Identifying Moral Hazard in Car Insurance Contracts[1]

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Abstract

This paper capitalizes on a unique situation in Israel where car insurance coverage is often distributed as a benefit by employers. In our sample, employer-determined coverage resulted in an average $235 discount in accident costs. Using instrumental variable analysis on data provided by an insurance firm in Israel (2001-2008), we find that each $100 reduction in accident costs results in a 1.7 percentage point increase in the probability of an accident. At an average accident rate of 16.3 percent, this 10 percent increase in auto accidents can be interpreted as the effect of moral hazard on car accidents. (JEL: D82, G22)

1 Introduction

Moral hazard implies that insurance will alter individual's behavior by decreasing their motivation to prevent loss. In situations where monitoring is costly, a positive correlation between accidents and insurance coverage will emerge. Yet this in itself cannot provide evidence of moral hazard, as an alternative explanation is that people with a higher risk of accidents self-select into insurance coverage. This "adverse selection" will also generate a positive correlation between accidents and insurance coverage since insured individuals will be disproportionately more likely to suffer accidents in the first place. Clearly, both explanations of the observed correlation are plausible and, as much of the empirical research has emphasized, it is challenging to separately identify them in the available data.[1]

Empirically disentangling moral hazard from adverse selection is important as it can give us insight into the effects of monetary incentives on risk-taking behavior. The presence of a moral hazard effect would suggest that increasing penalty rates applicable after involvement in a car accident would decrease accident rates. This policy recommendation will hold true if people adjust their driving behavior to expected accident costs. However, if driving behavior does not respond to increases in penalty rates, these policies will increase insurance costs without affecting accident outcomes.

This paper estimates the effect of accident costs on driving behavior in a context where car insurance coverage is included as a fringe benefit distributed by employers. This benefit reduces the cost of an accident and could result in a moral hazard effect where accidents increase. Our data set consists of information on employees of a large Israeli company

[1]See work by Boyer and Dionne (1989), Chiappori and Salanie (2000), Abbring et. al. (2003), Chiappori et. al. (2006), and Abbring et. al. (2008).

between 2001-2008. While all of these employees drive their own private cars, workers holding contracts that are part of a collective-bargaining agreement receive insurance free of charge, while other workers holding individual contracts are not given access to this benefit.[2] Those receiving the insurance benefit pay only a set deductible averaging \$120 when reporting an accident, while those holding private insurance pay a higher deductible averaging \$160. After reporting an accident, individuals holding private coverage also face the additional penalty of a 10-30 percent increase in their annual insurance premium for the next 3 years.[3]

Importantly, the selection mechanism for obtaining the insurance benefit is a function of occupation and not of individual preferences regarding insurance coverage.[4] Thus, the allocation to company coverage creates a plausibly exogenous source of variation in insurance coverage that cannot be attributed to adverse selection. This provides an opportunity to estimate the moral hazard effect of increased insurance coverage using an instrumental variables strategy. After controlling for available policy holder and car characteristics we find that a \$100 discount in accident costs increases the likelihood of an accident by 1.7 percentage points. This represents a 10 percent increase in auto accidents as a result of moral hazard since the mean accident rate for people in our sample is 16.3 percent. We compare small

[2]The average cost of a policy for those who purchased insurance privately was \$700.

[3]The size of the penalty is dependent on the driver's accident history and annual policy price and can amount to over \$1,000 if this is the second reported accident in a two year period. This penalty is expected to remain even if the private client transfers to a different insurance firm as clients are required by law to submit an accident history form from their previous insurer.

[4]While membership in a trade union is voluntary in Israel, the coverage created by a collective-bargaining agreement is applied to all relevant workers. Thus, the insurance benefit is not a matter of individual choice (Cohen et. al., 2003)

and large accidents to provide additional support for the moral hazard effect interpretation of these results and find that increased costs have a significant effect on accidents with low rather than high risks of physical harm.

To the best of our knowledge this is the first paper that attempts to identify the effect of insurance on accident outcomes when insurance costs are not determined by individual choice or driving behavior. However, individuals employed in different occupations may have different unobserved levels of driving riskiness. To ensure that omitted variable bias is not driving our results, we also estimate a moral hazard effect using a differencing approach. We focus on drivers who are observed in the data from the start of their relationship with the insurance provider (i.e., individuals who started receiving coverage after 2000). In this first period of coverage the driving behavior of individuals allocated to company coverage may still reflect pre-benefit conduct. We can then estimate a moral hazard effect by comparing driving behavior in the first period to driving behavior in the second period and onwards within each group. The change in accident rates occurring within the group of drivers receiving company coverage provides a moral hazard effect that is separate from unobserved heterogeneity among individuals holding different types of jobs. We again find a significant moral hazard effect that increases the accident rate for those receiving company insurance. This differencing framework, which was only applied to a subset of new employees who began their insurance policies after 2000, measures a larger moral hazard effect of 3.4 percentage points. New employees receiving company coverage may be more susceptible to the moral hazard effect since they are likely to be younger than long-serving employees.[5]

[5] Younger drivers may be overconfident that they will be able to avoid an accident with injuries; this would lead them to take accident risks under moral hazard that older, more experienced drivers would avoid.

This paper is organized as follows. In the next section we begin by reviewing relevant research on insurance and its effects on behavior. Section 3 outlines the modeling framework relating driving behavior to insurance and shows how the allocation to company coverage can be used as an instrumental variable for identifying the moral hazard effect. Section 4 describes the institutional setup and the data used in the empirical analysis while Section 5 reports the empirical results for both the instrumental variable analysis and differencing approach. Section 6 concludes.

2 Empirical Research on Moral Hazard

The problem faced by prior studies in measuring the effect of post-insurance accident costs on behavior (moral hazard) is that individuals can choose their level of coverage (adverse selection). This endogeneity in costs can result in mixed answers to the question of whether or not moral hazard exists in car insurance. Chiappori and Salanie (2000) find no evidence of moral hazard when focusing on a cross-section of young French drivers to assess whether there is unobserved information affecting both the insurance choice and the accident outcome. In an attempt to separately identify adverse selection and moral hazard, Abbring et. al. (2003) stress the importance of using a panel of individuals. They also find no evidence of moral hazard based on a model where moral hazard would imply that each accident decreases the chance of a future accident, as the additional cost of a future accident has increased.[6]

In more recent studies, Abbring et. al. (2008) using Dutch longitudinal micro data and Dionne et. al. (2013) using French longitudinal micro data do find evidence of moral

[6] In the French system the premium level each year is determined by the premium in the previous year multiplied by a bonus-malus coefficient. This results in accident costs being convex in the number of past accidents that occurred.

hazard. Abbring et. al. compare accident timing for people with the same number of total accidents in a given year who face different costs due to their bonus-malus class.[7] Dionne et. al. (2013) identify moral hazard by examining both the effects of the previous year's insurance contract as well as the driver's bonus-malus class on car accidents.

Comparing driving patterns between people who own versus lease their vehicle has also been used to identify moral hazard. Dunham (2003) examines differences in vehicle depreciation of corporate owned fleet and rental versus private vehicles. He estimates an upper bound for moral hazard since there remain significant differences between fleet and private vehicles that provide alternative explanations for the increased depreciation rate. Schneider (2010) investigates differences in driving behavior between taxi owners and leasers in New York City. His dataset allows him to control for a wide range of observable differences in driver characteristics of those who choose to lease versus those who choose to own taxis and examine changes in driver behavior due to moral hazard. Schneider finds that moral hazard increases the accident rate by 16 percent. In these papers the ownership decision is endogenous and the validity of the results relies on accurately controlling for adverse selection.

