage-accidents correlation eventually disappears for policyholders that have been with the insurer for a long period of time is also not readily explainable by a moral hazard story with no adverse selection. If regular deductibles reduce the number of accidents by increasing incentives to take precautions, why would this incentive effect work for given policyholders with a certain driving experience when they are new with the insurer but not when they have been with the insurer for a while? All these are issues that should be considered by future research seeking to disentangle moral hazard and adverse selection in this market.

## 7 Conclusion

Using a unique and rich database, which includes all the data that an insurer had about its policyholders, this paper has tested the predictions of adverse selection models. Consistent with the presence of asymmetric information, I found that an insurance menu with different deductibles results in sorting that produces a coverage-accident correlation. Low-deductible choices are correlated with more accidents and higher losses from accidents.

Whether any informational asymmetry is present (and, if so, what its magnitude is) it might change over time, as parties obtain more information. Consistent with the presence of learning by policyholders, I found that the coverage-accidents correlation exists only for groups of policyholders that have had sufficient driving experience prior to joining the insurer. Consistent with the presence of learning by insurers about the risk type of their customers, the coverage-accidents correlation diminishes in magnitude over time and eventually disappears for policyholders who stay with the same insurer for a sufficiently long period of time.

Finally, the evidence is consistent with insurers' obtaining information about their repeat customers that other insurers to which such customers might turn

would not fully have. Consistent with switchers' under-reporting past claims history, I found that switchers perform less well than repeat customers with the same past claims record as self-reported by the switchers. Furthermore, consistent with new insurers having less information about the past record of switchers than the switchers' prior insurers, I found that customers that leave their insurer are disproportionately ones with a poor past claims record.

One aspect of the market that I have not investigated concerns whether insurers take advantage of the informational advantage they have over rival insurers with respect to repeat customers to make larger profits on such customers. I investigate this question in a separate study (Cohen (2002)). I find that insurers make greater profits on repeat customers. This profits increases – but at a decreasing rate – the longer the period that the customers stays with the insurer. This evidence is consistent with the possibility that the additional information gained by an insurer over time with respect to repeat customers provides the insurer with some market power over customers with good record.

Another aspect of adverse selection models that I have not investigated concerns the consistency of the evidence with cross-subsidization of high-risk (high-coverage) policyholders by low-risk (low coverage) policyholders. Such cross-subsidization is predicted by the Spence-Miyazaki line of adverse selection models but not by the Rothschild-Stiglitz-Wilson-Riley line of such models. Also, as already noted, it would be worthwhile to disentangle moral hazard and adverse selection by examining predictions that, unlike the prediction of coverage-accidents correlation, are associated with only one of the two phenomena. These two issues would be worthwhile targets for future research.

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# Appendix I
## List of Variables (in Alphabetical Order)

| | |
|---|---|
| Academic education | Equal to 1 if the policyholder has a university degree |
| Age | Age of policyholder |
| Car model year | Car model year |
| CC | Size of engine |
| Company experience | Equal to the number of years that the policyholder has been with the insurer |
| Calendar year | Equal to the calendar year |
| Driving experience | Length (in years) that the policyholder has had a driving license |
| Earned premium | Premium paid |
| Immigrant index | Equal to 1 if the policyholder is an immigrant |
| Immigration year | The year in which an immigrant policyholder immigrated to Israel |
| Gender | The policyholder's gender |
| Main car | Equal to 1 if the car is used as main car |
| Number of claims | Number of claims submitted during the life of the policy |
| Number of claims last year | Number of claims occurring in the year prior to joining the insurer |
| Number of claims three years ago | Number of claims occurring three years prior to joining the insurer |
| Number of claims two years ago | Number of claims two year before the policyholder joined the insurer |
| Number of drivers | Equal to 1 if only the policyholder and his spouse are using the car |
| Premium | Yearly premium |
| Regular deductible | Equal to 1 if the policyholder chose a regular deductible |
| Regular Premium | The premium the policyholder were quoted for a regular deductible |
| Single | Equal to 1 if the policyholder is single |
| Social and private use | Equal to 1 if the car is used for social and private needs |
| Stayed | Equal to 1 if the policyholder stayed with the insurer in the preceding year |
| Total annual costs | All payments resulting from the issuance of the policy |
| Total insurance payments | Payments made to the policyholder in connection with claims |
| Value of the car | The value of the car |
| Young driver age | The age of the youngest driver who is allowed to use the car |
| Young driver experience | The driving experience of the youngest driver using the car |
| Young driver gender | The youngest driver's gender |
| Young driver index | Equal to 1 if a young driver is using the car |

