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Collusion between Retailers and Customers: The Case of Insurance Fraud in Taiwan

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Abstract

The outsourcing of retail services is frequently at the origin of agency costs, associated with the discretion in the way retailers do their job. This is particularly the case when retailers and customers collude to exploit loopholes in the contracts between producers and customers. In this paper, we analyze how insurance distribution channels may affect such misbehaviors, when car repairers join policyholders to defraud insurers. We focus attention on the Taiwan automobile insurance market by using a database provided by two large Taiwanese automobile insurers. The theoretical underpinning of our analysis is provided by a model of claims fraud with collusion and audit. Our econometric analysis confirms that fraud occurs through the postponing of claims to the end of the policy year, possibly by filing a single claim for several events. It highlights the role of car dealer agencies in the collusive fraud mechanism.

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1 Introduction

Vertical relationships frequently involve the outsourcing of services from upstream firms to downstream retailers. This may be at the origin of agency costs, associated with the discretion in the way retailers do their job. Such agency costs sometimes go through the collusion between retailers and customers, who exploit loopholes in the contracts between producers and customers. Discount fraud and warranty fraud are instances of such customer misbehaviors that involve collusion with retailers or frontline employees. Discount fraud exploits the special discounts that companies may offer under particular circumstances, for instance when discounted products are used for a specific purpose, e.g., educational use for softwares. Warranty fraud occurs especially when a service provider - e.g. a car repairer - replaces a defective part with a new spare part and triggers the producer's warranty, although the defective part was not original and thus was not protected by the warranty.¹

This paper investigates another form of customer misbehavior facilitated by service providers acting on behalf of distributors: insurance fraud. Our empirical focus is on the Taiwan automobile insurance market and on the role of car dealer-owned insurance agents (DOAs) in this market. In such cases, dealers sell not only cars, but also automobile insurance to their clients, and furthermore they own an auto repair shop. Understandably, the multi-faceted activity of dealership agencies and their long-term connection with car owners favor the creation of a mutually advantageous policyholder-DOA alliance. Concerning fraud itself, we will focus attention on the behavior that consists in postponing claims to the last month of the policy year and in merging two losses in a single claim. Deductibles and the bonus-malus mechanism are the underlying reasons for such behavior.

¹See Harris and Daunt (2013) on managerial strategies under the risk of customer misbehavior. Murthy and Djamaludin (2002) survey the literature on new product warranty. Insufficient maintenance effort by buyers and inadequate behavior by retailers are at the origin of a double moral hazard problem in warranty management.

An insurance market model yields the theoretical underpinnings of our analysis. The model focuses on the strategic interaction between, on the one side, policyholders who file fraudulent claims by colluding with car repairers, and, on the other side, insurers who audit claims. Auditing claims is all the more costly when collusion between policyholders and car repairers is more difficult to detect, which is particularly the case when car repairers are sheltered by DOAs. In addition, should irregularities be detected by the insurer, the high bargaining power of DOAs may allow them to deter insurers from enforcing penalties. The outcome is a higher fraud rate when insurance is distributed by DOAs than through other channels. This is reinforced in the case of deductible contracts, because deductibles increase the gain that policyholders obtain from fraud, and weaken the insurers' incentives to monitor claims.

Our empirical analysis builds on a database obtained from two large insurance companies in Taiwan. This data includes all of the policyholders who have filed an automobile claim in 2010, amounting to nearly 10,000 files. Our results sustain the prediction that fraud is greater when insurance policies have been sold through DOAs than through other distribution channels, and also that deductibles stimulate fraud.² We also show that the causal mechanisms at the origin of fraud (i.e., postponing claims, and possibly filing one claim for several accidents) are linked to the bonus-malus system in force in Taiwan, and with incentives that are inherent in the design of deductible contracts. This will go through an approach which consists of providing indirect evidence of such misbehaviors and of its mechanisms.³ More explicitly, we show that the intertemporal pattern of claims

²Other authors have emphasized the effect of deductibles on insurance fraud. Using data from Québec, Dionne and Gagné (2001) show that the amount of the deductible is a significant determinant of the reported loss when no other vehicle is involved in the accident which led to the claim, and thus when the presence of witnesses is less likely. Miyazaki (2009) highlights through an experimental study that higher deductibles result in a weaker perception that claim padding is an unethical behavior, and thus in a larger propensity toward fraud.

³Although Dionne et al. (2009a) is an exception, it is usually very difficult to use direct information on fraudulent claims to analyze insurance fraud, either because identified fraud is just the top of the iceberg, or because of insurers' reluctance to share confidential information on any fraud they are victims of. The preferred approach consists in establishing indirect evidence of fraud. For instance, Dionne and

is consistent with policyholder’s fraudulent behavior favored by DOAs, after controlling for other explanations, including adverse selection, moral hazard and the money recouping behavior highlighted by Li et al. (2013).

The paper is organized as follows. Section 2 provides further motivation for our analysis. We introduce some factual observations that should convince the reader that there is a significant degree of claim manipulation in the Taiwanese car insurance market, and we describe regular fraud patterns. Section 3 develops a simple theoretical model of insurance fraud that shows how these insurance fraud patterns are linked to specific features of insurance contracts, particularly per-claim deductibles, and how the intensity of fraud may be correlated with the insurance distribution channel. Section 4 describes the data in more detail, presents our econometric approach, and discusses our results about claim manipulation. Particular attention is paid to robustness tests, in order to control for other possible explanations of the observed claim pattern. Section 5 concludes. It is followed by an appendix that contains complementary developments of our empirical analysis.

2 Factual background

As reflected in our data, DOAs hold a substantial market share in the Taiwan automobile insurance market. Our database, presented more extensively in Section 4, includes information yielded by two large Taiwanese insurance companies, referred to as companies 1 and 2, about their 121,952 automobile policyholders and their claims in 2010. In our sample, company 1 sold 44.17% of its automobile policies through DOAs, contrary to company 2 which did not use this distribution channel. In addition to their large market share, DOAs have the benefit of owning the list of their customers, which increases their bargaining power when they negotiate contractual deals with insurance companies

Gagné (2002) and Dionne and Wang (2013) deduce the existence of fraud in automobile theft insurance from the time pattern of claims among the twelve policy months. Pao et al. (2014) provide evidence of opportunistic theft insurance fraud by analysing the claim pattern in areas hit by a typhoon.

or when insurers monitor the claims filed by their clients. In particular, an insurer who discovers a claim manipulation by a DOA may be reluctant to take retaliatory actions because of this strategic advantage of DOAs, who could switch to another insurer.⁴ Finally, DOAs work in partnership with car repairers, both being sheltered by car dealers, which provides them with an informational advantage: establishing that a claim has been falsified is particularly difficult and costly when it has been filed through a DOA.

