

# Insurance Fraud through Collusion between Policyholders and Car Dealers: Theory and Empirical Evidence.

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# Insurance fraud and collusion

Motivation

Model

Data

Estimation

- Claims fraud is an important source of inefficiency in insurance markets.
- Collusion between policyholders and service providers (car repairers, health care providers...) make fraud easier.
- Focus on the Taiwan automobile insurance market and on the role of car dealer-owned agents (DOAs).

## On the role of DOAs

- In Taiwan, a large percentage of automobile insurance contracts are sold through DOAs : 51.4% in our data base.
- Most DOAs own a repair shop : they have an informational advantage (difficult to establish that a claim has been falsified).
- DOAs own the list of their clients : they have a large bargaining power.
- Repairing or maintaining vehicles, handling claims and renewing insurance contracts enable DOAs to maintain constant contact with their clients.

# The curious timing of automobile claims in Taiwan

- Li et al. (2013) observe that a large proportion of claims are filed during the last month of the policy year.
- This is confirmed by our own data base.
- They interpret this phenomenon as a recouping premium effect.

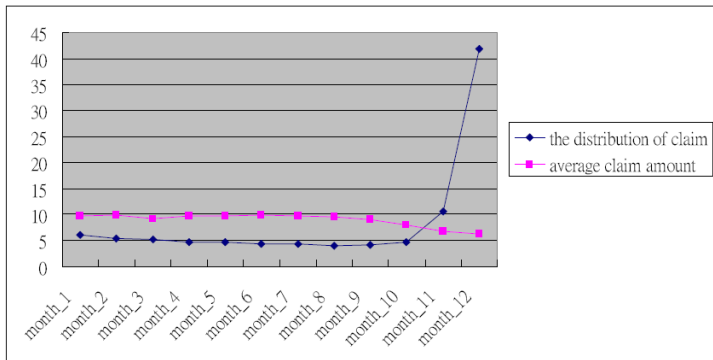


Figure 1 Distribution of claims and average claim cost (first claims)

## Three types of damage insurance contracts in Taiwan

- Type A contracts : widest scope of coverage (all kinds of collision and non-collision losses) + deductible.
- Type B contracts : the same area of coverage as type A contracts with some exclusions in the case of non-collision losses + either deductible or no deductible.
- Type C contracts : covers only collision losses without deductible.
- Claims are per accident : one claim for each accident.

# Bonus-malus system

- The insured who has not filed any claim during one year gets a discount on the next year premium.
- Symmetrically, there is an increase in premium proportionally to the number of claims.
- The bonus-malus forgives the first claim within three years.

## Manipulating claims

- Opportunist policyholders may take advantage of manipulating claims.
- Li et al. (2013) : the policyholders who didn't file any claim before the policy going to an end may feel legitimate to recoup some money back from the insurance company by filing small false claims near the end of the year.
- Policyholders may file one unique claim with the cumulated losses of two events in order to bear the deductible burden only one time  $\implies$  postponing the claim of an accident in case another accident follows.



- Type A and B contracts are particularly subject to this kind of manipulation (they include coverage for other losses than collision between two cars).
- The Taiwanese bonus-malus system reinforce the gain of this manipulation for policyholders who plan to renew their contract : claims filed in the last month of the policy year  $t$  will be taken into account in the premium paid in  $t + 2$  + first accident is forgiven.
- Thus, postponing claims and filing a unique claim for two events is at the same time a way to defraud the deductible contractual mechanism and an abuse of the Taiwanese bonus-malus system

## Interpreting the concentration of claims during the last month

- *Premium recouping interpretation*  $\implies$  defrauders are more likely to be policyholders who plan not to renew their contract with the same insurance company (they have lower moral cost of defrauding) : a "**recoup group**".
- *Claims manipulation interpretation*  $\implies$  defrauders are more likely to be policyholders who have taken out deductible contracts and who renew their contract : a "**suspicious group**".
- Type C contracts are difficult to manipulate  $\implies$  may be used as a comparison base in the analysis of fraudulent behaviors generated by the other contracts.

