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Contract design and insurance fraud: an experimental investigation^{*}

Frauke Lammers[†] and Jörg Schiller[‡]

Abstract

This paper investigates the impact of insurance contract design on the behavior of filing fraudulent claims in an experimental setup. We test whether or not peoples' fraud behavior varies for insurance contracts with full coverage, a straight deductible or variable premiums (bonus-malus contract). In our experiment filing fraudulent claims is a dominant strategy for selfish participants without any psychological costs of commit fraud. While some people never commit fraud, there is a substantial share of people who only occasionally or never defraud. In addition, we find that deductible contracts may be perceived as unfair and thus increase the extent of fraudulent claims compared to full coverage contracts. In contrast, bonus-malus contracts with variable insurance premiums significantly reduce insurance fraud both compared to full coverage and deductible contracts. This reduction cannot solely be explained by monetary incentives. Our results indicate that bonus-malus contracts are therefore a good means to reduce insurance fraud.

Preliminary version

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1. Introduction

Fraudulent behavior of policyholders is generally an important issue in insurance markets. Within the last 15 years, there has been substantial research on many different aspects of insurance fraud. First of all, there exist many different definitions. Rather strict definitions may only encompass such situations as fraud in which policyholders deliberately misrepresent the actual loss by filing fictitious claims, inflating valid claims or deliberately causing damages. In these situations of “hard” fraud policyholders know the true state of nature but file false claims in order to get indemnity payments from insurance companies. Rather wide insurance fraud definitions may also regard reduced carefulness of policyholders¹ (ex ante moral hazard) or insurance induced increases in prices and or quantity for certain goods which compensate consequences of unfavorable events, such as an accident or an illness² (ex post moral hazard) as “soft” insurance fraud. In this paper, we only consider “hard” insurance fraud.

Many empirical papers, like, e.g. Artís et al. (1999) or Caron and Dionne (1997) try to measure the actual amount or fraction of fraudulent claims in different insurance markets. For example, Caron and Dionne (1997) find that about 10% of all claims in the Quebec automobile insurance market can be attributed to fraudulent behavior. These claims add up to about 113.5 million Canadian dollars per year. Related empirical studies, like, e.g. Artís et al. (1999, 2002), Brockett et al. (1998, 2002), Dionne and Gagné (2001), Derrig and Ostaszewski (1995) and Viaene et al. (2002) try to identify certain observable characteristics of fraudulent claims in order to improve the detection of insurance fraud. For example, in respect to impact of prior claims Artís et al. (1999, 2002) find that the number of previous claims in the Spanish auto insurance market positively affects the fraud probability. Although these studies do not find a significant impact of deductibles on fraudulent behavior, Dionne and Gagné (2001) show that in Canadian auto insurance a higher deductible is associated with higher reported losses.

With respect to the theoretical research, two different models are used in order to derive effective measures for fighting insurance fraud. In the spirit of Townsend (1979), Costly State Verification models, like, e.g. Picard (1996), Boyer (2000, 2001) and Schiller

¹ See, e.g., Ehrlich and Becker (1972) or Shavell (1979).

² See, e.g., Pauly (1968), Gaynor et al. (2000) or Nell et al. (2009).

(2006), are mainly concerned with incentive effects of claims auditing and the associated design of optimal insurance contracts, when policyholders have superior information with respect to the occurrence of insured losses. In contrast, Costly State Falsification models, like, e.g. Crocker and Morgan (1998) and Lacker and Weinberg (1989), are mainly concerned with contractual incentives when policyholders can exaggerate their actual claim amount by costly and unobservable activities. In this model framework insurance companies can only reduce incentives for fraudulent behavior by contractual means and specifically the slope of the indemnity function. Small losses are generally overcompensated whereas high losses are underpaid.

The above-mentioned theoretical literature usually employs standard rational choice models in the spirit of Becker (1968), where selfish and amoral individuals evaluate (potential) gains and expected sanctions under uncertainty. However, there is now a great deal of evidence that only some people behave strictly selfish while others care for social norms or fairness considerations (see, e.g., Ichino and Maggi, 2000, or Fehr and Schmidt, 1999).