This brief review illustrates how in the absence of complete information on the accident risk level of each individual, alternative methods of risk classification can result in different evaluations of insurance outcomes. Ideally, to estimate a moral hazard effect we would like to eliminate the adverse selection aspect of insurance. That is, we would want to have a sample of individuals that are "as if" randomly allocated to different insurance contracts

[7]The bonus-malus class is determined at each annual contract renewal date and is based on accident history. This class defines the premium paid by the insured.

regardless of their preferences. Section 3 explains how employer allocated insurance provides an opportunity to move in this direction.

3 An Empirical Framework

A moral hazard estimate should capture how the "demand" for car accidents or dangerous driving behavior responds to a change in their post-insurance price. While this price can be calculated from an insurance contract, it is a clearly endogenous variable driven by individual choice. We demonstrate how estimation of moral hazard becomes feasible when the allocation to company coverage creates exogenous variation in accident costs. Potential objections to this method of identification as well as techniques employed to address these issues are discussed below.

We assume that each individual has his/her own preferred level of dangerous driving behavior which is a function of personal and car characteristics x, the financial cost of an accident C_A, and an unobserved individual factor v. This level of dangerous driving behavior is measured by the latent variable y^*, while we observe only the binary variable y taking the value of 1 when involved in an accident and zero otherwise ($y = I[y^* > 0]$),[8]

$$y^* = x\beta_0 + \beta_1 C_A + v - \varepsilon \tag{1}$$

$$\Pr(y = 1 \mid x, C_A, v) = \Pr(y^* > 0 \mid x, C_A, v) = G(x\beta_0 + \beta_1 C_A + v) \tag{2}$$

The variables included in x capture how personal characteristics (e.g. age, gender, driving experience) as well as car characteristics (e.g. speed capabilities, brake technology,

[8]We do not exploit the natural risk variable of number of accidents per year, as less than 2 percent of the sample report more than one accident per policy.

commute distance) can affect the level of dangerous driving behavior.[9] The unobserved individual component v refers to time-invariant unobservable personal characteristics. The additional unobserved component ε (which is uncorrelated with x, C_A, and v) reflects the randomness associated with the occurrence of an accident involving other automobiles and unexpected road hazards. G is the cumulative distribution function of ε. Importantly, v is known by the individual while ε is not.

The critical variable in the analysis is C_A, the out-of-pocket cost of an accident. Without insurance coverage this cost is simply the expected damage resulting from an accident. With the introduction of an insurance contract this cost is predetermined at the start of the contract, and does not depend on the expected car damage. Thus, C_A is potentially known to individuals and lower costs may result in more dangerous driving behavior and consequently higher rates of car accidents ($\beta_1 < 0$). This is the moral hazard effect we wish to estimate.

We examine a simple insurance contract $\{p(x), \delta, k\}$ composed of a base annual premium $p(x)$, a deductible δ and a penalty rate k (in percentage terms) in case of an accident. The base premium is calculated by the insurance provider as a function of the driver and car characteristics that are relevant for determining the probability and expected cost of an accident. In general, more dangerous drivers and drivers with more expensive cars face higher base premiums. The deductible δ is constant across individuals and paid to the provider immediately after reporting an accident. The accident penalty k is paid upon renewal of the insurance contract and increases the annual cost of insurance by k percent.

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[9] See Cohen and Einav (2007) for an analysis of how different driver characteristics affect accident outcomes.

Given an insurance contract, the cost of an accident for each individual is the deductible (δ) as well as the expected increase to their annual insurance contract resulting from a car accident,

$$C_A = p(x) \times \frac{k}{100} + \delta \tag{3}$$

In a strict bonus-malus system where x includes only characteristics that remain constant over time and k is public information, the driver could calculate the exact change in his/her annual premium that would occur after an accident as $p_{t+1}(x) = p_t(x) \times \left(1 + \frac{k}{100}\right)$. While equation (3) implicitly assumes a one period increase in the annual premium, in many insurance systems this penalty will remain for a given duration of time. The expected accident cost will then be a function of the length of the penalty spell as well as the extent to which individuals discount future penalties. Penalty duration is further addressed in the next section when examining the Israeli context.

The problem with estimating the effect of C_A on car accidents through equation (1) is that C_A is likely to be endogenous as the unobserved factor v can affect the choice of k and δ. More precisely, when drivers choose from a menu of annual premiums, penalties and deductibles, more dangerous drivers may choose higher premiums (p) and lower out-of-pocket costs (k, δ) in order to minimize the expected cost of an accident. This adverse selection effect could result in a negative correlation between C_A and the unobserved factor (v), thereby biasing downwards the estimate of β_1 in equation (1).[10] Thus, a negative estimate of β_1 may

[10]Let p_H (p_L) be the *higher*(*lower*) annual premium options and $k_H\,(k_L)$ be the *higher*(*lower*) penalty options. The negative correlation between v and C_A is guaranteed when the higher premium lower penalty combination $(p_H \times k_L)$ chosen by dangerous drivers is larger than the combination $(p_L \times k_H)$ chosen by low risk drivers.

be indicative of adverse selection and not moral hazard.

Even if adverse selection is not present, a correlation between the unobserved individual effect and accident costs can still exist. While accident costs are sometimes selected based on individual choice, they are always subject to criteria of the insurance provider. Because drivers who are identified as more dangerous (larger v) present a higher financial risk to the insurance provider they are often assigned higher accident costs C_A. When the econometrician lacks access to all information utilized by the insurance firm to assess initial accident risks this will create a positive correlation between v and C_A in equation (1). Thus, omitted variable bias in this context could hide an existing moral hazard effect by biasing the β_1 estimate towards zero.

3.0.1 The Israeli Context

In Israel, all car owners are required by law to hold a minimal level of insurance coverage. Mandatory insurance covers claims on injuries incurred by people in the insured vehicle and pedestrians injured in an accident. Most drivers purchase additional coverage against damage to their vehicle and other vehicles in the case of an accident.[11] There also exist options of lower premium costs and higher deductibles or higher premium costs and no deductible. Despite these alternative options, the majority of drivers purchase a standard package insuring them against damage to their own vehicle and other vehicles.

[11]This additional coverage usually includes a deductible averaging $200 if involved in an accident and using an in-policy auto mechanic. In cases where the driver is under age 24, or has his/her license for less than a year, the deductible increases by 50% at most insurance companies. There is also the opportunity to purchase additional legal and third party coverage as well as windshield damage coverage, towing, and temporary vehicle replacement. Alternatively, drivers can purchase third party insurance which covers damage to other vehicles but does not cover damages to their own vehicle.

Similar to the US and Canada there does not exist a general bonus-malus system in Israel. Instead, each firm uses its own formula to compute an annual premium based on the financial risk to the insurance firm associated with a general accident, with an accident resulting in total loss, and with the burglary of the vehicle. The general technique applied by these firms is to use observed characteristics of the vehicle (e.g. model, age, cost of replacement parts, blue book value, etc.) to estimate the cost of the three different outcome risks. They then calculate the probability of each outcome risk based on the characteristics of the driver. The annual premium is computed for each individual as the sum of the three ($cost \times probability$) products.

The probability of an accident (including total loss) in Israel is computed as a function of accident history within the past 3 years. Both at-fault and not at-fault claims are included in this calculation.[12] Information sharing is achieved between insurance firms by use of a no-claims form that the prior insurance provider is required to produce.