# Table 1: Descriptive Statistics

| Type of policies<br>Variable | All<br>Mean | Regular<br>deductible<br>policies<br>Mean | Low<br>deductible<br>policies<br>Mean |
|---|---|---|---|
| Buyer Demographics characteristics: | | | |
| Age | 42.5<br>(12.54) | 42.6<br>(12.47) | 42.4<br>(12.78) |
| Gender | 1.32<br>(0.47) | 1.31<br>(0.47) | 1.32<br>(0.46) |
| Single | 0.13<br>(0.33) | 0.13<br>(0.33) | 0.13<br>(0.33) |
| Academic education | 0.26<br>(0.04) | 0.25<br>(0.43) | 0.32<br>(0.46) |
| Buyer's car characteristics: | | | |
| CC | 1,565<br>(3750) | 1,566<br>(380) | 1,559<br>(358) |
| Car model year | 1,993<br>(3.20) | 1,993<br>(3.20) | 1,993<br>(3.20) |
| Value of the car | 61,932<br>(34,998) | 60,997<br>(37,780) | 65,202<br>(35,559) |
| Social and private use | 1.08<br>(0.27) | 1.08<br>(0.27) | 1.07<br>(0.26) |
| Main car | 1.15<br>(0.36) | 1.15<br>(0.36) | 1.14<br>(0.35) |
| Buyer 's driving characteristics: | | | |
| Driving experience | 19.03<br>(10.13) | 18.97<br>(10.12) | 19.2<br>(10.13) |
| Past claim history: | | | |
| Number of claims last year | 0.10<br>(0.31) | 0.09<br>(0.30) | 0.12<br>(0.34) |
| Number of claims two years ago | 0.07<br>(0.26) | 0.06<br>(0.25) | 0.08<br>(0.29) |
| Number of claims three years ago | 0.05<br>(0.22) | 0.04<br>(0.21) | 0.06<br>(0.24) |
| Realization of policy: | | | |
| Number of claims | 0.19<br>(0.45) | 0.18<br>(0.44) | 0.23<br>(0.50) |
| Damage | 2,136<br>(8,718) | 2,032<br>(8,561) | 2,501<br>(9,239) |
| Total insurance payments | 1,538<br>(7.301) | 1,455<br>(7,163) | 1,824<br>(7,755) |
| Total actual payment | 2,028<br>(7,526) | 1,966<br>(7,382) | 2,246<br>(8,004) |
| N | 213,660 | 166,118 | 45,542 |

# Table 2: Premium and Total Annual Costs as a Function of Characteristics

| Dependent Variable: OLS | Premium Coef. | Total Annual Cost coef. |
|---|---|---|
| Buyer demographic characteristics: | | |
| Age | -1.42*** | -2.91 |
| | (0.18) | (2.78) |
| Gender | 53.43*** | 127.65*** |
| | (2.63) | (41.10) |
| Single | 32.04*** | 43.00 |
| | (3.87) | (60.36) |
| Academic education | -46.28*** | -215.94*** |
| | (2.73) | (42.67) |
| Prefer | -215.89*** | -110.88** |
| | (0.288) | (45.00) |
| Buyer's car characteristics: | | |
| CC | 0.24*** | 0.36*** |
| | (0.04) | (0.06) |
| Car model year | -13.37*** | -79.12*** |
| | (0.56) | (8.80) |
| Value of the car | 0.02*** | 0.02*** |
| | (0.0001) | (0.001) |
| Main car | 36.61*** | 80.66 |
| | (3.32) | (51.81) |
| Buyer's driving experience: | | |
| Driving experience | -1.99*** | -18.79*** |
| | (0.22) | (3.46) |
| Number of claims submitted last year | 438.04*** | 696.39*** |
| | (3.87) | (60.43) |
| Number of claims submitted two years ago | 365.04*** | 569.19*** |
| | (4.62) | (72.09) |
| Number of claims submitted three years ago | 300.05*** | 685.99*** |
| | (5.40) | (84.39) |
| Number of drivers | -80.52*** | -143.05*** |
| | (2.75) | (42.9) |
| Young driver age | -294.64*** | -227.22*** |
| | (3.44) | (53.80) |
| Young driver experience | -263.05*** | -142.41** |
| | (4.15) | (64.82) |
| Young driver gender | -178.36*** | -341.13*** |
| | (5.65) | (88.28) |
| Young driver index | 2240.96*** | 2063.43*** |
| | (12.54) | (195.90) |
| Other: | | |
| Company experience | -89.05*** | -63.23 |
| | (1.18) | (18.50) |
| | | |
| Time Fixed Effect | YES | YES |
| N | 166,116 | 166,116 |
| Adj-R$^2$ | 0.7206 | 0.013 |

***,**,* - Significant at 1%, 5%, and 10% confidence level, respectively

## Table 3: Summary Statistics

| Level of Deductible | "Low" | "Regular" | "High" | "Very high" |
|---|---|---|---|---|
| Percentage of choosing | 21.96% | 76.72% | 0.74% | 0.6% |
| Claim frequency* | 22.99% | 17.75% | 11.45% | 9.32% |
| Loss Ratio** | 72.62% | 66.65% | 65.29% | 42.34% |
| Average premium | 2,853 | 2,623 | 2,085 | 1,920 |

* The total number of claims made by customers divided by the number of policies weighted by the exposed time of the policy, which is the time (in year unit) that the policy was in effect.