Our study is also related to the specific forms of automobile insurance fraud in Taiwan. Li et al. (2013) have observed that a large proportion of automobile insurance claims are filed during the last months of the policy year. This is confirmed by our own database. Figure 1 presents the distribution of claims and their average cost (in hundred US dollars) over the twelve policy months. The heavy concentration of claims in the last months of the policy year is striking. Policy years and calendar years do not coincide and, as shown in Figures 2 and 3, the concentration of claims during the last months of the policy year is compatible with seasonal fluctuations in the number of claims over the calendar year, with peaks during vacation months (June, July and October). In addition, the average claim amount reported in Figure 1 slightly decreases in the final policy months. Li et al. (2013) interpret this phenomena as a "premium recouping effect": some policyholders without an accident during the previous months would tend to file small false claims during the last month of the policy year to express their feeling that they have been unfairly treated by the insurance company.

(Insert Figures 1, 2 and 3 here)

⁴On average, DOAs sell more policies than other agents (three times more on average and considerably more for the largest DOAs), and their market power is particularly significant for deductible contracts. They are independent agents, and, as emphasized by Mayers and Smith (1981), this status gives them more discretion in claim administration (e.g. they may intercede on behalf of their customers at the claim settlement stage) because they can credibly threaten to switch their business from one insurer to another. Actually, DOAs provide comparatively less stable customers to insurers than other insurance agents, with continuation rates (i.e. the fraction of customers who continue purchasing insurance from the same insurer year on year) which are about sixty percent for DOAs and seventy to eighty percent for other insurance agents.

Some information about insurance contracts is useful for what follows. There are three different types of automobile physical damage insurance contracts in Taiwan: types A, B and C. Type A and B contracts cover all kinds of collision and non-collision losses, with more exclusions for B than for A,⁵ while type-C contracts only cover the damages incurred in a collision involving two or more vehicles. Contracts also differ in terms of indemnity: Type A contracts offer low coverage with a deductible, type B contracts may be purchased with or without a deductible, and type C contracts provide full coverage without a deductible. Claims are per accident, with a specific deductible for each claim. The change in premium is ruled by a bonus-malus system when policyholders renew their contracts with the same insurance company, with a no-claim discount and an increase in premium proportional to the number of claims, without reference to their severity. The policyholders who switch to another insurance company bargain with this company about the new starting point of their bonus-malus record

In this setting, opportunist policyholders may take advantage of manipulating claims for several reasons. According to the premium recouping interpretation of Li et al. (2013), defrauders are more likely to be among the policyholders who do not plan to keep a long term relationship with the same insurance company if, on average, such policyholders feel a lower moral cost of defrauding.⁶ In our empirical analysis, this will lead us to define a "recoup group" RG that includes the policyholders who have not renewed their contract more than one year after the policy year under consideration.⁷

The bonus-malus system and the per-claim deductibles also provide incentives to de-

⁵Type B contracts cover all the areas of type-A contracts, except the non-collision losses caused by intentional damage, vandalism, and any unidentified reasons.

⁶It is well known that insurance fraud is often associated with the feeling that the insurance company is unfair; see Fukukawa et al. (2007), Miyazaki (2009) and Tennyson (1997, 2002). The premium recouping phenomenon could reflect a kind of resentment against insurers, particularly from policyholders who have not filed a claim during the policy year.

⁷Because of the bonus-malus system, the policyholders who intend to renew their contract only one year have the same incentive to defraud by manipulating claims as the policyholders who have the intention of switching insurers at the end of the policy year. See below for details.

fraud by manipulating the timing of their claims, and possibly by aggregating two events in one single claim. Firstly, the claims filed during the last month of policy year t are not registered in the bonus-malus record of year $t + 1$ (they will be taken into account in the premium paid in year $t + 2$), and consequently, the policyholders who plan to renew their contract with the same insurer may be incited to postpone their claim to the last policy month, in order to delay the increase in premium.⁸ Secondly, since the bonus-malus record depends on the number of claims and not on their severity, policyholders may be prompted to file one single claim for two accidents, should a second accident occur. This is even more profitable in the case of deductible contracts, since deductibles are per-claim: the strategy that consists in postponing the first claim and merging any other accident with the first one within a single claim yields full coverage for the part of the year that follows the first accident.⁹

Type A and B contracts are subject to such claim manipulation, because they include coverage for losses other than those associated with the collision between two cars. There is no third-party involved in such claims and no police report. On the other hand, the claims filed for type C contracts correspond only to collisions, and they have to include a police report, which makes manipulation very unlikely. In our empirical analysis, the set of policyholders who renew type A or B contracts in 2011, but not in 2012, with the same insurer will be called the "suspicious group" SG because of this incentive to manipulate the bonus-malus system, with subgroups $SG1$ and $SG2$ for no-deductible and deductible contracts, respectively.

If we conjecture that a substantial number of claims filed in the last policy month correspond in fact to postponed claims with the cumulated losses of two events, then we should expect that the ratio of "the average cost of first claims" over "the average cost of

⁸In addition, the bonus-malus system forgives the first accident for drivers who have had no other accidents for three years, which provides an even larger manipulation gain.

⁹Since 1996, the per-claim deductible is increasing with the number of claims, which strengthen even more the incentives to manipulate claims.

all claims" (hereafter called the *first claim cost ratio*) should increase during this month. Note however that this prediction could also be interpreted as the outcome of a moral hazard mechanism: this would be the case if a first accident made drivers more cautious, and thus they have less severe accidents should a second accident occur during the same policy year. To disentangle these two explanations, we may consider type C contracts as a benchmark to isolate the moral hazard effect, since claims manipulation is unlikely for such contracts. Figure 4 confirms our intuition: the first claim cost ratios for *SG1* and *SG2* significantly jump in the last month, and this is not the case for type C policies.

(Insert Figure 4 here)

At this stage, we may come back to the part played by DOAs. Figure 5 confirms our intuition that DOAs may favor the manipulation of claims. While the claims filed by the policyholders of the two suspicious groups, *SG1* and *SG2*, are significantly concentrated in the last policy month, this pattern is even more obvious for the policyholders of each subgroup that have purchased insurance from DOAs in company 1. Figure 5 also shows that the last policy month pattern is much less obvious in the benchmark group, which includes those policyholders who are covered by no-deductible contracts and who have not renewed their contract with the same insurance company at the end of the policy year.