In a strict bonus-malus system the penalty rate (k) is a predetermined number based on the driver's bonus-malus class. In a merit-ranking system where the premium function remains private information of the insurance firm, individuals can still calculate expected accident costs C_A using equation (3) and an average value of k. This average malus cost (k) differs between insurance companies in Israel and ranges in size from as low as 10 percent to as high as 45 percent per reported accident.

[12] This differs from insurance policies in other countries where only at-fault accidents are considered for premium surcharges. The Israeli policy is driven by the reality that one driver is unlikely to take full responsibility for an accident. Thus, an accident coded as not at-fault, only means the insured driver is not willing to take full responsibility for the accident. The insurance companies therefore treat all reported collisions as indicators for future accident risks.

We evaluate accident results in a company where some employees face lower accident costs (C_A) due to receiving a fringe benefit of company paid car insurance. Drivers who are allocated to company coverage face no post-accident penalty ($k = 0$) and receive a 25 percent discount on the deductible ($0.75\delta = \$120$). Employees without company coverage pay the full deductible (averaging $\delta = \$160$) as well as a penalty that is dependent on involvement in an accident in the past year (averaging $k = 10$ percent for a first accident and $k = 30$ percent for a second accident). A first accident is expected to result in a 10 percent increase in the driver's annual insurance premium that will persist over 3 years. However, if this individual reports an additional accident either during the same policy year or during the next policy year he/she will face an expected 30 percent increase that will persist over three years. Thus, individuals who receive company coverage face lower out-of-pocket accident costs (C_A) than identical individuals who are privately insured.[13] Importantly, the allocation of this fringe benefit is not dependent on the extent to which the car is used for job-related purposes.[14]

The persistence of the penalty over 3 years requires us to consider a per-period discount factor γ_t, as a \$100 penalty due in 2 years may not be equivalent to a \$100 fine due today or next year. Let $z = 1$ denote receiving company coverage, while $z = 0$ denotes private coverage. Accident costs can then be expressed as,

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[13]In addition, the annual cost of the insurance policy is paid by the employer. This large benefit, however, may not be relevant to moral hazard since these expenses are sunk at the beginning of the contract period.

[14]The employer also allocated company vehicles to individuals with increased job-related car usage as well as managers and senior level employees, but these individuals are not included in the sample as they were only insured by the data-provider for one year. Additionally, for these individuals it would be difficult to disentangle increased accidents resulting from moral hazard versus increased accidents resulting from differential driving patterns.

$$C_A = \begin{cases} 160 + \sum_{t=1}^{3} \gamma_t \left(0.1 \times p + 0.2 \times p \times y_{-1}\right) & \text{if } z = 0 \\ \\ 120 & \text{if } z = 1 \end{cases} \tag{4}$$

Using information on the annual insurance premium p paid by individuals in our data over time as well as accident history y_{-1} we compute C_A at the start of each annual contract. We apply the mean discount rates calculated by Benzion et. al. (1989) based on responses to questions regarding the current value of a future fine of \$200 in 6 months, 1 year, and 2 years ($\gamma_1 = \frac{1}{(1+0.321)^{0.5}}, \gamma_2 = \frac{1}{(1+0.236)}, \gamma_3 = \frac{1}{(1+0.210)^2}$).[15] Our calculation uses the average deductible set by the insurance provider $\delta = \$160$. While we would have preferred individual level data on deductible fees, the main cause of variation in this variable is differences in car values which are controlled for in our analysis. This new variable C_A is directly affected by past accidents y_{-1} which generates a positive correlation with v in equation (1). OLS estimation will not capture the moral hazard effect in the presence of this omitted variable bias where more dangerous individuals face higher accident costs.

When the allocation of company coverage z is not correlated with car usage and driving preferences we can use it as an instrumental variable to identify β_1, the moral hazard effect of increased coverage. If we were to assume equation (1) follows a linear probability model then absent additional individual controls, the instrumental variables estimator simplifies into a Wald estimator. In other words, we could estimate the moral hazard effect as the difference in accident rates between those with and without company insurance ($E[y|z = 1] - E[y|z = 0]$)

[15]We also run our analysis using alternative discount factors ranging between $\gamma = 0.473$ and $\gamma = 1$ (where $\gamma = 0.473$ applies the maximum discount rate estimated for a fine by Benzion et. al. (1989)).

divided by the difference in accident costs between these 2 groups ($E[C_A|z = 1] - E[C_A|z = 0]$).

Consistent estimation of the moral hazard effect depends on the identification assumption that without differential coverage we would not expect those with company coverage ($z = 1$) to drive more dangerously. We must still account for this possibility even when the allocation to company coverage is determined by occupation and not decided upon by the individual. Intuitively, however, we may expect the opposite to be true since workers in Israel holding positions covered under collective-bargaining agreements are generally found to be older and predominately female in comparison to workers holding private contracts. If anything, these characteristics are associated with better driving behavior and lower riskiness levels.[16] If this were the case, our estimate of β_1 would underestimate the moral hazard effect of car insurance. This can be clearly illustrated using the Wald estimator. When individuals allocated to company coverage are better than average drivers in our sample $E[y|z = 1]$ is lower than its true value, resulting in a difference ($E[y|z = 1] - E[y|z = 0]$) that underestimates the moral hazard effect. This result should be contrasted to the possible overestimate of a moral hazard effect when adverse selection exists in car insurance.

One may still be concerned that individuals who receive company coverage ($z = 1$) work in occupations that are less likely to require a college degree (Cohen et. al. (2003)), a characteristic associated with higher riskiness levels. In this case, the allocation of company coverage is positively correlated with (v) and our instrument will result in an overestimate of the moral hazard effect. In order to allow a causal interpretation of the moral hazard effect

[16] See Cohen et. al. (2003) for a comparison of characteristics of Israeli workers who do and do not hold collective-bargaining agreements.

we include a control for unobserved heterogeneity in riskiness levels in our main specification via first period accidents. Additionally, in section 5.1 we estimate a moral hazard effect by comparing changes in driving behavior occurring within the company and private coverage groups. This differencing specification provides additional evidence of a moral hazard effect that cannot be explained by pre-existing driving differences.

We do not have detailed data on car usage (kilometers driven, speed, driving hours) to control for pre-existing driving differences between individuals receiving company coverage and individuals paying privately. But we can differentiate between different types of accidents in order to support our interpretation of β_1 as a moral hazard effect. If individuals allocated to company coverage have different driving patterns or risk preferences than those purchasing private insurance, we would expect a constant difference in accident rates regardless of accident size or years experience with the insurance provider. Alternatively, if individuals are reacting to financial incentives we would expect a larger effect on small accidents (where the damage is only financial) than on large accidents (where the damage can also involve physical risk). Thus, we may expect two identical individuals with different levels of coverage to both drive carefully in a situation where they feel their life is at risk, but to have differential levels of driving care in situations where they believe the only risk is monetary. In the following sections we present evidence along these lines supporting the interpretation of a moral hazard effect despite the possible non-random allocation of company insurance coverage.

4 The Data

Data for this study come from a private insurance firm and from Israel's Central Bureau of Statistics. Under a confidentiality agreement with the insurance firm we received data on 6,813 policies activated between 2001 and 2008. These policies belong to employees of a single, large Israeli company. 4,590 of the policies were paid for by the employer as a benefit, while 2,223 were paid for privately by the employees. Since we will be interested in analyzing the number of car accidents per policy it is important to maintain a uniform policy duration and to control for systematic differences, if any, in the contract duration of company and privately paid clients. We therefore combine consecutive insurance contracts for the same vehicle when the duration of one of them was under six months[17] and exclude policies that were not renewed and therefore do not provide enough information to calculate C_A.[18] Details of the data cleaning process and variable definitions are in Appendix A.