** The sum of all the payments made to customers by the insurer divided by the insurer's total earned premium.

## Table 4: The Association between Deductible Choice and Accidents

| Column | | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Company year | | 1994-1995 | 1995-1996 | 1996-1997 | 1997-1998 | 1998-1999 | All years |
| **Dependent variable: Number of Claims** | | | | | | | |
| Order Probit | | -0.10*** | -0.09*** | -0.10*** | -0.09*** | -0.16*** | -0.10*** |
| | | (0.019) | (0.015) | (0.016) | (0.017) | (0.021) | (0.008) |
| | Pseudo-$R^2$ | 0.011 | 0.009 | 0.009 | 0.009 | 0.011 | 0.0258 |
| Poisson | | -0.15*** | -0.14*** | -0.15*** | -0.15*** | -0.32*** | -0.16*** |
| | | (0.028) | (0.023) | (0.23) | (0.026) | (0.04) | (0.012) |
| | Pseudo-$R^2$ | 0.012 | 0.010 | 0.010 | 0.010 | 0.012 | 0.0275 |
| OLS | | -0.04*** | -0.03*** | -0.03*** | -0.03*** | -0.03*** | -0.03*** |
| | | (0.007) | (0.007) | (0.005) | (0.005) | (0.005) | (0.002) |
| | Adjusted-$R^2$ | 0.0073 | 0.0076 | 0.0091 | 0.0073 | 0.0153 | 0.0224 |
| **Dependent variable: Total Insurance Payments** | | | | | | | |
| OLS | | -241.44*** | -286.14*** | -236.89*** | -315.19*** | -229.28*** | -221.61*** |
| | | (126.6) | (92.1) | (83.3) | (80.5) | (63.8) | (38.4) |
| | Adjusted-$R^2$ | 0.032 | 0.035 | 0.034 | 0.038 | 0.008 | 0.0127 |
| | N | 21,715 | 38,201 | 45,760 | 50,571 | 57,410 | 213,660 |

• I only report the coefficient of the regular deductible
• standard errors adjusted for clustering on policy base
• ***,**,* - Significant at 1%, 5%, and 10% confidence level, respectively

# Table 5: The Effect of Driving Experience before Joining the Insurer Only for New Customers

**Dependent variable: Number of claims**

| | Number years of experience not in the insurance company | 0 | 1 | 2 | 3 | 4+ |
|---|---|---|---|---|---|---|
| Order probit | Regular deductible | 0.816 | 0.031 | -0.029 | -0.347*** | -0.102*** |
| | | (0.0684) | (0.223) | (0.183) | (0.1225) | (0.0119) |
| | Pseudo R² | 0.1437 | 0.1238 | 0.0634 | 0.0480 | 0.0190 |
| Poisson | Regular deductible | 1.29 | 0.167 | -0.065 | -0.375** | -0.159*** |
| | | (1.02) | (0.258) | (0.231) | (0.16) | (0.017) |
| | Pseudo R² | 0.1037 | 0.0590 | 0.0426 | 0.0320 | 0.0170 |
| OLS | Regular deductible | 0.207 | 0.018 | -0.011 | -0.137*** | -0.037*** |
| | | (0.228) | (0.10) | (0.075) | (0.048) | (0.004) |
| | Adjusted R² | 0.0739 | 0.1143 | 0.0386 | 0.0334 | 0.0198 |
| | Time fixed effect | YES | YES | YES | YES | YES |
| | N | 160 | 366 | 616 | 988 | 99138 |

- I only report the coefficient of regular deductible
- ***,**,* - Significant at 1%, 5%, and 10% confidence level, respectively


# Table 6: The Effect of Company Experience

**Dependent variable: Number of Claims**

| | Company years of experience | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| Order Probit | Regular deductible | -0.10*** | -0.11*** | -0.112*** | -0.087*** | -0.07 |
| | | (0.012) | (0.015) | (0.02) | (0.03) | (0.05) |
| | Pseudo R² | 0.0196 | 0.0217 | 0.0234 | 0.0295 | 0.0141 |
| Poisson | Regular deductible | -0.155*** | -0.17*** | -0.185*** | -0.15*** | -0.110 |
| | | (0.017) | (0.022) | (0.029) | (0.046) | (0.085) |
| | Pseudo R² | 0.0210 | 0.0230 | 0.0248 | 0.0307 | 0.0144 |
| OLS | Regular deductible | -0.037*** | -0.036*** | -0.034*** | -0.021*** | -0.008 |
| | | (0.004) | (0.005) | (0.006) | (0.006) | (0.008) |
| | Adj-R² | 0.0218 | 0.0217 | 0.0218 | 0.0230 | 0.026 |
| | Time Fixed Effect | YES | YES | YES | YES | YES |
| | N | 97,976 | 56,628 | 31,423 | 15,634 | 8,558 |
| | Adj-R² | 0.0218 | 0.0217 | 0.0218 | 0.0230 | 0.026 |