- Let the *First Claim Cost Ratio* be

$$FCCR = \frac{\text{average cost of first claims}}{\text{average cost of all claims}}.$$

- Postponing and cumulating claims  $\implies FCCR \nearrow$  in the last policy month.
- That could also result from moral hazard (if a first accident makes drivers more cautious).
- Type C contracts may be used to isolate the moral hazard effect (the manipulation of claims is unlikely for such contracts).

- Figure 2 suggests that the claim postponing theory is grounded in empirical evidence :

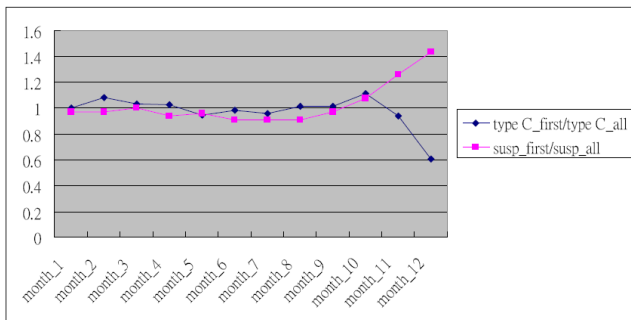


Figure 2 Average cost of first claims / Average cost of all claims: Comparing the suspicious group and type C contract

- Figure 3 confirms that DOAs may favor the manipulation of claims.

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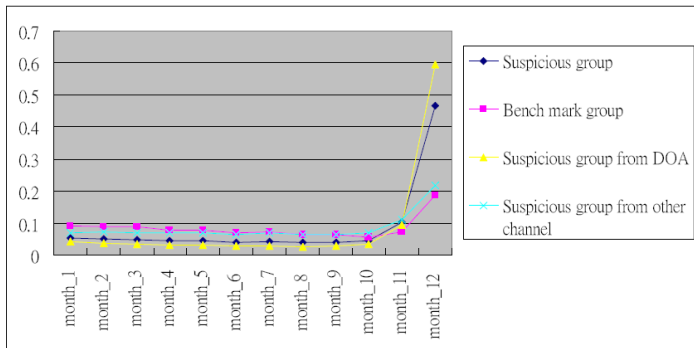


Figure 3 Distribution of claims during the policy year

## The Model

- An economy with a competitive insurance market, in which automobile insurance can be purchased either through car dealers who act as insurance agents (DOAS) and own car repair shops or through standard insurance agents.
- Insurance policies : Premium  $P$  with loading factor  $\sigma$  and deductible  $d$  for each accident.
- Each individual suffers 1 accident with probability  $\pi_1$  and 2 accidents with probability  $\pi_2$ , with  $0 < \pi_1 + \pi_2 < 1$ .
- Accidents are minor or serious, with repair cost  $\ell$  and  $2\ell$  and probability  $q_m$  and  $q_s$  respectively ( $q_m + q_s = 1$ ).

- There is a unit mass of risk averse individuals, with initial wealth  $w$  and final wealth  $w_f$ , and  $vN-M$  utility function  $u(\cdot)$ , with  $u' > 0, u'' < 0$ . They may be more or less risk averse : types 1 have a smaller degree of absolute risk aversion than types 2 :

$$-\frac{u_1''(w_f)}{u_1'(w_f)} < -\frac{u_2''(w_f)}{u_2'(w_f)}$$

and they correspond to proportions  $\lambda_1$  and  $\lambda_2$  of the population, with  $\lambda_1 + \lambda_2 = 1$ .

- Type 2 individuals purchase a larger coverage (lower deductible) than type 1 because they are more risk averse.
- Car repairers are risk neutral.

- Individuals have differentiated preferences between purchasing insurance through a car dealer (DOA) or through a standard insurance agent.
- **Hotelling model** : both types of individuals are uniformly located on interval  $[0, 1]$  : a representative DOA is at  $x = x_D = 0$  and a representative standard agent is at  $x = x_A = 1$ . The expected utility is written as

$$\bar{u}_h(P, d) - t |x - x_i|,$$

where

$$\begin{aligned} \bar{u}_h(P, d) \equiv & (1 - \pi_1 - \pi_2)u_h(w - P) \\ & + \pi_1 u_h(w - P - d) + \pi_2 u_h(w - P - 2d), \end{aligned}$$

with  $h = 1$  or  $2$  and  $i = D$  if the customer purchases insurance through the representative DOA and  $i = A$  if he goes through the standard agent.