The final sample consists of a panel of 1,046 employees of a large Israeli company holding 5,472 yearly policies. Thus, the statistical unit of analysis is an employee-policy pair. The employer paid for 4,233 policies (77 percent) belonging to 755 individuals, while 1,239 policies (23 percent) were paid for privately by 291 employees who chose to be insured through the same firm as those receiving company coverage.[19]

Each individual in the sample holds an average of 7 policies since policies must be

[17]Some insurance policies lasted for a short period of time because the insurance firm attempts to set a uniform starting month (September) for those with company coverage. Thus, clients who started their policy mid-year often had short first year policy lengths. In addition, we excluded private policies with only mandatory and/or third-party insurance so that the remaining private policies are standard insurance packages against damage to the client's own vehicle and other vehicles. This ensures that private and company-paid policies are the same homogeneous product.

[18]We find no evidence that this would create selection bias in this sample since the accident rates of those employees with private coverage who leave after 1 year are lower (though not statistically significant) than those who remain in the sample.

[19]The insurance provider estimated that about 50 percent of the employees not covered by company insurance chose them as their insurance provider.

renewed yearly. These policies do not include the option of paying a higher annual premium in order to decrease deductible costs. For those holding private coverage the insurance premium is calculated annually by the insurance provider as a function of individual and car characteristics as well as accident history.

Using information on annual policy costs, penalties and deductibles we estimate cost of an accident for each individual in the data. This value is set to \$120 for those with company coverage. For those with private coverage we follow equation (4) and compute cost of an accident as \$160 plus an additional 2.36×0.1 or 2.36×0.3 of their annual premium depending on accident involvement in the previous period. We are unable to estimate this cost in the first period of insurance for individuals holding private coverage (since we do not have access to their previous accident rates).

All policies included in the data are full-coverage insurance policies (insured against damage to their vehicle and other vehicles in the case of an accident). In addition to policy price, we also have information on policy length, the gender and city of residence of the policy holder, car characteristics, and accident characteristics. In order to allow for further controls between employees receiving company coverage and those purchasing private insurance, we expanded the dataset to include socioeconomic and geographical information corresponding to the cities where the 1,046 policy holders live. The Central Bureau of Statistics provides economic and geographical data through its GEOBASE program. We use data on average family income and percentage of students passing their matriculation exams by city in Israel. Additionally, we collected information on annual vehicle blue book values for each car model in the data from the assessor Levy Yitzhak, who publishes the Israeli "blue book" of used car prices.

We exploit the fact that all drivers work at the same location to control for different driving patterns. The 60 cities in the sample are divided into 4 groups according to their location relative to that of the employer. In addition, we calculate distances between the employees' city and both their employer's location and all reported accident locations. This allows us to better understand commute differences between those holding company and private coverage. These data will help to control for differences in the population that may be correlated with allocation to company coverage.

Table 1 provides summary statistics for key variables used in this study. The individuals in our data all commute to the same office and live in similar areas. They all drive their own private cars and do not receive any type of gasoline subsidy. Despite these similarities, people were not randomly allocated to company coverage. We therefore expect there to be differences between the two groups and discuss the direction in which these differences may affect accident outcomes. To begin with, people with company coverage tend to stay with the provider for longer periods. An earlier start with the provider can be explained by the insurance firm securing all employees with the company insurance benefit directly, while needing to advertise for those purchasing private insurance. Since company insured drivers do not have the flexibility to switch to a difference insurance provider it is not surprising that they stay in the sample for longer durations.

Company policy holders are 76 percent male while those with private insurance are 84 percent male. Because men have been shown to have a higher probability of accidents this means that we would expect more collisions from those allocated to private insurance. While both private and company policy holders face similar commute distances to work, those with private coverage are more likely to reside NE of their workplace. If there is any effect on car accidents we would expect those allocated to private insurance to be more collision-prone due to facing higher traffic volumes during their daily commute. Additionally, we find no evidence that collisions of drivers with company insurance occur farther from their home. These findings are reassuring because they suggest that company-insured drivers may not be using their cars significantly more than privately-insured drivers (actual car usage is not observed).

Unfortunately we do not have data on driver's age and driving experience (defined as the number of years elapsed since receipt of first driving license) except for those drivers that were involved in an accident in 2004-2005. This year of accident data shows no significant difference in age and driving experience across types of insurance.

One issue when using accident data provided by an insurance firm is that reported incidents are only a fraction of the total number of accidents that occurred. Private policy holders face higher reporting costs than those holding company insurance and are therefore less likely to report smaller accidents when only their car is involved. Thus, using the difference in accident outcomes between private and company policy holders to estimate moral hazard may also pick up the effect of increased reporting. In order to mitigate this we only include collision accidents where at least two cars were involved in our analysis, as done by Chiappori & Salanie (2000). The probability of reporting is much higher in accidents involving other cars (for both types of insurance holders) and therefore restricting the analysis to this subset is less affected by selective reporting. Indeed when comparing the median damage estimates in this subset for both groups, we find no evidence that those with company coverage have a higher frequency of low-cost collisions.

Each policy contains information on the number of accidents occurring during each period of coverage. For the majority of policies (83.7 percent) there is no accident reported, 14.4 percent report having one accident, and 1.9 percent report having more than one accident per period. We assign the value $y = 1$ to those policies reporting at least one accident in the given period.

5 Empirical Results

As a first step in understanding the effect of insurance coverage on driving behavior we examine the components of a Wald estimate of β_1 abstracting from the presence of covariates and assuming a linear probability model.[20] The numerator consists of the difference in accident occurrence (y) between those with company and private insurance (z). The denominator of the Wald estimate provides information on the strength of the instrument, which in our case refers to the effect of company coverage on the cost of an accident. Table 2 shows a statistically significant \$235 difference in accident costs between those holding private and company coverage. This difference explains 66 percent of the variation in cost of an accident in the sample. We find that an estimated \$235 increase in C_A decreases the accident rate by 3.1 percentage points. This can be translated into a 1.3 percentage point reduction in accident occurrence as a result of a \$100 increase in C_A.

Examining the accident rate by years of coverage with the provider allows a closer look at differences between those allocated to private and company insurance. In the first year of insurance drivers with company coverage are six percent less likely than those with company coverage to be involved in an accident. This significantly lower initial accident rate

[20]When the instrument z is a binary variable the instrumental variable estimate of β_1, $(z'C_A)^{-1} z'y$ simplifies into the Wald estimator.

of drivers holding company coverage could reflect the negative correlation between individuals who receive the insurance benefit and unobserved characteristics resulting in more dangerous driving. Remarkably, while the collision rate remains relatively constant across periods for those with private insurance, it increases significantly between period 1 and 2 for those with company coverage, and remains relatively constant in periods 3 and onwards. One possibility is that moral hazard does not affect people's driving behavior immediately and thus the consequences of increased coverage appear with a one-year delay. We explore this issue further in Section 5.1.

Table 3 compares estimates of the moral hazard effect (β_1) from equation (1) using a linear probability model. In specification (i) we find no effect of cost of an accident (C_A) on the probability of an accident. This is not surprising due to the presence of the unobserved individual effect v in equation (1). While accident costs are unlikely to be affected by adverse selection (drivers were not given a choice of accident costs), they were constructed based on accident risks. Thus, more dangerous drivers who hold private insurance are more likely to be involved in accidents in past periods, which will result in higher accident costs and a positive bias on the moral hazard effect (β_1) in column (i).