- I only report the coefficients of interest
- ***,**,* - Significant at 1%, 5%, and 10% confidence level, respectively

## Table 7: The Two Dimensions of Experience

| Years of driving experience \ Years of company experience | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| 0 | NO<br>Number of Observation: 200 | ✕ | ✕ | ✕ | ✕ |
| 1 | NO<br>Number of Observation: 344 | NO<br>Number of Observation: 147 | ✕ | ✕ | ✕ |
| 2 | NO<br>Number of Observation: 570 | NO<br>Number of Observation: 158 | NO<br>Number of Observation: 117 | ✕ | ✕ |
| 3 | **-0.126 (0.04)**<br>**Number of Observation: 947** | -0.103 (0.07)<br>Number of Observation: 286 | NO<br>Number of Observation: 95 | NO<br>Number of Observation: 93 | ✕ |
| 4 | **-0.104 (0.04)**<br>**Number of Observation: 1398** | -0.06 (0.04)<br>Number of Observation: 505 | NO<br>Number of Observation: 40 | **-0.28 (0.08)**<br>**Number of Observation: 72** | NO<br>Number of Observation: 77 |
| 5 | **-0.104 (0.03)**<br>**Number of Observation: 2052** | **-0.20 (0.042)**<br>**Number of Observation: 768** | **-0.072 (0.006)**<br>**Number of Observation: 336** | -0.095 (0.08)<br>Number of Observation: 135 | NO<br>Number of Observation: 109 |
| 6+ | **-0.06 (0.004)**<br>**Number of Observation: 92523** | **-0.054 (0.005)**<br>**Number of Observation: 54796** | **-0.057 (0.005)**<br>**Number of Observation: 30695** | **-0.036 (0.006)**<br>**Number of Observation: 15369** | **-0.015 (0.007)**<br>**Number of Observation: 8218** |

## Table 8A: Inside vs. Outsize Records as Predictor of Subsequent Performance

In the regression below I include (i) all new customers, and (ii) all repeat customers that have been with the insurer for at least three years.

| Dependent variable: | Number of claims | Total insurance payment | Total annual cost |
|---|---|---|---|
| New | 0.034*** | 142.21*** | 269.413*** |
|  | (0.004) | (53.90) | (68.28) |
| Regular deductible | -0.0298*** | -272.88*** | -134.45** |
|  | (0.003) | (66.32) | (55.50) |
| Number of claims in the past three years | 0.05*** | 554.37*** | 665.81*** |
|  | (0.003) | (48.89) | (50.34) |
|  |  |  |  |
| Time fixed effect |  | YES |  |
| N |  | 125583 |  |
| Adj-R² | 0.028 | 0.013 | 0.014 |

- I only report the coefficient of interest
- ***,**,* - Significant at 1%, 5%, and 10% confidence level, respectively

# Table 8B: Past Record of Departing vs. Staying Customers

**Dependent variable: stayed**

|  | OLS | LOGIT |
|---|---|---|
| Number of claims | -0.102*** | -0.522*** |
|  | (0.002) | (0.0124) |
| Regular deductible | 0.0157*** | 0.1182*** |
|  | (0.002) | (0.016) |
|  |  |  |
| Time Fixed Effect | YES | |
| N | 156,245 | |
| Adj-R² | 0.3100 | 0.3021 |

- I only report the coefficients of interest
- ***,**,* - Significant at 1%, 5%, and 10% confidence level, respectively

# Table 8C: The Performance of Repeat Customers

Testing whether, within each group (low/regular deductible), the number of claims is lower for individuals with more years of experience with the insurer:

**Dependent variable: number of claims**

|  | Order Probit | Poisson | OLS |
|---|---|---|---|
| Company years of experience | -0.050*** | -0.094*** | -0.009*** |
|  | (0.0058) | (0.011) | (0.001) |
| Regular deductible | -0.168*** | -0.322*** | -0.0336*** |
|  | (0.021) | (0.038) | (0.004) |
|  |  |  |  |
| N | 57410 | 57410 | 57410 |
| Adjusted-R²/Pseudo-R² | 0.0112 | 0.0119 | 0.0075 |

- I only report the coefficient of interest
- This regression includes only data for the company fifth year of operation. Doing the same for the whole sample (for the whole five years of the company operation) yields similar results.
- ***, **, * - Significant at 1%, 5%, and 10% confidence level, respectively