The literature offers several explanations as to why people might not be purely selfish. For instance, in line with findings from Falk and Fischbacher (1999) some people would never consider committing a crime, like insurance or tax fraud, due to social norms.³ Other work, like Spicer and Becker (1980), provides evidence that people who believe that they are treated unfairly by the tax system are more likely to evade taxes in order to restore equity. Hence, in addition to social norms, fairness effects with respect to insurance firms might also significantly affect fraudulent behavior.

The aim of our experimental study is to evaluate the impact of social norms and fairness effects on insurance fraud. As a first step, we examine whether or not general findings from other economic experiments, like tax evasion, public good or cheap talk games, can be transferred to the insurance fraud context. In particular, not all people behave purely selfish and amoral. While some people in our experiment never commit fraud, there is a substantial share of people who only occasionally file fraudulent claims. The latter group is especially interesting for policy implications. In a second step, we therefore examine the

³ In fact, some theoretical models, like Picard (1996) or Boyer (2000), do consider two types of policyholders: opportunists, who just consider costs and benefits of their actions and honest people, who never commit any insurance fraud.

question what triggers fraudulent behavior in this group? Our focus is on insurance-specific effects and we examine whether and how different contractual designs affect the decision to commit fraud. In particular, we consider two contractual forms commonly employed in the insurance industry in order to prevent fraud: a straight deductible contract and a variable premiums (bonus-malus) contract. Therefore, we consider three different treatments (insurance arrangements): a full coverage contract, a deductible insurance contract with a fixed insurance premium and partial coverage, and a bonus-malus insurance contract with full coverage and variable premium. We do not consider social interaction or any monitoring of claims, because we are mainly interested in peoples' attitudes to insurance fraud.

We find that subjects commit more fraud in the deductible treatment compared to the full coverage treatment. In contrast, bonus-malus contracts significantly reduce fictitious claims compared to a situation with a fixed premium. Most notably, this result is surprising as bonus-malus contracts with full coverage are payoff-equivalent to deductible contracts. One can presume that the reduction of fraud is due to two effects: First, like deductible contracts, bonus-malus contracts reduce the net-benefit from insurance fraud. Second, this contract type is not associated with any negative consequences resulting from fairness effects. Thus, whereas deductible contracts seem to be perceived as unfair, this is not the case for bonus-malus contracts.

Why could deductible contracts be perceived as unfair? According to Arrow (1971) and Raviv (1979) a deductible contract is optimal when insurance premiums entail linear transaction costs. In addition, as shown by Townsend (1979), a modified deductible contract is also optimal in a Costly State Verification model with deterministic auditing, where a fixed deductible is applied to all claims that are above a certain threshold. Although deductibles may be optimal from a risk sharing point of view and common in real insurance markets, they might be perceived as unfair by policyholders. For example, by using survey-data Miyazaki (2009) finds that the deductible amount influences perceptions of ethicality and fairness regarding insurance claim build-up. In this respect, deductible contracts may lead to (additional) incentives for insurance fraud and fairness effects may explain why higher deductibles are associated with significantly higher reported losses. Dionne and Gagné (2001) show that in Canadian auto insurance a deductible raise from \$250 to \$500 increases the average claim by 14.6%-31.8% (or respectively \$628 to \$812). Thus, their results

indicate that higher deductibles increase fraudulent activities. Our experimental results indicate that the increase in fraudulent activities is mainly due to an increase in inflated claims.