Columns (ii), (iii) and (iv) of Table 3 report the estimated moral hazard effect when accident costs (C_A) are instrumented by the allocation of company coverage (z). Specification (ii) presents the Wald estimate calculated in Table 2 without controlling for available observed differences between individuals within the dataset. Specifications (iii) and (iv) include controls for observed differences in individual and car characteristics, as described in the table notes. After adding controls for gender, commute distance, etc. in specification (iii) we find that a \$100 increase in the cost of an accident (C_A) decreases the probability of an accident by 1.6 percentage points (s.e. 0.7 percentage points). Thus, even when controlling for observed differences in characteristics of individuals we find a significant moral hazard effect, suggesting that the Wald estimate cannot be explained by observed differences in the allocation of the insurance benefit. This result is consistent with an environment where, if anything, less dangerous drivers may have been allocated to company coverage and therefore without additional individual controls we underestimate the moral hazard effect. We also find that driving in more congested areas has a significant effect on the accident rate.

In specification (iv) we include additional controls for unobserved individual heterogeneity (v) such as accident involvement in the first period y_0 and observed characteristics during the entire period of insurance summarized by their time average for each component of x.[21] Whether or not a driver had an accident in his/her first period of insurance can give us added information on his/her general level of driving care. This is especially relevant given the collision rates in Table 2 since the first period of insurance may provide information on driving behavior prior to changes invoked by differential coverage. The coefficient on accident first period is positive, as we would expect since this controls for an initial tendency towards dangerous driving. Importantly, controlling for unobserved heterogeneity via first period accidents does not alter the moral hazard effect, suggesting that the correlation between receiving company insurance and unobserved individual characteristics in v may not be that important in these data. While our analysis estimates the effect of increases to cost of an accident (C_A), the allocation of company coverage provides a discount in accident costs. We find that this \$100 discount resulted in a moral hazard effect of 1.7 percentage

[21] Use of these types of controls for unobserved heterogeneity were introduced by Blundell (1999) and Wooldridge (2002).

points (s.e. 0.7).[22] This represents a 10 percent increase in the mean probability of being involved in an accident (16.3 percent).

Our estimate of the moral hazard effect is significant and large compared to what has been documented in previous research.[23] Earlier studies often found no evidence of a moral hazard effect (see Chiappori & Salanie (2000), Abbring et. al. (2003)). While later studies examining insurance contracts over time produced evidence for the existence of moral hazard they did not supply a measure of its effect size (Abbring et. al. (2008), Dionne et. al. (2013)). Schneider (2010) identifies what he describes as a conservative estimate of the moral hazard effect- a 16 percent increase in the accident rate for drivers who own versus lease their taxicabs. This measure may be more relevant for our dataset as both individuals receiving company coverage and drivers who lease vehicles do not pay annual insurance costs. While those with company coverage drive their own private vehicle and are thus affected by long-term decreases in the valuation of their vehicle, they are also guaranteed coverage regardless of accident outcomes. Our moral hazard estimate may capture both the effect of a \$100 discount as well as additional incentives created by group contracting.

We also estimate marginal effects from the probit distribution for all specifications in Table 3 to account for the binary nature of involvement in an accident. Importantly, the linear probability model does provides reasonable estimates for the probability of an accident

[22]It is interesting to note that when including all reported accidents (as opposed to only collision accidents) we find a much larger estimate of 2.7 percentage points. This finding is consistent with the idea that including all accidents measures a reporting effect which overestimates the effect of coverage on driving behavior.

[23]This outcome still holds when using alternative discount factors ranging between 0.473 and 1 to estimate C_A. The estimated moral hazard effect remains significant and ranges in size from 1.1 to 2.6 percentage points.

(ranging between 0 and 1) for 99.9 percent of the sample. Table 4 provides a slightly larger estimate of the moral hazard effect in the nonlinear framework, a 1.8 percentage points decrease in the accident rate (s.e. 0.7).

Table 5 provides estimates of the moral hazard effect for all specifications in Table 3 focusing on at-fault accidents.[24] While the insurance provider does not differentiate between at-fault and not at-fault accidents in terms of penalties and deductibles (due to uncertainty regarding which driver is directly responsible for the accident), drivers may have more control in preventing at-fault accidents. We estimate that a $100 discount in accident costs increases the likelihood of an at-fault accident by about 1 percentage point. This represents a 13.2 percent increase in the at-fault accident rate, as the mean at-fault accident rate for people in this sample is 7.6 percent. This moral hazard estimate is very close to the 10-11 percent increase in auto accidents estimated when including both at-fault and not at-fault accidents. As it is generally accepted in Israel that there remains uncertainty regarding which driver is directly responsible for an accident, we continue to group together at-fault and not at-fault accidents in the remaining specifications.

An objection to these findings might be that they do not represent moral hazard but rather a non-random allocation mechanism where pre-existing differences in accident rates are correlated with the allocation to company coverage. We conduct a sensitivity analysis by checking these results over different definitions of accident occurrence. Small collisions are defined as those occurring within the process of parking or within parking areas, while large collisions are defined as those occurring on roads. Since small collisions have a lower

[24] Dionne et. al. (2011) do not find a significant moral hazard effect when examining data which include both at-fault and not at-fault accidents. They note that the incentive effect is expected to be stronger for at-fault accidents.

risk of physical harm we would expect a stronger moral hazard effect on this outcome. We use a multinomial probit model to separately estimate the effect of accident costs on small and large collisions.

We find that accident costs have a statistically significant negative effect on small collisions at the one percent level, but find no effect on large collisions (see Table 6).[25] These results are consistent with an effect of financial incentives (i.e., moral hazard) on driving behavior. In other words, we expect financial incentives to manifest themselves in accidents where the costs are mostly financial (such as accidents in parking areas) and not in accidents likely to involve physical injury. We further examine this issue of correctly identifying moral hazard in the following section by comparing changes in driving behavior occurring over the course of the insurance coverage.

5.1 A Driver's First Introduction to Company Coverage

Table 2 illustrates a distinct change in accident rates that occurs between the first and later periods of insurance for those with company coverage (an increase from a 9 to a 19 percent annual accident rate). This phenomenon appears only for drivers with company coverage as opposed to drivers holding private coverage who keep a fairly constant annual accident rate of 15 percent throughout all periods. Drivers receiving employer-paid insurance may not adjust their driving behavior immediately because, initially at least, they may not understand and/or internalize the changes in insurance coverage. As time elapses and

[25]As noted by an anonymous referee it is also important to understand whether or not moral hazard has an effect specifically on severe accidents. While, we do not find evidence of a moral hazard effect for large collisions, we cannot rule out a more significant effect at higher price discounts than those available in this dataset.

information becomes available, these drivers may change their driving behavior with the knowledge that they face a constant and relatively low accident cost (C_A). If we take the first year of insurance as the initial period when moral hazard does not yet play a role, we can then estimate the insurance effect by contrasting the change in accident rates between the first year of insurance and later years for those holding private and company coverage.

Using a subset of 449 newly insured employees holding 1,837 policies, we estimate the following model,[26]

$$y_{it} = x_{it}\psi_0 + \psi_1 z_i + \psi_2 post_{it} + \beta_1 \left(z_i \times post_{it}\right) + u_{it} \tag{5}$$

where $post_{it}$ takes the value of 0 for the first year of insurance and 1 for later years. This specification requires less assumptions regarding the zero mean error term u_{it} than equation (1) as only characteristics that differentially effect those with private and company coverage over time would bias our estimate of moral hazard (β_1).