(Insert Figure 5 here)

3 The model

Before further empirical analysis, let us focus attention on the logical links between insurance fraud and relevant features of insurance contracts, particularly the size of deductibles and the distribution channel. This may be done by modelling the strategic interaction

between, on the one side, policyholders who defraud by colluding with car repairers, and, on the other, insurers who allocate resources to monitor claims.¹⁰

Consider a population of risk-averse drivers, whose type is defined by the couple (i, h) with $i \in \{D, A\}$ and $h \in \{1, 2\}$. Index i refers to the individuals' preference for a specific distribution channel through which they purchase insurance: DOA when $i = D$ or standard insurance agents when $i = A$.¹¹ Index h reflects the individual's degree of absolute risk aversion: $h = 1$ corresponds to a higher absolute risk aversion than $h = 2$. Assume that drivers may have either 0,1 or 2 accidents during the same policy year, with probability π_1 and π_2 for 1 and 2 accidents, respectively, and $\pi_1 + \pi_2 < 1$, and also that these probabilities are independent of the policyholders' type. Insurance contracts include a deductible per accident. We respectively denote d_{ih} and P_{ih} the deductible and the premium of the contract chosen by type h individuals who purchase insurance through channel i . Less risk averse individuals choose a larger deductible, and thus we have $d_{i2} > d_{i1} \geq 0$.¹²

Each accident may be severe or minor, and the corresponding claims small or large, with probability q_s or $q_m = 1 - q_s$, respectively, irrespective of the policyholder's type, and whether it is the first or second accident during the policy year. To simplify our analysis of claim manipulation, it is assumed that a large claim exactly doubles a small claim, with loss ℓ and 2ℓ , respectively. Fraud is committed by policyholders who postpone small claims till their last policy month. They will file one single large claim for two minor

¹⁰The model features the non-cooperative interaction between policyholders and insurers, in a costly state verification setting as in Picard (1996). For the sake of brevity, several aspects of the insurance market analysis are deliberately overlooked here. This particularly concerns the way individuals choose their contracts and their insurance distribution channel, depending on their risk aversion and on their intrinsic preference for a specific channel.

¹¹For the sake of simplicity and brevity, we do not analyze the reasons for which an individual may prefer to purchase insurance through a car dealer or through another distribution channel. Such preferences are likely to depend on many factors, such as the valuation of time saved by bundling the purchase of a new car and the taking out of an insurance policy, the repeated relationship between individuals and car dealers that also provide repair services, or the level of trust in car dealers.

¹²For notational simplicity, we assume that the deductible is the same whether it is the first or second claim during the policy year.

accidents presented as a severe accident that occurred during the last policy month, should another minor accident occur later during the same policy year. Otherwise, the claim corresponding to the first minor accident will be denied because filed outside the permitted time. Fraud reduces the retained cost of the accidents by half since the deductible is paid only once. It also provides a supplementary gain through the manipulation of the bonus-malus system if the policyholder intends to stay with the same insurer at least during the next year.

Defrauding requires collusion with a car repairer, and, in the case of successful fraud, the policyholder and the repairer will share these benefits according to their respective bargaining powers. The audit of claims by the insurer makes fraud risky since each member of a policyholder-repairer coalition that is spotted defrauding has to pay a penalty (considered, for simplicity, as a fine to the government), and, in that case, the claim is fully denied (i.e. the policyholder does not receive an indemnity).

Let us denote by α_{ih} and β_{ih} the fraud and audit mixed strategy of the policyholder and the insurer, respectively, for a population of type (i, h) individuals. α_{ih} is the probability that a type (i, h) policyholder postpones a first small claim (when the corresponding minor accident occurs before the last policy month), with the intention to file a single large claim for two accidents during the last policy month, should another minor accident occur before the end of the year. Fraud is concentrated among those policyholders who are willing to stay with the same insurer at the end of the policy year because they are the ones who benefit the most through the bonus-malus mechanism.¹³ β_{ih} is the probability that a large claim (filed by a type (i, h) policyholder) is audited by the insurer.¹⁴ Such

¹³The policyholders who may benefit the most from defrauding through claim manipulation are those who have a first minor accident before the last month of their policy year and who do not intend to switch insurers. If these policyholders are just indifferent between defrauding and not-defrauding, as will be the case at the equilibrium of the policyholder-insurer interaction game presented in the following analysis, then the other policyholders will be deterred from defrauding.

¹⁴Note that the degree of risk aversion is not directly observed by the insurer. However, individuals choose different contracts (i.e., different deductibles) depending on their risk aversion, and thus insurers can condition their audit probability on the level of the deductible, and thus indirectly on the policy-

large claims correspond either to true severe accidents or to two minor accidents that have been fraudulently aggregated and postponed to the last month). We assume that audit allows the insurer to detect with certainty whether the claim has been manipulated or not.

The expected cost of claims per type (i, h) policyholder is written as

$$C_{ih} = L - D_{ih} + FC_{ih} + AC_{ih}, \quad (1)$$

where L is the expected costs of accidents, D_{ih} is the cost retained by the policyholder (in the absence of fraud), FC_{ih} is the cost of fraudulent claims and AC_{ih} is the audit cost.

L and D_{ih} are equal to the expected number of accidents per policyholder $\pi_1 + 2\pi_2$ multiplied by the weighted average loss per accident and by the deductible per accident, respectively. This gives

$$\begin{aligned} L &= (\pi_1 + 2\pi_2)[q_s\ell + 2q_m\ell] \\ &= (\pi_1 + 2\pi_2)(2 - q_s)\ell, \end{aligned}$$

and

$$D_{ih} = (\pi_1 + 2\pi_2)d_{ih}.$$

FC_{ih} is proportional to α_{ih} but, for given α_{ih} , it decreases linearly with β_{ih} , because auditing a larger fraction of large claims reduces average indemnity payment through the detection of falsified claims. DOAs have some bargaining power with insurers and they may intercede with the insurer when a claim is denied for fraud. This intervention

holder's type. Note also, that the policy year and the calendar year do not coincide. The beginning of the policy year is evenly distributed over the calendar year among the policyholders. Only the first claims that correspond to (true or falsified) severe accidents are audited. For practical reasons, it is assumed that insurers audit all these claims with the same probability, whether they are filed within or outside the last month of the policy year.

is successful with some probability, and thus it decreases the financial benefit drawn by the insurer from spotting a defrauding policyholder-car repairer coalition. Thus, we may write

$$FC_{ih} = \alpha_{ih}[a_1(d_{ih}) - a_2(d_{ih}, \zeta_i)\beta_{ih}], \quad (2)$$

with $a_1(d_{ih}), a_2(d_{ih}, \zeta_i) > 0$, where ζ_i is a parameter that measures the bargaining power of distribution channel i , with $\zeta_D > \zeta_A$.¹⁵ We have $a'_1 > 0$ and $a'_{2d} < 0$ because the larger the deductible, the larger the financial impact of claims falsification and the smaller the gain to the insurer when a claim is denied after audit. We also have $a'_{2\zeta} < 0$ because the distribution channel's bargaining power leads to a smaller insurer's expected benefit when fraud is detected.