## The fraud mechanism

- Fraud = **putting back claims to the suspicious period and filing one large claim for two small losses, with the complicity of a car repairer.**
- Collusive gain :  $d + v$  where  $v$  is is the gain from bonus-malus fraud.
- The policyholder makes a take-or-leave it offer  $G$  to the car repairer:

gain of the policyholder:  $d + v - G$ ,

gain of the car repairer:  $G$ .

## Collusion and audit

- **Collusion can be detected by audit**, which costs  $c_i$ , with  $i = D$  or  $A$ . If fraud is detected, no indemnity is paid and the policyholder, and the repairer have to pay fines,  $B$  and  $B'$ , respectively.
- Policyholder-repairer **coalition bargaining power**: defrauders are not punished with probability  $\tilde{\zeta}_i$ , with  $i = D$  or  $A$ .
- **Assumption:**

$$c_D > c_A \text{ and } \tilde{\zeta}_D \geq \tilde{\zeta}_{A'}$$

or

$$c_D \geq c_A \text{ and } \tilde{\zeta}_D > \tilde{\zeta}_A.$$

## Fraud and audit strategy

- **Strategies:** fraud rate  $\alpha_{ih} \in [0, 1]$  and audit rate  $\beta_{ih} \in [0, 1]$ .
- Individuals defraud if the audit rate is not too large. Insurers audit claims if the fraud rate is large enough.
- **Nash equilibrium:** the fraud rate  $\alpha_{ih}$  and the audit rate  $\beta_{ih}$  should be mutually best-response.
- The equilibrium is in mixed strategies:  $\beta_{ih}$  is the audit rate that makes individuals indifferent between defrauding and not defrauding and  $\alpha_{ih}$  is the audit rate that makes insurers indifferent between auditing and not auditing.

## Equilibrium contracts (case of no bargaining power)

- The expected cost of an insurance contract is written as

$$C_{ih}(d_{ih}, c_i) = \bar{L} - (\pi_1 + 2\pi_2)d_{ih} + FC_{ih}(d_{ih}, c_i),$$

where  $\bar{L}$  is the expected repair cost and  $FC_{ih}$  is the cost of fraud (audit cost + cost of undetected fraud), with  $\partial FC_{ih} / \partial d_{ih} > 0$  and  $\partial FC_{ih} / \partial c_i > 0$ .

- $d_{ih}, P_{ih}$  maximizes  $\bar{u}_h(P, d)$  w.r.t.  $P, d$ , s.t.

$$P = (1 + \sigma) \times C_{ih}(d, c_i),$$

for  $h = 1, 2$  and  $i = D, A$ .

- **Proposition 1:** *The equilibrium deductibles and fraud rates are such that  $d_{i1} > d_{i2} \geq 0$ , and  $\alpha_{i1} > \alpha_{i2}$  for  $i = A$  or  $D$ .*
- **Intuition:** Type 2 individuals choose smaller deductibles than type 1 because they are more risk averse. This reduces the incentives to audit claims, hence a larger equilibrium fraud rate.

- **Proposition 2:** *The equilibrium fraud rates are such that  $\alpha_{D1} > \alpha_{A1}$  and  $\alpha_{D2} > \alpha_{A2}$ , that is, for both types of individuals the fraud rate is larger among insurance policies purchased through  $D$  than through  $A$ .*
- **Intuition:** insurers need additional incentives to audit claims when insurance policies have been purchased through  $D$  than through  $A$ , because audit is more costly (or because DOAs have a larger probability to escape the penalties) for  $D$  than for  $A$ . This is reached when the fraud rate is larger. The proof shows that this intuition remains valid if  $d_{Dh} \neq d_{Ah}$  for  $h = 1, 2$ .