The differencing framework provides an additional understanding of pre-treatment differences between those allocated to private and company coverage. The coefficient $\psi_1 = E(y|z = 1, x, post = 0) - E(y|z = 0, x, post = 0)$ estimates unobserved heterogeneity between individuals in these 2 insurance groups. We expect $\psi_1$to be negative when those receiving company coverage are also better drivers.

The coefficient on the interaction term $\beta_1 = E(y_{post} - y_{pre}|z = 1, x) - E(y_{post} - y_{pre}|z = 0, x)$ estimates the moral hazard effect. In essence, we compare the change in accidents between the first period of insurance – when, by assumption, there is no moral hazard – and

[26]If some of these drivers are new to the company as well as to the insurance provider they may have received higher level insurance coverage at their previous company. In this case they may have already altered their driving behavior due to moral hazard and a differencing technique will underestimate the moral hazard effect.

future periods for individuals with company coverage – $E(y_{post} - y_{pre}|z = 1, x) = \psi_2 + \beta_1$– and for individuals with private insurance coverage –$E(y_{post} - y_{pre}|z = 0, x) = \psi_2$.

Table 7 presents estimates of the moral hazard effect of company provided insurance on accidents using this approach. Under the assumption in equation (5) that treatment occurs from period 2 onwards, we find that providing company insurance (an estimated $235 discount in accidents costs) increases the accident rate for those employees new to company coverage by 7.9 percentage points, with a s.e. of 4.3 (see column (i)). Thus, a $100 discount in coverage is expected to increase the accident rate by 3.4 percentage points. As mentioned above, the coefficient on receiving company coverage (ψ_1) estimates the level of unobserved heterogeneity in accident outcomes between those receiving company insurance and those who do not. We estimate that without differential coverage, if anything, employees allocated to company insurance were less likely than those in the private group to be involved in an accident.

In specifications (ii)-(iv) we look at alternative period cutoffs at which individuals with private or company coverage could be adjusting their driving behavior. We find no evidence of significant changes in accident probabilities occurring after the second period. This is consistent with our explanation that drivers adjust their behavior according to incentives created by lower accident costs only in the second period. It would seem unlikely for a change in driving behavior to occur after two or more years of high coverage insurance.

This 3.4 percentage points moral hazard estimate is double the effect estimated by the instrumental variables approach ($1.7 - 1.8$ percentage points). Taking into account that the average accident rate in the data is 14.6 percent, a 3.4 percentage point estimate indicates a 23 percent increase in the accident rate for those receiving company coverage. A possible explanation for this large effect is that the drivers in this subsample are likely to be new to the company and therefore tend to be younger than the employees already insured at the beginning of the sample period. Since younger drivers have been found to be more prone to accidents these results may overestimate the moral hazard effect in the population.

6 Conclusion

For over 50 years economists have been analyzing the existence of moral hazard and the role it plays in human behavior. There is much debate today over whether our basic assumptions on rational decision making hold true in reality. Ultimately when dealing with car accidents and the physical harm connected with risky driving behavior, it is especially important to understand if moral hazard has a significant effect. This paper addresses the question: do changes in financial incentives affect behavior even when physical injury could result?

In order to analyze whether moral hazard exists in car insurance contracts it is essential to control for the confounding effect of adverse selection. In prior research this has been a constant obstacle, since car insurance is selected by the policy owner and thus personal preferences play a direct role in coverage. The allocation of company insurance creates variation in accident costs regardless of individual preferences. Using an instrumental variables approach, we find that a $100 discount in the cost of an accident increases the probability of an accident by 1.7 percentage points. At an average accident rate of 16.3 percent, this 10 percent increase in auto accidents is consistent with the idea that people take accident costs into consideration when choosing their driving behavior.

This paper differs from previous research in that it examines the effect of a relatively large discount in insurance prices combined with guaranteed coverage. These types of policies are widespread throughout Israel due to their direct inclusion in company vehicles. During 2010 there were 2,053,248 private cars in Israel, and 316,844 of these vehicles were registered as company leased or owned cars. Thus, approximately 15.5 percent of vehicles in Israel are not privately owned. This percentage increases three-fold when considering new cars of which 52 percent of those purchased in 2010 were company cars.[27] The prevalence of company cars in Israel is attributed to the significant tax benefit provided for these cars, and is often used as an additional salary incentive (or fringe benefit) for employees. The analysis in this paper applies directly to these groups who are receiving high insurance coverage at low costs. Our findings show that increasing rates of car accidents are an unintended consequence of increasing implementation of this type of salary incentive scheme.

The most significant monetary benefit of company coverage for employees in our dataset was employer coverage of their policy cost (averaging $700). However, we believe that it was the smaller differential cost of an accident (averaging $235) that resulted in a moral hazard effect of increased accidents. Our analysis suggests that both government and car insurance providers can play a significant role in reducing accidents at the relatively low cost of redesigning insurance contracts that will ensure drivers bear sufficient consequences after involvement in an accident.

Theoretical work has shown that the use of these types of deductibles and penalties can make both insurance providers and drivers better off (see works by Shavell (1979), Holmstrom (1979), and Rubinstein & Yaari (1981)). Without deductibles and penalties which allow the insurer to share accident costs with the insured, insurance companies will

[27] The Israel Central Bureau of Statistics (2010 Motorized Vehicles Report , Table 17).

only offer contracts that provide positive gains when drivers exert zero effort.[28] These types of all inclusive contracts imply higher annual premiums (bad for drivers), and lower uptake of coverage (bad for insurance providers). However, once a third party - the employer of these drivers, enters the model this outcome becomes more complex. It is no longer the drivers who face higher annual premiums, but rather, their employer. The employer may prefer a higher set premium that remains constant over time to changes in costs that are driven by accident occurrence. Especially in a group bargaining context, it may be difficult for an employer to uphold a penalty system where employees face different fees based on driving behavior. This type of system could be viewed as unfair, thus creating friction between employees (see Fehr and Schmidt, 1999). Additionally, unlike insurance companies who are very familiar with the concept of moral hazard, employers may be less aware of the negative driving incentives an insurance benefit can create.

It would seem reasonable that government intervention fill the gap created by group insurance contracting. This solution may be especially relevant for Israel where a tax loophole regarding company vehicles is considered the primary source of this phenomenon. However, governments may lack the incentives to create this type of legislation. Despite its large costs to society, car accidents are not considered a top issue of political debate. Especially in times of economic downturn an increase in costs (via taxing car insurance fees) could be considered an unpopular measure to take. Even when government does enforce insurance penalties it can result in market distortions. In 1994 "the European Union decreed that all its member countries had to drop their mandatory bonus-malus systems, claiming that such

[28]This will hold true when insurance companies lack information regarding driving care. If driving care was observed then the optimal contract would include a different premium for every level of driving care.

systems reduced competition between insurers." While the bonus-malus systems in France and Luxembourg were upheld in a 2004 ruling by European Court of Justice, the case itself points to possible shortcomings of these policies.[29] Additionally, research has shown that private insurance companies are more successful than the government at estimating accident risks and preventing moral hazard effects (see Yin et. al., 2011).