DOAs own and control their repair shop. Thus, it is assumed that auditing a claim (i.e., spending resources to discover whether a claim has been falsified or not) is more costly when insurance has been purchased through a DOA than through a standard insurance agent, because the protection of the DOA makes the detection of the policyholder-repairer collusion more difficult. Let c_i be the audit cost when the insurance distribution channel is $i = D$ or A , with $c_D > c_A$. Since defrauders manipulate claims by filing one single large claim for two accidents, the number of large claims filed by type (i, h) policyholders is linearly increasing with α_{ih} , which allows us to write¹⁶

$$AC_{ih} = c_i\beta_{ih}(a_3 + a_4\alpha_{ih}). \quad (3)$$

¹⁵Fraud, as it is described, may be committed by policyholders who intend to renew their insurance policy and who have two accidents, the first one being minor and occurring before the last month of the policy year. Thus, $a_1(d_{ih})$ and $a_{2i}(d_{ih})$ depend on the probability that a type (i, h) individual is in this situation, which depends on π_1, π_2 and q_s , but also on the timing of accidents throughout the policy year, which is left undescribed for the sake of brevity.

¹⁶Here also, a_3 and a_4 depend on π_1, π_2 and q_s (but not on d_{ih}), and furthermore a_4 depends on the timing of accidents throughout the policy year.

The insurer chooses β_{ih} in $[0, 1]$ in order to minimize C_{ih} , which gives

$$\beta_{ih} \begin{cases} = 0 & \text{if } \alpha_{ih} < \alpha^*(d_{ih}, \zeta_i, c_i), \\ \in [0, 1] & \text{if } \alpha_{ih} = \alpha^*(d_{ih}, \zeta_i, c_i), \\ = 1 & \text{if } \alpha_{ih} > \alpha^*(d_{ih}, \zeta_i, c_i), \end{cases} \quad (4)$$

where

$$\alpha^*(d, \zeta, c) \equiv \frac{ca_3}{a_2(d, \zeta) - ca_4}. \quad (5)$$

with $\alpha_d^* > 0$, $\alpha_\zeta^* > 0$ and $\alpha_c^* > 0$. Let us assume that $\alpha^*(d, \zeta, c) < 1$ for the relevant values of d, ζ, c , which means that systematic fraud would trigger the auditing of all the large claims. Depending on the bribe that they have to pay to car repairers for them to collude (which is not explicitly defined here)¹⁷, on the fine imposed on spotted defrauders, and on their degree of risk aversion, type h policyholders are willing to defraud if the probability of being caught is larger than a threshold $\beta_h^*(P_{ih}, d_{ih}) \in (0, 1)$. Individuals always defraud when the audit probability is zero, and they never defraud if all large claims are audited: hence the audit probability $\beta_h^*(P_{ih}, d_{ih})$ for which they are indifferent between fraud and honesty is between 0 and 1.¹⁸ This audit probability threshold is type dependent (hence the subscript h in the β_h^* function) because it is affected by the intrinsic risk aversion of the policyholder, but it also depends on P_{ih} because an increase in premium may affect the policyholder's risk aversion through a wealth effect,¹⁹ and it is increasing with d_{ih}

¹⁷We may, for instance, assume that policyholders make take it or leave it offers to car repairers. The word "bribe" refers to any form of advantage that the car dealer-repairer firm may obtain from the arrangement with the policyholder, such as the guarantee of a future car purchase.

¹⁸ β_h^* could be defined in a more explicit way by considering the expected utility of a type h individual who has a minor accident before the last policy month, and who has to choose between two strategies: either honestly filing a small claim without delay, or postponing her claim to the last policy month in order to file a single large claim if another minor accident occurs. β_h^* is the audit probability that makes the policyholder indifferent between these two strategies.

¹⁹For instance, under DARA preferences, an increase in the insurance premium makes the policyholder more risk averse, and thus less prone to conclude a risky fraudulent arrangement with a car repairer. In

because an increase in the deductible makes fraud more attractive. Thus, we have

$$\alpha_{ih} \begin{cases} = 0 & \text{if } \beta_{ih} > \beta_h^*(P_{ih}, d_{ih}), \\ \in [0, 1] & \text{if } \beta_{ih} = \beta_h^*(P_{ih}, d_{ih}), \\ = 1 & \text{if } \beta_{ih} < \beta_h^*(P_{ih}, d_{ih}). \end{cases} \quad (6)$$

A type (i, h) policyholder who has a minor accident before the last policy month and her insurer play a non-cooperative game, with strategies α_{ih} and β_{ih} respectively. Its Nash equilibrium is easily characterized. If $\alpha_{ih} = 0$, then (4) gives $\beta_{ih} = 0$, which implies $\alpha_{ih} = 1$ from (6), hence a contradiction. Similarly, if $\alpha_{ih} = 1$, then (4) gives $\beta_{ih} = 1$, which implies $\alpha_{ih} = 0$ from (6), hence again a contradiction. Thus, $\alpha_{ih} \in (0, 1)$ and (4),(6) give $\beta_{ih} = \beta_h^*(P_{ih}, d_{ih}) \in (0, 1)$ and $\alpha_{ih} = \alpha^*(d_{ih}, \zeta_i, c_i) \in (0, 1)$.

Thus, at equilibrium, the audit probability $\beta_{ih} = \beta_h^*(P_{ih}, d_{ih})$ makes the policyholder indifferent between fraud and honesty, and the fraud probability $\alpha_{ih} = \alpha^*(d_{ih}, \zeta_i, c_i)$ makes the insurer indifferent between auditing and not-auditing.