Moreno et al. (2006) argue that bonus-malus contracts provide significant incentives against insurance fraud in a multi-period setting, when policyholders are selfish and rational. Although theoretically appealing, these contractual features may also influence the fairness perception of the insured. As in Sliwka (2007), motivation crowding out can occur, that is, the agents could consider these features as a signal from the insurer that insurance fraud is considered as the social norm. Thus, experience rating (or specifically bonus-malus contracts) may be considered as unfair, because after a claim is made subsequent insurance premiums are increased. Consequently, even if policyholders are in the first place fully reimbursed for a loss, they face an implicit deductible as any indemnity is partly self-financed by higher future premiums. In our experiment, this potential source of unfairness has no effect on subjects' behavior.

To our knowledge the current paper is the first to examine the influence of contractual design on insurance fraud in an experimental setting. Only a few insurance-related empirical papers do explicitly consider behavioral factors which might affect fraudulent behavior of policyholders. For example, Cummins and Tennyson (1996) relate their measured differences in claiming behavior in automobile bodily injury liability insurance to survey data on consumer attitudes toward the acceptability of specific dishonest practices, like tax evasion or general fraudulent behavior, in automobile insurance. They find a strong positive relationship between the attitude of accepting dishonest and fraudulent activities and rates of liability claiming. Their study also shows that claim rates are significantly affected by variables measuring the costs and benefits of claiming in each federal state.

By analyzing national survey data for the United States, Tennyson (1997) finds that social norms and ethical factors significantly influence attitude formation in the insurance fraud context. In particular, her results show that the social or ethical environment for fraud is related to the respondents' attitudes toward insurance fraud. Both the social climate for insurance fraud (measured by the fraction of all other respondents in the state who find fraud acceptable) and the respondent's internalization of social norms of honesty more generally (measured by his attitude toward tax evasion) are positively and significantly related to the

respondent's attitudes towards insurance fraud. Surprisingly, even though the respondents' attitude to exaggerate claims is also positively related to their negative perception of insurance institutions, insurance specific fairness effects seem to be less important than social norms with respect to the attitude towards insurance fraud.

The remainder of this article is organized as follows: In section 2 we describe the experimental design. In section 3 we derive our predictions for the empirical analysis. In section 4 we provide information about the subjects of the experiment. Section 5 presents our results and gives a discussion and section 6 concludes.

2. Experimental Design

In the experiment subjects are randomly and anonymously allocated into fixed groups of four. Each group plays five periods ($t=1, \dots, T=5$) of the following insurance game: Participants get a period endowment (W) and are informed that they have to insure against a loss x_j with $j=0, L, H$ and $x_0 = 0 < x_L < x_H$. Losses are in each period identical and independently distributed with $p_0 = 0.7$, $p_L = 0.2$ and $p_H = 0.1$. Insurance is mandatory for each participant. Thus, each group member must in every period pay an insurance premium (P) to a group-specific insurance account that finances all indemnities (I) paid to the group members. Hence, in our experiment we apply a mutual insurance setup. All payments from and to the group members are settled via the group-specific insurance account. After the last period the insurance account is automatically balanced by the group members. If the insurance account has a negative balance, all group members pay an additional contribution. A positive balance is equally shared by all group members. The instructions and therefore the whole experiment were framed in an insurance-specific wording.⁴ All information was common knowledge.

⁴ For example, Abbink and Hennig-Schmidt (2006) find that a context-free experiment framing does not have a significant impact on a bribery game. Schoemaker and Kunreuther (1979) found a significant impact of an insurance framing on participants' behavior in their survey. We also conducted a context-free treatment and did not find any significant differences with respect to the insurance-specific wording in our Base Treatment.

In respect to the claiming of indemnities, we apply the strategy method.⁵ Before knowing the actual loss realization in period t , each player is asked which indemnity she is going to file for each possible loss. In all treatments, the individual can only claim one of three possible indemnities $I_0 = 0$, $I_L = 10$, and $I_H = 15$ for each possible loss x_j . Hence, in each period participants choose a claiming strategy $s_i^t = (I(x_0), I(x_L), I(x_H))$ where $I(x_j) \in (I_0, I_L, I_H)$. It is common knowledge that strategies directly determine the individuals' period payoffs. We do not consider monitoring activities or punishments for players who lied. Indemnities are always paid as claimed, but due to transaction costs of 40% ($c = 0.4$), the insurance account is charged with an amount of $1.4I$ for each claim. Therefore, the insurance account is a costly means for reallocating premium and claim payments of the four group members that provides coverage against risk.