Combining a privately run insurance system with a government tax that is accident history dependent could provide the solution. Some countries already finance road safety through mandatory levies on insurance fees. Thus, Finland, Victoria (Australia), and Quebec (Canada) collect a tax ranging from 1 to 10 percent on annual insurance premiums. By setting the size of the tax as a function of accident history this would both promote information sharing between companies (and the government) and ensure that driving behavior affects insurance costs regardless of contract type.

[29] See Pitrebois et. al. (2006) for a thorough examination of the French bonus-malus system.

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A Data

A.1 Variable Definitions

1. *Time Period* in this dataset is defined as a chronological ordering of insurance policies from the point that the client joins the insurance firm. This allows us to utilize all of the available data using differencing techniques while controlling for the years in which the policy was active.

2. *Policy Length* denotes the length of time between the start date and end date of a given policy. Most policies last for about a year, but in cases where the insured switched a car mid-policy or began an insurance policy mid-year the length can be significantly shorter. In order to allow comparison of policies with similar lengths, when a policy length is less than six months and the adjacent policy insures the same car they are combined into one policy (see Data Cleaning).

3. *Policy Price* is defined as the annual premium (adjusted for policy length) paid for the given insurance policy in US dollars. After computing its value in 2001 NIS it was converted to dollars using the average exchange rate between 2001-2008 of \$1=4.41 NIS. The conversion rate during this period varied between 3.38 shekel to the dollar and 4.99 shekel to the dollar.

4. *Client Identifier* is a unique number that classifies the owner of a policy. There exist cases in the raw data where the same client holds policies for different cars that overlap (see Data Cleaning: Dealing with Overlap).

5. *Matriculation Exam Completion* is defined as the percent of 12th graders in the client's

city of residence who completed their matriculation exams in the year the current policy ended.

6. *Average Family Income* is defined as average family income in the client's city of residence in US dollars in the year the current policy ended. After computing its value in 2001 NIS it was converted to dollars using the average exchange rate between 2001-2008 of \$1=4.41 NIS. The conversion rate during this period varied between 3.38 shekel to the dollar and 4.99 shekel to the dollar.

7. *Winter Months* are defined as November through March.

8. *Distance from Work* is defined using a mapping program as the kilometers between the client's city of employment and city of residence.

9. *Accident Distance* is defined using a mapping program as the kilometers between the client's accident location and city of residence.

A.2 Data Cleaning

A.2.1 I. Privately Insured

1. 2,223 Observations - Base Data.

2. 1,517 Observations holding full coverage insurance.

3. 1,487 Observations deleting expanded policies.

4. 1,446 Observations deleting observations where one car is insured separately from others.

5. 1,360 Observations combining policies under 6 months.

6. 1,356 Observations deleting observations that do not have information on city of residence.

7. 1,239 Observations including only clients insured for over 1 period.

A.2.2 II. Company Insured

1. 4,590 Observations - Base Data.

2. 4,557 Observations deleting expanded policies.

3. 4,370 Observations combining policies under 6 months.

4. 4,350 Observations deleting observations that do not have information on city of residence, owner name, or vehicle.

5. 4,344 Observations deleting observations where one car is insured separately from others.

6. 4,233 Observations including only clients insured for over 1 period.

A.2.3 III. Dealing with Overlap

1. In cases where the overlap is under one year - the end date of the earlier policy is set to one day prior to the start date of the overlapping policy.

2. In cases where the overlap is over one year - we assume multiple drivers are insured under the same client (i.e. he/she can be insuring both his/her car and that of a spouse

or child). We therefore create a separate client identifier for the overlap and treat those observations as a separate client.

Table 1: Summary Statistics

		Private Insurance[a]	Company Insurance[a]	Difference[b]
Policy Holder Characteristics:	Male	0.835	0.760	0.075*
		(0.372)	(0.427)	(0.027)
	Years Insured	4.334	5.274	-0.941*
		(1.898)	(1.818)	(0.129)
	Policy Price ($)[c]	698.70	0	698.70*
		(201.50)		(11.81)
	Policy Start Year	2002.2	2001.9	0.220
		(1.642)	(1.611)	(0.113)
	Policy End Year	2006.6	2007.4	-0.840*
		(1.752)	(1.309)	(0.113)
Policy Holder Residence:	Distance from Workplace (km)	15.59	13.48	2.116
		(19.56)	(19.88)	(1.356)
	Distance from Collision (km)	16.99	15.04	1.950
		(26.93)	(29.90)	(2.963)
	Reside in City of Workplace	0.244	0.270	-0.026
		(0.430)	(0.444)	(0.030)
	Reside NE of Workplace	0.155	0.0927	0.062*
		(0.362)	(0.290)	(0.024)
	Reside NW of Workplace	0.412	0.434	-0.021
		(0.493)	(0.496)	(0.034)

	Reside SE of Workplace	0.079	0.0675	0.012
		(0.270)	(0.251)	(0.018)
	Reside SW of Workplace	0.110	0.135	-0.025
		(0.313)	(0.342)	(0.022)
	Average Monthly	3567.2	3409.9	157.40*
	Family Income ($)[c]	(600.2)	(599.4)	(41.40)
	Matriculation Exam	62.36	61.11	1.249*
	Completion	(6.381)	(6.201)	(0.437)
Car	Blue Book Value ($)[c]	10105.6	10800.2	-694.7
Characteristics:		(5132.6)	(5428.4)	(359.9)
	Engine Size	1583.7	1674.5	-90.81*
		(317.2)	(311.3)	(21.77)
	Year	1998.3	1998.0	0.319
		(3.399)	(3.455)	(0.236)
N:	Number of Clients	291	755	
	Number of Policies	1,239	4,233	

[a] Standard deviation in parenthesis.

[b] Standard errors in parenthesis , * $\rho < 0.05$

[c] This price was converted from NIS to dollars using the average exchange rate in this period $1=4.41 NIS. The conversion rate during this period varied between 3.38 shekel to the dollar and 4.99 shekel to the dollar.

Table 2: Wald Estimates

	Private Insurance[a]	Company Insurance[a]	Difference[b]
Cost of an Accident ($)[c]	355.40	120	235.40*
	(148.4)	(0)	(4.820)
	[948]	[3,478]	
Involved in Collision (0/1)[d]	0.153	0.184	-0.031*
	(0.360)	(0.387)	(0.013)
	[948]	[3,478]	
<u>Involved in Collision (0/1) By Period:</u>			
Collision (0/1) 1st Period	0.151	0.086	0.065*
	(0.359)	(0.281)	(0.023)
	[291]	[755]	
Collision (0/1) 2nd Period	0.120	0.195	-0.074*
	(0.326)	(0.396)	(0.024)
	[291]	[755]	
Collision (0/1) 3rd Period	0.164	0.188	-0.025
	(0.371)	(0.391)	(0.029)
	[220]	[680]	
Collision (0/1) 4th Period	0.164	0.178	-0.015
	(0.371)	(0.383)	(0.033)
	[165]	[594]	

Collision (0/1) 5th Period	0.136	0.190	-0.054
	(0.344)	(0.392)	(0.035)
	[125]	[511]	
Collision (0/1) 6th Period	0.220	0.193	0.027
	(0.416)	(0.395)	(0.047)
	[91]	[466]	
Collision (0/1) 7th Period	0.170	0.154	0.016
	(0.379)	(0.361)	(0.055)
	[53]	[423]	
Collision (0/1) 8th Period	0.333	0.122	0.211
	(0.577)	(0.331)	(0.337)
	[3]	[49]	

[a] Standard deviation in parenthesis, Number of policies in brackets.