This leads us to simple predictions about the effect of the type of contract and distribution channel on insurance fraud. Firstly, using $\alpha_d^{*'} > 0$ shows that higher deductibles go along with more fraud. Since $d_2 > d_1 \geq 0$, we have $\alpha_{i2} > \alpha_{i1}$: in other words, for a given distribution channel, fraud is more prevalent among type 2 than type 1 individuals. More simply, if $d_1 = 0$, we can say in a shortcut that deductibles encourage fraud. We also have $c_D > c_A$ and $\xi_D > \xi_A$, and thus using $\alpha_\zeta^{*'} > 0$ and $\alpha_c^{*'} > 0$ yields $\alpha_{Dh} > \alpha_{Ah}$. Put briefly, for a given type of individual, there is more fraud when insurance has been purchased through the DOA agents than through standard insurance agents, because of the ability of DOAs to shelter their car repairers either from full-fledged inquiries or from sanctions.

that case, the larger the insurance premium, the lower the audit probability threshold above which fraud is deterred.

4 Data and testing of hypotheses

4.1 The data

The data yielded by companies 1 and 2 is recorded at the individual level and provides detailed information about the policyholders, their insurance contracts and the claims they have filed. Available variables are listed in Table 1. Data was collected over the 2010-2012 period, but our analysis will be restricted to 2010, so that we know whether policyholders subsequently renewed their contracts for less or more than one year.²⁰ We target the owners of private usage small sedans and small trucks with type A, B or C insurance contracts for automobile physical damage. There are 121,952 policyholders, and 8.10% of them filed at least one claim in the year 2010, which corresponds to 9,874 observations. This subset defines our "research sample" (i.e., the sub-sample of policyholders with claims).

(Insert Tables 1 and 2 here)

The mean values of the variables in the two samples are displayed in the first two columns of Table 2, with some significant differences. In particular, the research sample includes a larger proportion of female, middle-aged owners, large-sized and new vehicles. The insureds in the research sample also tend to purchase higher coverage contracts than those in the whole sample. The percentages of type A or B contracts, and particularly those in the suspicious groups *SG1* and *SG2*, are comparatively much higher in the research sample. The share of the *RG* group is also larger in the research sample than in the whole sample. Furthermore, the claims record measured by the average bonus-malus coefficient is worse in the research sample than in the whole sample.²¹

²⁰In what follows, years are policy years: a contract corresponds to year 2010 if it started in 2010.

²¹The bonus-malus coefficient is a multiplier applied to the actuarial premium: the larger this coefficient, the larger the premium charged to the policyholder.

The other three columns in Table 2 separate the research sample into three subgroups, according to the insurance distribution channels (DOA in company 1 and non-DOA in companies 1 and 2), with significant differences in terms of gender, usage, and vehicle size. There is also a much higher proportion of new vehicles for the DOA channel, which reflects the fact that, most of the time, a DOA sells an insurance contract when the corresponding dealer sells a new car. The percentage of claims filed during the last month of the policy year, measured by the average value of dummy SC , and the share of the RG group are larger in the DOA channel than in the two other channels.

4.2 Evidence on claim manipulation

The Taiwan factual background and our theoretical approach invite us to test several hypotheses about insurance fraud through claim manipulation. We firstly test the hypothesis that the perspective of contract renewal and the choice of a deductible contract are factors that stimulate fraud. We focus on the fraudulent behavior that consists in manipulating the claim date by moving it to the last policy month, called the "suspicious period", possibly by filing one claim for two events. We define the fraud rate as the number of claims per policyholder filed during the suspicious period, hence the following Hypothesis 1.²²

Hypothesis 1 (H1): *The fraud rate is higher in the suspicious group than in the non-suspicious group, and this is particularly the case for individuals covered by deductible contracts.*

Testing **H1** amounts to identifying whether there is a conditional dependence between belonging to the suspicious group SG (or to one of its subgroups, $SG1$ and $SG2$) on the one side, and filing a claim within the suspicious period (measured by the dummy SC) on the other side. We do so through the following three Bivariate Probit models, where

²²Of course, this does not mean that all the claims filed in the suspicious period are fraudulent.

$\Phi(.)$ is the cumulative normal distribution function, and X is the vector of explanatory variables (with vectors of coefficients $\beta_{SC}, \beta_{SG}, \dots$), including the premium amount and all the variables available for pricing and underwriting decisions. In order to control for the recouping effect, a dummy for RG is also included in X .²³

Model 1:

$$\text{Prob}(SC = 1) = \Phi(X\beta_{SC} + \varepsilon_i) \quad (7)$$

$$\text{Prob}(SG = 1) = \Phi(X\beta_{SG} + \eta_i) \quad (8)$$

Model 2:

$$\text{Prob}(SC = 1) = \Phi(X\beta_{SC} + \varepsilon_i) \quad (9)$$

$$\text{Prob}(SG1 = 1) = \Phi(X\beta_{SG1} + \eta_i) \quad (10)$$

Model 3:

$$\text{Prob}(SC = 1) = \Phi(X\beta_{SC} + \varepsilon_i) \quad (11)$$

$$\text{Prob}(SG2 = 1) = \Phi(X\beta_{SG2} + \eta_i) \quad (12)$$

A bootstrapping approach is followed for each model by drawing samples 200 times. The empirical results of these regressions are listed in Table 3, with a special interest in the estimated residual correlation coefficients. **H1** should lead to a positive conditional correlation between filing a suspicious claim and belonging to a suspicious group. More formally, the estimated residual correlation coefficients of these models, $\hat{\rho}_{SC,SG}$, $\hat{\rho}_{SC,SG1}$ and $\hat{\rho}_{SC,SG2}$ respectively, should be positive and significantly different from 0, which leads

²³The pricing and underwriting variables include all the observable characteristics of the insured (e.g. age, gender, bonus malus coefficient, etc), and the characteristics of the vehicle (e.g. age, brand, registered area, etc). The premium amount and the recoup dummy are also included. In words, X includes all the variables listed in the first part of Table 1, and *logprem* and *recoup* in the second part.

us to test for the null hypothesis $H_0 : \rho_{SC,SG} \leq 0$, $H_0 : \rho_{SC,SG1} \leq 0$ and $H_0 : \rho_{SC,SG2} \leq 0$, in models 1, 2 and 3 respectively.

The three estimated residual correlation coefficients are significantly positive, which allows us to reject the null hypothesis in each model, and thus to state that there is a significantly positive conditional correlation between SC and SG , $SG1$ or $SG2$, in each model. In words, in accordance with **H1**, there is a conditional dependence between belonging to the suspicious group and filing a claim within the suspicious period, whether the individual is covered by a deductible contract or not.²⁴

(Insert Table 3 here)

If defrauders postpone their claims to the suspicious period and if they may cumulate losses in a single claim, then the suspicious period should be characterized by high values of first-claim cost ratios. This is expressed in Hypothesis 2.