- There is a threshold  $x_h^*$  such that type  $h$  individuals purchase insurance through  $D$  if  $x < x_h^*$  and through  $A$  if  $x > x_h^*$ . The proportion of full coverage contracts  $\theta_D$  and  $\theta_A$  respectively for  $D$  and  $A$  is

$$\theta_D = \frac{\lambda_2 x_2^*}{\lambda_1 x_1^* + \lambda_2 x_2^*},$$
$$\theta_A = \frac{\lambda_2 (1 - x_2^*)}{\lambda_1 (1 - x_1^*) + \lambda_2 (1 - x_2^*)}.$$

- **Proposition 3:**  $\theta_D > \theta_A$ , i.e., the proportion of full coverage contracts is larger among insurance policies purchased through  $D$  than through  $A$ .

## Data

- Data source: a large insurance company in Taiwan. Its market share in automobile insurance market is over 20%.
- The policyholders : the owners of private usage small sedans and small trucks.
- Data periods: from year 2003 to year 2006.
- Research period: from year 2003 to year 2005.
- 296,940 policyholders in the sample.
- We isolate a subsample with the policyholders who have filed at least one claim during the three years (33.26% of the full sample.)



- **Explained variables :**

- *susp* : dummy indicating that the insured belongs to the suspicious group,
- *nodedt* : dummy indicating a policy without deductible,
- *claimsusp* : dummy indicating that the first claim of the policy year has been filed during the suspicious period.

- **Explanatory variables :**

- *D* : dummy indicating that the insurance policy has been purchased through the DOA channel,
- *A, B* : dummy variables indicating a type A or B contract,
- *recoup* : dummy indicating that the insured belongs to the recoup group.

and **observable variables about the insured** (sex, marital status, age, location in Taiwan, type of car...).

## Estimation

- **Hypothesis 1:** *The fraud rate is higher in the suspicious group than in the non-suspicious group.*
- **Methodology:** Test the correlation between "belonging to the suspicious group" and "filing a claim in the suspicious period". We use two stage probit regressions to control for the endogeneity of the contract choice and of the renewal decision:

- Stage 1 :

$$\Pr(susp_{it} = 1|X_{it}) = \Phi(\alpha X_{it})$$

- Stage 2 :

$$\begin{aligned} \Pr(claimsusp_{it} = 1|\widehat{susp}_{it}, susp_{it}, recoup_{it}, X_{it}) \\ = \Phi(\beta_{es}\widehat{susp}_{it} + \beta_s susp_{it} + \beta_r recoup_{it} + \beta X_{it}). \end{aligned}$$

- **Prediction:**  $\widehat{\beta}_s$  should be positive and significantly different from 0.

# Remarks on adverse selection and moral hazard

- **Not mixing up with adverse selection :**
  - adverse selection : the relationship between contract coverage and the probability of filing a claim,
  - our fraud hypothesis: the relationship between the nature of contract and the timing of the claims.
  
- **Not mixing up with moral hazard :**
  - moral hazard : larger coverage  $\implies$  less cautious driver, particularly near the end of the contract period,
  - our fraud hypothesis: lower coverage (higher deductible)  $\implies$  higher claim probability in the last policy month,
  - concern about the scope of coverage  $\implies$  robustness test by limiting our research sample to type-B contracts.

- **Hypothesis 2 :** *The fraud rate in the suspicious group is even larger when insurance has been purchased through the DOA channel than through other distribution channels.*
- **Methodology:** We further add  $D_{it}$ , and interaction variables  $susp\_D_{it} = susp_{it} \times D_{it}$  and  $recoup\_D_{it} = recoup_{it} \times D_{it}$  in the second stage regression:

$$\begin{aligned} & \Pr(\text{claims}_{susp_{it}} = 1 | \widehat{susp}_{it}, susp_{it}, D_{it}, susp\_D_{it}, \\ & \quad recoup_{it}, recoup\_D_{it}, X_{it}) \\ & = \Phi(\beta_{es} \widehat{susp}_{it} + \beta_s susp_{it} + \beta_D D_{it} + \beta_{sD} susp\_D_{it}, \\ & \quad + \beta_r recoup_{it} + \beta_{rD} recoup\_D_{it} + \beta X_{it}). \end{aligned}$$

- **Prediction :**  $\widehat{\beta}_{sD}$  should be positive and significantly different from 0.