[b] Standard errors in parenthesis, * $\rho < 0.05$

[c] This variable is only available between period 2 and period 8. This price was converted from NIS to dollars using the average exchange rate in this period $1=4.41 NIS. The conversion rate during this period varied between 3.38 shekel to the dollar and 4.99 shekel to the dollar.

[d] The dependent variable is summarized between period 2 and period 8 as this is the relevant group for whom we can calculate accident costs.

Table 3: OLS and 2SLS Estimates of the Moral Hazard Effect

Variables	(i) Linear RE	(ii) IV	(iii) IV 2SLS	(iv) IV 2SLS
Cost of an Accident (C_A)[a]	-0.002	-0.013*	-0.016**	-0.017**
	(0.006)	(0.007)	(0.007)	(0.007)
Male	-0.002		0.001	0.001
	(0.016)		(0.016)	(0.016)
High Traffic Density Commute	0.070**		0.074***	0.074***
	(0.029)		(0.029)	(0.029)
Policy Length	-0.078		-0.051	-0.080
	(0.063)		(0.064)	(0.069)
Insured During Winter Months	0.121*		0.107	0.120*
	(0.066)		(0.068)	(0.070)

Accident 1st Period				0.040*
				(0.023)
Additional Individual Controls[b]	Yes	No	Yes	Yes
Time Averaged Controls[c]	No	No	No	Yes
Observations	4426	4426	4426	4426

Standard errors account for clustering at the individual level.

[a]Measured in hundreds of US dollars.

[b]Additional individual controls: commute distance, policy year, blue-book car value, car year, engine size, matriculation completion, and average income.

[c]Time averaged controls: mean car value, mean car year, mean engine type, mean matriculation completion, and mean average income.

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

Table 4: Estimated Marginal Effects of Accident Costs on Collisions

Variables	(i) Probit RE	(ii) Probit IV	(iii) Probit IV	(iv) Probit IV
Cost of an Accident (C_A)[a]	-0.004	-0.015**	-0.018**	-0.018**
	(0.005)	(0.007)	(0.007)	(0.007)
Male (0/1)	0.000		0.000	0.000
	(0.016)		(0.016)	(0.016)
High Traffic Density Commute (0/1)	0.072**		0.079**	0.078**
	(0.032)		(0.032)	(0.032)
Policy Length	-0.041		-0.036	-0.061
	(0.049)		(0.057)	(0.060)
Insured During Winter Months (0/1)	0.095**		0.098*	0.105**
	(0.041)		(0.053)	(0.049)
Accident 1st Period (0/1)				0.040*
				(0.023)
Additional Individual Controls[b]	Yes	No	Yes	Yes
Time Averaged Controls[c]	No	No	No	Yes
Observations	4426	4426	4426	4426

Standard errors account for clustering at the individual level.

Marginal effects were calculated at the mean for continuous variables. For binary variables the marginal effect was computed as the mean difference in predicted collision outcomes when the variable equals 0 versus 1.

[a]Measured in hundreds of US dollars.

[b]Additional individual controls: commute distance, policy year, blue-book car value, car year, engine size, matriculation completion, and average income.

[c]Time averaged controls: mean car value, mean car year, mean engine type, mean matriculation completion, and mean average income.

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

Table 5: OLS and 2SLS Estimates of the Moral Hazard Effect on At-Fault Accidents

Variables	(i) Linear RE	(ii) IV	(iii) IV 2SLS	(iv) IV 2SLS
Cost of an Accident (C_A)[a]	0.000	-0.007	-0.009*	-0.009**
	(0.005)	(0.005)	(0.005)	(0.005)
Male	-0.006		-0.004	-0.004
	(0.011)		(0.011)	(0.011)
High Traffic Density Commute	0.025		0.028	0.029
	(0.019)		(0.019)	(0.019)
Policy Length	0.037		0.053	0.048
	(0.043)		(0.044)	(0.047)
Insured During Winter Months	0.034		0.025	0.026
	(0.040)		(0.042)	(0.043)

Accident 1st Period				0.025
				(0.016)
Additional Individual Controls[b]	Yes	No	Yes	Yes
Time Averaged Controls[c]	No	No	No	Yes
Observations	4426	4426	4426	4426

Standard errors account for clustering at the individual level.

[a]Measured in hundreds of US dollars.

[b]Additional individual controls: commute distance, policy year, blue-book car value, car year, engine size, matriculation completion, and average income.

[c]Time averaged controls: mean car value, mean car year, mean engine type, mean matriculation completion, and mean average income.

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

Table 6: The Effect of Accident Costs Using a Multinomial Probit Model

	Small Collisions		**Large Collisions**	
	(i)	(ii)	(iii)	(iv)
Variables[a]	Probit	Probit Marginal Effects [b]	Probit	Probit Marginal Effects [b]
Cost of an Accident (C_A)[c]	-0.205***	-0.005***	-0.042	-0.010
	(0.065)	(0.002)	(0.031)	(0.006)
Male (0/1)	-0.148	-0.004	0.036	0.008
	(0.108)	(0.003)	(0.060)	(0.013)
High Traffic Density Commute (0/1)	-0.063	-0.002	0.323	0.085***
	(0.214)	(0.005)	(0.197)	(0.030)
Policy Length	1.073**	0.028**	-0.297	-0.069
	(0.472)	(0.014)	(0.253)	(0.042)

Accident 1st Period (0/1)	0.120	0.003	0.129	0.031
	(0.150)	(0.005)	(0.101)	(0.020)
Additional Individual Controls[d]	Yes	Yes	Yes	Yes
Observations	4426	4426	4426	4426

Standard errors account for clustering at the individual level.

[a]We were unable to control for coverage over winter months in this specification due to its strong correlation with policy length (as all individuals insured for a full year are insured over winter months). We were also unable to control for Time Averaged Controls as they were highly correlated with per-policy year controls and thus, did not allow convergence.

[b]Estimated average marginal effects.

[c]Measured in hundreds of US dollars.

[d]Additional individual controls: policy year, blue-book car value, car year, engine size, commute distance, matriculation completion, and average income.

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

Table 7: The Effect of Company Provided Car Insurance on Accidents: DID Approach

Variables	(i) Post= Period>1	(ii) Post= Period>2[a]	(iii) Post= Period>3[b]	(iv) Post= Period>4[c]
Company×Post	0.079*	-0.048	0.017	0.069
	(0.043)	(0.042)	(0.061)	(0.061)
Company	-0.051	0.064*	0.016	-0.017
	(0.036)	(0.035)	(0.049)	(0.056)
Post	-0.023	0.068*	-0.019	-0.043
	(0.039)	(0.038)	(0.058)	(0.052)
Male	0.036*	0.036	0.043	0.033
	(0.020)	(0.024)	(0.030)	(0.035)
High Traffic Density Commute	0.033	0.038	0.036	0.078
	(0.037)	(0.045)	(0.054)	(0.066)

Policy Length	-0.076	-0.001	0.172	0.178
	(0.059)	(0.117)	(0.144)	(0.201)
Insured During Winter Months	0.021	0.080	0.040	0.043
	(0.057)	(0.108)	(0.090)	(0.113)
Observations	1837	1388	939	594

Standard errors account for clustering at the individual level.

Additional individual controls: commute distance, policy year, blue-book car value, car year, engine size, matriculation completion, average income, mean car value, mean car year, mean engine type, mean matriculation completion, and mean average income.

[a] Does not include the first period of insurance.

[b] Does not include the first two periods of insurance.

[c] Does not include the first three periods of insurance.

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