Hypothesis 2: *The first-claim cost ratio is larger in the suspicious period than during the rest of the policy year, particularly for the suspicious group.*

Hypothesis 2 is tested through the following regression:

$$clmamt = \alpha_c lastmonth + \alpha_f first + \alpha_{fs} first * lastmonth + \alpha_X X + e, \quad (13)$$

which is performed among the claims filed by members of the SG group, where $clmamt$ is the value (in US dollars) of the claim. In this regression, $lastmonth$ and $first$ are dummies indicating respectively that the claim was filed during the last month of the

²⁴Table 3 also offers some interesting byproducts that are worth mentioning. Firstly, the policyholders from the RG group tend to file their first claims in the suspicious period, which echoes the conclusions of Li et al. (2013). Secondly, females file their first claim during the suspicious period more frequently than males, but that does not necessarily reflect a gender effect in fraudulent behavior. It is usual in Taiwan to register cars under the name of females (e.g. a wife or mother), even when the primary driver is a male, in order to benefit from cheaper insurance premiums. Hence, instead of a gender effect, the above mentioned correlation may just reflect the fact that the policyholders who carefully manage their insurance budget may also try to obtain undue advantage from their insurance company.

policy year, and that it was the first claim of the policyholder during this policy year. Regression (13) also includes the interaction variable $first * lastmonth$. We perform the above test separately for $SG1$ and $SG2$. In our sample, this corresponds to 6,974 claims filed by 6,521 policyholders from $SG1$, and 695 claims filed by 647 policyholders from $SG2$. Results are reported in Table 4.

(Insert Table 4 here)

The estimated coefficients of the interaction terms are $\hat{\alpha}_{fs} = 111.7$ with p -value 0.0852 for $SG1$, and $\hat{\alpha}_{fs} = 549.2$ with p -value 0.0007 for $SG2$, which confirms the validity of Hypothesis 2, with a lower significance level for $SG1$ than for $SG2$.²⁵ For the sake of completeness, we have also run the regression that explains the value of the claims over the whole sample (not only the SG group) by including dummies $SG1$, $SG2$, $lastmonth$, $first$, RG and their double and triple interaction terms in the explanatory variables. Results confirm the validity of Hypothesis 2 (see sub-section 6.2 in the Appendix).

Our third hypothesis relates the fraud rate to the insurance distribution channel.

Hypothesis 3 (H3): *The fraud rate in the suspicious group is comparatively even larger when insurance has been purchased through the DOA channel than through other distribution channels.*

We test **H3** by coming back to Bivariate Probit models 1, 2 and 3 with three distinct sub-samples, including the policyholders who purchased insurance from company 1 through the car dealer channel (sub-sample 1) or through the non-dealer channel (sub-sample 2), and from company 2 (sub-sample 3), respectively. This leads us to estimated residual correlation coefficients $\hat{\rho}_{SC,SG}$, $\hat{\rho}_{SC,SG1}$ and $\hat{\rho}_{SC,SG2}$ in each subsample.

(Insert Tables 5,6 and 7 here)

²⁵This is consistent with the fact that the policyholders with deductible contracts (i.e. the $SG2$ subgroup) have a greater incentive to file a single claim for two events than the policyholders with no-deductible contracts (the $SG1$ subgroup).

Detailed results are displayed in Tables 5, 6 and 7, for models 1, 2 and 3 respectively. The following table summarizes our conclusions about the conditional dependence between SC on the one side, and $SG, SG1$ and $SG2$ on the other, with $*$ and $***$ referring to significance levels at the 10% and 1% thresholds, respectively.

		Company 1 Dealer	Company 1 Non-dealer	Company 2
Model 1	$\hat{\rho}_{SC,SG}$	0.9997*	-0.7874	-0.7874
Model 2	$\hat{\rho}_{SC,SG1}$	0.9996***	-0.7496	0.4906
Model 3	$\hat{\rho}_{SC,SG2}$	0.6735***	-0.7999	0.5195

Hence, when the regressions are performed in the sub-sample of policyholders who purchased coverage through the dealer-owned agents of company 1, there is a significantly positive residual correlation between SC and SG at the 10% threshold, and between SC and $SG1$ or $SG2$ at the 1% threshold. This residual correlation becomes insignificant, when the regressions are performed in the two other sub-samples, where insurance is not purchased through car dealers. This is clearly in line with an effect of the distribution channel on the propensity to defraud by filing claims during the suspicious period.

Complementary evidence on the role of car dealers on insurance fraud has been obtained by testing whether $\hat{\rho}_{SC,SG}$, $\hat{\rho}_{SC,SG1}$ and $\hat{\rho}_{SC,SG2}$ are significantly larger among the policyholders who purchased insurance through car dealers than through other channels. In other words, in model 1, we successively consider the two null hypotheses $H_0 : \hat{\rho}_{SC,SG}^D \leq \hat{\rho}_{SC,SG}^{ND}$ and $H_0 : \hat{\rho}_{SC,SG}^D \leq \hat{\rho}_{SC,SG}^{C2}$, where D, ND and $C2$ refer respectively to insurance purchased from company 1 through dealers, from company 1 through other distribution channels, and from company 2. For the sake of completeness, we also consider the null hypothesis $H_0 : \hat{\rho}_{SC,SG}^{ND} \leq \hat{\rho}_{SC,SG}^{C2}$. We do the same for models 2 and 3 (hence with $SG1$ and $SG2$ instead of SG). As before, we proceeded by bootstrapping each model 200 times, which allowed us to derive the standard deviation for each residual

correlation coefficient and to perform the t test for each null hypothesis. Our results are displayed in Table 8. The null hypothesis $\hat{\rho}_{SC,SG}^D \leq \hat{\rho}_{SC,SG}^{ND}$ and $\hat{\rho}_{SC,SG}^D \leq \hat{\rho}_{SC,SG}^{C2}$ are rejected at the 1% significance level, and the same applies if SG is replaced by $SG1$ or $SG2$. In other words, whatever the definition of the suspicious group (SG , $SG1$ or $SG2$), the conditional correlation between filing a suspicious claim and belonging to the suspicious group is significantly larger when contracts are sold through the car dealer associated with company 1 than through another distribution channel of company 1 or from company 2.