All periods are identical and consist of four steps:

Step 1: Subjects confirm the payment of the insurance premium to the insurance account.

Step 2: Each player has to decide upon their claiming strategy s_i^t .

Step 3: Players are informed about the actual loss \tilde{x}_i^t in period t .

Step 4: Actual indemnities $\tilde{I}_i^t = I(\tilde{x}_i^t)$ are paid according to s_i^t .

After the last period the insurance account is automatically balanced by the group members. Overall, we conduct three different treatments that are described below.

In our Base Treatment the period endowment is $W^t = 25$ and loss sizes are $x_L = 10$ and $x_H = 15$. As participants are able to claim $I_j = \{0, 10, 15\}$ from the insurance account, this setup resembles a situation with a full-coverage insurance contract. The insurance premium $P^t = 5$ corresponds to expected losses including transaction costs. It does not cover any fraudulent claims.

⁵ This approach goes back to Selten (1967). Participants have to state contingent responses for each information set. But only one response will correspond to an effective action and will determine the responder's and other players' payoff. For example, Hoffmann et al. (1998), Brandts and Charness (2000), Oxoby and MacLeish (2004), do not find any differences in behavior when using the strategy method in simple sequential games. However, e.g. Blount and Bazermann (1996), Güth et al. (2001) and Brosig et al. (2003) found significant differences between the strategy method and unconditional decision-making.

In the Deductible Treatment (Deduct) both losses x_L and x_H are increased by 5 points to $x_L = 15$ and $x_H = 20$. Participants are informed that there is a deductible of 5 points and thus they are only able to claim $I_j = \{0, 10, 15\}$. The premium is unchanged but the endowment is increased to $W^t = 27$ to cover for higher expected losses.

Finally, in our Bonus-Malus Treatment (BoMa) losses, the endowment, and indemnities are the same as in the Base Treatment ($x_L = 10$, $x_H = 15$, $W^t = 25$, $I_j = \{0, 10, 15\}$). In this treatment the insurance premium is conditioned upon past claims. If participants received a positive payment $\tilde{I}_i^t > 0$, their subsequent premium P_i^{t+1} is increased by 2 points, otherwise the subsequent premium decreases by 1 point. The initial premium is $P_i^1 = 5$ and the premium in period $t+1$ is

$$P_i^{t+1} = \begin{cases} P_i^t - 1 & \text{if } I_i^t = 0 \\ P_i^t + 2 & \text{otherwise} \end{cases}. \quad (1)$$

3. Theoretical predictions

3.1. Individual treatments

In order to derive an optimal period strategy for participants, we assume that individuals possess a non-decreasing Bernoulli utility function $u_i(\cdot) > 0$. For the Base and Deduct Treatment behavior in period $t-1$ does not affect decision-making in period t since premium payments are constant. Furthermore, as participants are paid after the last period, it is straightforward to assume that individuals do not discount their expected period utility U_i^t , and hence maximize $U_i = \sum_t U_i^t$.

Related experimental research has shown that people may experience psychological costs of committing fraud. These costs may vary between individuals and may depend on the amount of money defrauded or on other factors such as contractual arrangements. For the sake of simplicity, we assume that costs correspond to $\theta_i \cdot K_m$ where θ_i is continuously distributed in $[0, 1]$ according to $F(\theta)$ and $K_m > I_H$. These assumptions imply that costs vary

by individuals with the factor θ_i and are independent of the amount defrauded but may depend on the contractual arrangement in a treatment $m \in \{Base, Deduct, BoMa\}$. These costs only incur if the individual defrauds, therefore we define

$$\kappa_{im} = \begin{cases} \theta_i \cdot K_m & \text{if } I_i^t(x_j) > x_j^t \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