# Table 4: Comparing the suspicious and non-suspicious groups

|                    | First stage |                 | Second stage |                 | Second stage |                 |
|--------------------|-------------|-----------------|--------------|-----------------|--------------|-----------------|
|                    | Eq (6)      |                 | Eq (7)       |                 | Eq (8)       |                 |
|                    | Est. coef.  | <i>p</i> -value | Est. coef.   | <i>p</i> -value | Est. coef.   | <i>p</i> -value |
| <i>constant</i>    | -4.6568     | <.0001          | -2.0690      | <.0001          | -2.0124      | <.0001          |
| $\widehat{susp}_i$ |             |                 | -0.1983      | <.0001          | -0.2048      | <.0001          |
| <i>susp</i>        |             |                 | 0.5187       | <.0001          | 0.1775       | 0.1178          |
| <i>D</i>           |             |                 |              |                 | 0.4523       | <.0001          |
| <i>susp_D</i>      |             |                 |              |                 | 0.4813       | <.0001          |
| <i>recoup</i>      |             |                 | 0.3019       | <.0001          | 0.4577       | <.0001          |
| <i>recoup_D</i>    |             |                 |              |                 | -0.2593      | <.0001          |

## Results for Hypothesis 1

- In Table 4 :  $\hat{\beta}_s$  is positive, and significantly different from 0 at the 5% significance level
- There is a significantly positive conditional correlation between belonging to the suspicious group and filing a claim in the suspicious period.
- *The insured whose contract choice is in the suspicious group are more likely than other policyholders to file their first claim during the suspicious period.*

## Robustness test

- In Table 5 (restriction to B contracts) :  $\hat{\beta}_s$  is positive, and significantly different from 0 at the 1% significance level
- Within the sub-group of type-B contracts, the conditional correlation between the suspicious contracts and the claims in the last policy month is significantly positive.
- This is not only the evidence of fraud which can be distinguished from adverse selection, but it is also an evidence that can be distinguished from ex ante moral hazard.

Table 5: Restriction to B  
contracts

|                    | First stage |                 | Second stage |                 | Second stage |                 |
|--------------------|-------------|-----------------|--------------|-----------------|--------------|-----------------|
|                    | Eq (6)      |                 | Eq (7)       |                 | Eq (8)       |                 |
|                    | Est. coef.  | <i>p</i> -value | Est. coef.   | <i>p</i> -value | Est. coef.   | <i>p</i> -value |
| <i>constant</i>    | -1.0542     | 0.0210          | 2.3170       | <.0001          | 2.3409       | <.0001          |
| $\widehat{susp}_i$ |             |                 | -0.1962      | <.0001          | -0.1927      | <.0001          |
| <i>susp</i>        |             |                 | 0.0599       | 0.0010          | 0.0113       | 0.2102          |
| <i>D</i>           |             |                 |              |                 | 0.2943       | <.0001          |
| <i>susp_D</i>      |             |                 |              |                 | 0.0571       | 0.0010          |
| <i>recoup</i>      |             |                 | 0.0296       | 0.0640          | 0.0487       | 0.0820          |
| <i>recoup_D</i>    |             |                 |              |                 | -0.1272      | <.0001          |



## Results for Hypothesis 2

- In Table 4 :  $\hat{\beta}_s$  is positive, but not significantly different from 0 anymore. However, the  $\hat{\beta}_{sD}$  is positive and significantly different from 0 at 1% significant level.
- After we control for the interaction between the DOA channel dummy variable and the suspicious group dummy variable, the conditional correlation between choosing the suspicious contract and filing claim in suspicious period disappears.
- This confirms the conjecture that the DOAs are the main channel of fraud.

## Robustness test

- In Table 5 (restriction to B contracts) :  $\hat{\beta}_s$  is positive, but not significantly different from 0 anymore. However, the  $\hat{\beta}_{sD}$  is positive and significantly different from 0 at 1% significant level.
- The policies of type-B contracts purchased through the DOA channel also provide significant evidence of fraud.
- *The whole fraud in the market comes from the DOA channel.*