(Insert Table 8 here)

4.3 Robustness tests

1. To check the robustness of our conclusions, we have also tested Hypothesis 1 and Hypothesis 3 by following a two-stage approach inspired from Dionne et al. (2001). The results are reported and discussed in Appendix 6.1. They confirm our conclusion about the conditional correlation between SG , $SG1$ or $SG2$ and SC . They also confirm that these conditional correlations are comparatively higher when the contracts are sold by company 1 through the dealer channel than through other channels.
2. In a setting with adverse selection, past and future claim experiences may be linked, but man-made claim manipulation should reduce the predictive power of this link. Furthermore, adverse selection may lead to a positive correlation between the coverage and the probability of filing claims, but it does not induce any particular timing for claims. These observations open the door to additional tests reported in Appendix 6.3, confirming that our conclusions on claim manipulation are not called into question by hidden information on risk types.
3. It is legitimate to question whether the higher expected cost of claims in the DOA

channel may simply reflect the fact that, on average, the individuals who take out insurance from DOAs have higher risks, rather than fraudulent behaviors. An additional test, reported in Appendix 6.4, shows that this is not the case.

4. It is also worth investigating whether the validity of our conclusions could be affected by the hypothetical presence of (ex ante) moral hazard. Ex ante moral hazard explains why a more comprehensive insurance coverage may make a driver less cautious. This incentive effect is even stronger for policyholders who had no accidents before the suspicious period, because the bonus-malus system forgives the first accident. Hence, under the moral hazard hypothesis, the policyholders from the *SG1* group (i.e., those with a no-deductible contract) should be less cautious than those from *SG2* (the policyholders with a deductible contract), and, according to the moral hazard interpretation, they should have more severe first accidents in the last policy month. The comparison of coefficient $\hat{\alpha}_{fs}$ in regression (13) for *SG1* and *SG2* leads to the opposite conclusion.

5. We have analyzed the collusion process as a bilateral car repairer-policyholder agreement, that the insurers may prove only through costly audit. In this setting, insurers - as well as honest policyholders - are victims of hidden claim manipulation. Is it conceivable that insurers themselves are part of collusive agreements ? A possible story along this vein would transform claim manipulation into a strategy to build customer loyalty, deliberately encouraged by insurers, particularly through car dealers. Insurers would be guaranteed of insurance renewals, just as car dealers are guaranteed of future car purchases from this arrangement. Data does not confirm this interpretation. As previously mentioned, DOAs provide less stable clientele to insurers than other insurance agents,²⁶ which runs contrary to the idea

²⁶As shown in Table 1, the average value of *SG*, i.e., the fraction of policyholders who have renewed their contract only for one year, is much larger in the sub-sample with claims than in the global sample,

that encouraging DOAs to manipulate claims could be a way to build customer loyalty. We cannot exclude that claim manipulation is part and parcel of DOAs' marketing strategy, under the form of repeated one-shot deals in order to attract new customers, but this would not create a long-lasting customer loyalty.²⁷

5 Conclusion

This paper has focused attention on the policyholder-service provider coalition in insurance mechanisms: how it can affect the credibility of claim auditing, how several patterns of fraud may emerge in the car insurance market, and how service providers and policyholders may draw benefit from such a coalition. The important role of car dealers in Taiwan provides an exceptional opportunity to analyze this interaction between insurer, policyholder and provider.

It is a fact that the economic analysis of insurance fraud is often based on a very abstract picture of claims fraud (filing a fraudulent claim although no accident has occurred, or exaggerating a claim), but in practice understanding insurance fraud often requires a much more specific analysis of the claims fraud process. The Taiwan case offers such a possibility, with fraud frequently taking place through the manipulation of the claim's date in order to avoid a penalty from the bonus-malus system and to reduce the burden of a second deductible, should another accident occur.

We hope to have brought convincing evidence that the intertemporal manipulation of claims is actually a significant determinant of insurance fraud in Taiwan. In particular, policyholders with deductible contracts who intend to renew their policies (the suspicious

which is coherent with our analysis of claim manipulation. However, this fraction is even larger when when policyholders have taken out their insurance policies through a DOA than through other distribution channels.

²⁷Insurers may be obliged to tolerate these misbehaviors, under the threat of car dealers who can guide their customers towards other insurers. The theoretical model of section 3 incorporates this dimension through the large bargaining powers of repairers sheltered by car dealers.

group) have a larger propensity to defraud than other policyholders, by postponing their claims until the last month of the policy year, and possibly by merging two events into a single claim. Consequently, there is an increase in the average cost of first claims filed by the suspicious group in the last month of the policy year. Furthermore, the collusion between policyholders and car repairers sheltered by car dealers is a crucial mechanism that contributes to the development of fraud in the Taiwanese car insurance market.

The size of claim manipulation in the Taiwan insurance market and the role of DOAs are so significant that it is hard to believe that insurers are unaware of them. Informal exchanges with the industry confirm that this is the case. Of course, there may be different views of the underlying mechanisms, varying from granting small advantages to policyholders in order to build customer loyalty and closing ones eyes to small false claims - i.e. the end of year "car wash" and the recouping money behavior, respectively - up to organized large scale insurance fraud through claim manipulation and collusion with car repairers. All these components of customers' misbehaviors are likely to coexist. The lack of response of the Taiwan insurers concerned is more striking. Our analysis suggests that it is in fact very difficult to incentivize DOAs through contractual mechanisms so that fighting fraud would be in their own interest. The main revenue of car dealers comes from the sales of new vehicles and from the activity of their repair shops. Although DOAs are major intermediaries in the Taiwan insurance market, selling insurance is for most car dealers mainly a way to improve their relationships with car buyers, it is not their core business. Reducing the intensity of fraud through the DOA channel would in fact require a structural reorganization that would be very costly to insurers. Integrating car dealers as part and parcel of the firm (i.e. regrouping the insurance activity and the sale of cars within a common holding company) might completely change the story. It would reduce the bargaining power of DOAs and, presumably, it would also allow insurers to reduce the asymmetry of information with their DOAs by implementing regular cost reviews, instead

of triggering costly audits on a case by case basis, and with the insurer in a position of weakness. Other Taiwanese insurers have made that choice. The size of fraud in the Taiwan automobile insurance market should persuade insurers that comparing the costs and benefits of these decentralized and integrated schemes is of utmost importance.

6 Appendix

6.1 Testing Hypothesis 1 and 3 through two-stage regressions

Dionne et al. (2001) follow a two-stage approach in order to analyze the link between the claim frequency and the choice of a deductible (vs full insurance) contract. This led them to appraise the conditional dependence between these two variables by the estimated coefficient of the deductible contract dummy in the regression that explains the claim frequency. We have checked the robustness of our conclusions using a similar method. Stage 1 coincides with the regressions (2), (4) and (6), already performed. Stage 2 consists in performing regressions to explain SC , by adding the estimated probability of belonging to a suspicious groups \widehat{SG} , \widehat{SG}_1 or \widehat{SG}_2 derived from Stage 1 results, and the dummies SG , SG_1 or SG_2 for belonging to each specific suspicious group, to the vector of observable variables X .