In the *Base and Deductible Treatment* expected utility in period t is given by

$$U_i^t(s_i^t) = \sum_j p_j u_i^t(W^t - P^t - x_j^t + I_i^t(x_j) - \kappa_{im} - \varepsilon_{it} + 1/4 [4P^t - (1+c)(I_i^t(x_j) + 3I_{-i}^t)]) \quad (3)$$

where I_{-i}^t denotes the expected indemnity payments claimed by all other group members except individual i . In line with Palfrey and Prisbrey (1997), we assume that for each subject i 's decisions in period t there is an identically and independently distributed random component, $\varepsilon_{it} \sim N(0, \sigma^2)$, that is added to the psychological costs of committing fraud κ_{im} . This error term represents some random added propensity for the subject to either commit fraud or not. As all four group members pay the flat premium to the insurance account and receive 1/4 of the account's balance, the insurance premium cancels out. Rearranging (3) and considering the transaction cost parameter $c = 0.4$ gives

$$U_i^t(s_i^t) = \sum_j p_j u_i^t(W^t - x_j^t - 1.05I_{-i}^t + 0.65I_i^t(x_j) - \kappa_{im} - \varepsilon_{it}). \quad (4)$$

In a *high loss situation* there is no possibility of fraud and each individual maximizes her state utility by claiming I_H . For the *no-loss situation* individuals can either honestly claim $I_0 = 0$ or defraud by claiming $I_L = 10$ or $I_H^t = 15$. Clearly, claiming I_H strictly dominates I_L since κ_{im} is independent of the claim size for $I_j > 0$. As W^t , x_j^t and $1.05I_{-i}^t$ are independent of the individual's claiming behaviour, there is no strategic interdependence between group members. Here, the optimal action of i depends on the individual costs κ_{im} . Individual i will commit fraud if

$$0 < 0.65I_H - \theta_i K_m - \varepsilon_{it}. \quad (5)$$

As long as $\varepsilon_{it} < 0.65I_H - \theta_i K_m$, individual i will commit fraud in period t . On average, since $E[\varepsilon_{it}] = 0$, the marginal individual with $\hat{\theta}_m$ is indifferent between both possibilities with

$$\hat{\theta}_m = \frac{0.65I_H}{K_m} > 0 \quad \text{with } m = \text{Base, Deduct}. \quad (6)$$

For the *low-loss situation* individuals can either honestly claim I_L or defraud by claiming I_H . Similarly, the marginal individual with $\tilde{\theta}_m$ is on average indifferent between both possibilities. From (4) we get

$$\tilde{\theta}_m = \frac{0.65(I_H - I_L)}{K_m} > 0 \quad \text{with } m = \text{Base, Deduct} \quad (7)$$

In the Base and the Deduct Treatment the assumption $K_m > I_H$ directly implies $0 < \hat{\theta}, \tilde{\theta} < 1$. Hence, an individual without any psychological costs $\theta_i = 0$ in the Base and the Deduct Treatment maximizes her expected utility by choosing $s_i^t(\theta_i = 0) = (I_H, I_H, I_H) \forall t$. In contrast an individual with $\theta_i = 1$ would never commit fraud and therefore chooses $s_i^t(\theta_i = 1) = (I_0, I_L, I_H) \forall t$.

As θ_i is continuously distributed in $[0,1]$ and $E[\varepsilon_{it}] = 0$, the expected overall fraud probability p_m for the population corresponds to $F(\hat{\theta}_m)$ and $F(\tilde{\theta}_m)$ respectively. Due to $\hat{\theta} > \tilde{\theta}$, we have $F(\hat{\theta}_m) > F(\tilde{\theta}_m)$ for $m = \text{Base, Deduct}$. Consequently, the probability to commit fraud in the Base and Deduct Treatment is higher in the no loss than in the low loss situation ($\hat{p}_m > \tilde{p}_m$). Furthermore, when the psychological cost parameter K_m increases, the overall fraud probabilities decrease, as $\partial \hat{\theta}_m / \partial K_m < 0$ and $\partial \tilde{\theta}_m / \partial K_m < 0$ hold.