(Insert Tables 9, 10 and 11 here)

Results are reported in Tables 8, 9 and 10. The estimated coefficient of SG , SG_1 or SG_2 is positive and significantly different from 0 at the 1% significance threshold level for the three definitions of the suspicious group, which confirms the validity of our Hypothesis 1. We have also added the interaction terms $D * \widehat{SG}$ and $D * SG$, and also $C_2 * \widehat{SG}$ and $C_2 * SG$ (and the same for SG_1 and SG_2), where C_2 is a dummy for company 2 where contracts are not sold through car dealers. In the three models, the coefficients

of $D * SG$, $D * SG_1$ and $D * SG_2$ are positive and significantly different from 0, contrary to the coefficients of $C_2 * SG$, $C_2 * SG_1$ and $C_2 * SG_2$, which provides additional evidence on the validity of our Hypothesis 3.

6.2 Additional test for Hypothesis 2

The regression that explains the claim value (hitherto regression (13)) has also been performed over the whole sample (not only the SG group) by adding dummies SG_1 and SG_2 and their double and triple interaction with $lastmonth$ and $first$, among the explanatory variables. Furthermore, in order to be able to distinguish fraud going through claim manipulation from the premium recouping behavior, the set of explanatory variables also includes RG and its double and triple interaction with $lastmonth$ and $first$. This leads to the following regression:

$$\begin{aligned}
clmamt = & \alpha_{S1}SG_1 + \alpha_{S2}SG_2 + \alpha_{RG}RG + \alpha_Clastmonth + \alpha_ffirst \\
& + \alpha_{Rf}RG * first + \alpha_{Cf}lastmonth * first + \alpha_{Sf1}SG_1 * first + \alpha_{Sf2}SG_2 * first \\
& + \alpha_{SC1}SG_1 * lastmonth + \alpha_{SC2}SG_2 * lastmonth + \alpha_{SC2}SG_2 * lastmonth + \alpha_{RC}RG * lastmonth \\
& + \alpha_{SCf1}SG_1 * lastmonth * first + \alpha_{SCf2}SG_2 * lastmonth * first \\
& + \alpha_{RCf}RG * lastmonth * first + \alpha_X X + e.
\end{aligned}$$

Performing this regression among the 10,684 claims filed by the members of the research sample gives $\hat{\alpha}_{SCf1} = 156.06$ with p -value 0.0513, $\hat{\alpha}_{SCf2} = 885.23$ with p -value 0.0004, and $\alpha_{RCf} = -200.52$ with p -value 0.0233. The inequalities $\hat{\alpha}_{SCf2} > \hat{\alpha}_{SCf1} > 0$ once again validate Hypothesis 2. Symmetrically, $\alpha_{RCf} = -200.52 < 0$ confirms that members of the RG group tend to file small claims at the end of the policy year, when they have not filed a claim during the previous months.²⁸

²⁸The tables with detailed results are not reported here for the sake of brevity. They are available from the authors upon request.

6.3 Taking adverse selection into account

In a setting with adverse selection, past and future claim experiences may be linked, but man-made claim manipulation should reduce the predictive power of this link. To check if this is actually the case, we have used the 2010 data to run two Probit regressions that estimate the probability of filing a claim either in any month of 2011 or in the suspicious period of 2011, respectively. The regressions were run separately for the suspicious and non-suspicious groups. Observing the policyholders' 2011 claim records allows us to calculate the prediction error for the claims filed either throughout 2011 or during the suspicious period of the same year. In a second stage, we may use a t -test to check whether the first prediction error is smaller than the second one.

(Insert Table 12 here)

Panel A of Table 12 confirms that this is the case for the suspicious and non-suspicious groups. Furthermore, the difference of the prediction error is significantly larger in absolute value in the suspicious groups, especially in SG_2 , than in the non-suspicious group. This confirms the manipulation of claims, beyond any possible hidden information about policyholders' risk types.

Secondly, we know that adverse selection may lead to a positive correlation between the contract coverage and the probability of filing claims, but it does not induce any particular timing for claims over the year. Panel B of Table 12 provides the incident rate ratio for SG_1 and SG_2 , as well as in the non-suspicious group. In SG_1 and SG_2 , the incident rate ratios are significantly higher in the last policy month than in the other months, and these last month hazard rates are significantly higher than in the non-suspicious group, which confirms once again that claim manipulation does occur. The fact that the last month hazard rate is even larger for SG_2 than for SG_1 confirms that our observations cannot be attributed to adverse selection.

6.4 Additional test for Hypothesis 3

It is legitimate to question whether the higher expected cost of claims in the DOA channel may simply reflect the fact that, on average, the individuals who take out insurance from DOAs have higher risks, rather than fraudulent behaviors. This issue may be clarified by estimating the claim amount using the following OLS regression:

$$\begin{aligned} clmamt = & \alpha_0 + \alpha_D D + \alpha_{C2} C_2 + \alpha_{AB} AB \\ & + \alpha_{DAB} D * AB + \alpha_{C2AB} C_2 * AB \\ & + \alpha_X X + e, \end{aligned}$$

where AB is a dummy for contracts of type A or B , with type C contracts as counterpart. The estimated results are in Table 13, with $\hat{\alpha}_{AB}$ positive and significantly different from 0, which means type A and B contracts are associated with claim costs that are significantly larger than for type C . $\hat{\alpha}_D$ is negative, but not significantly different from 0. Furthermore, α_{C2} is positive and significantly different from 0. We may deduce from these results that the contracts are not associated with higher claim costs when they are sold through the DOA channel rather than through other channels. Meanwhile, the contracts of company 2 have higher claim costs than those of company 1. Furthermore, $\hat{\alpha}_{DAB}$ is negative and $\hat{\alpha}_{C2AB}$ is positive, both coefficients being significantly different from 0. This means that the type A and B contracts going through the car dealer channel in company 1 (respect. through other distribution channels in company 2) entail comparatively lower claim costs (respect. higher claim costs) than other contracts. In other words, the increase in claim costs is not an intrinsic characteristic of the distribution channel: it reflects the fraudulent behaviors of some policyholders (the suspicious groups) who may take advantage of the manipulation of claims, and this behavior is facilitated by DOAs.

(Insert Table 13 here)

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