Proposition 1: *In the Base and Deduct Treatment, individuals always claim high indemnities irrespective of the actual loss size if they have no psychological costs of committing fraud ($\theta_i = 0$). If θ_i is continuously distributed in $[0,1]$ with $F(\theta)$, $\varepsilon_{it} \sim N(0, \sigma^2)$ and $K_m > I_H$, there will be three groups of individuals: those who always, those who never and those who sometimes commit fraud. For both treatments the overall probability to commit fraud is constant for all periods and higher in the no loss situation with $\hat{p}_m > \tilde{p}_m$. For $K_{Base} = K_{Deduct}$ we get $\hat{p}_{Base} = \hat{p}_{Deduct}$ and $\tilde{p}_{Base} = \tilde{p}_{Deduct}$.*

In the *BoMa Treatment* premiums depend on prior claiming. Hence, optimal strategies can be derived via backwards induction. When deciding whether or not to claim an indemnity, individuals now have to additionally consider the impact on future premium adjustments. Thus, the individual's utility in period t including the future impact of current actions is given by

$$U_i^t(s_i^t) = \sum_j p_j u_i^t \left(W^t - x_j^t - P_i^t - \Delta P_i^t + I_i^t(x_j) - \kappa_{im} - \varepsilon_{it} \right. \\ \left. + 1/4 \left[P_i^t + \Delta P_i^t + 3(P_{-i}^t + \Delta P_{-i}^t) - 1.4(I_i^t(x_j) + 3I_{-i}^t) \right] \right) \quad (8)$$

where ΔP_i^t accounts for the sum of future premium adjustments with

$$\Delta P_i^t = \begin{cases} -(T-t) & \text{if } I_i^t = 0 \\ 2(T-t) & \text{otherwise} \end{cases}.$$

Rearranging (8) gives

$$U_i^t(s_i^t) = \sum_j p_j u_i^t \left(W^t - x_j^t - 3/4(P_i^t - P_{-i}^t) - 3/4(\Delta P_i^t - \Delta P_{-i}^t) \right. \\ \left. + 0.65I_i^t(x_j) - 1.05I_{-i}^t - \kappa_{im} - \varepsilon_{it} \right). \quad (9)$$

Here, premiums do not cancel out. However, premium payments ($P_i^t, P_{-i}^t, \Delta P_{-i}^t$) and indemnities claimed by other group members (I_{-i}^t) are independent of the individual's claiming strategy in period t . As there are no future premium adjustments in period $t = 5$, clearly $\Delta P_i^5 = 0$ holds. Consequently, optimal behavior in $t = 5$ is the same as in the Base and Deduct Treatments. But for all other periods, an individual has to trade-off current indemnity payments and future premium adjustments.

The net-benefit of an indemnity payment in each period is still $0.65I_i^t(x_j) - \kappa_{im} - \varepsilon_{it}$. If a positive claim is made, the premium in each future period will be increased by 2 points. Otherwise the premium in each future period will be decreased by 1 point. Given our reasoning above, the objective function for individuals in period t simplifies to

$$\max_{I_i^t(x_j)} \sum_j (0.65I_i^t(x_j) - 0.75\Delta P_i^t - \kappa_{im} - \varepsilon_{it}). \quad (10)$$

Again, for the *no-loss situation* claiming I_H strictly dominates I_L . Here, the optimal action of i depends on the individual costs κ_{im} , ε_{it} , and the future premium adjustments $0.75\Delta P_i^t$ which decrease in t . An individual claims a high indemnity if

$$0.75(T-t) < 0.65I_H - 1.5(T-t) - \theta_i K_m - \varepsilon_{it} \quad (11)$$

The marginal individual with $\hat{\theta}_{BoMa}^t$ is in period t indifferent between both possibilities with

$$\hat{\theta}_{BoMa}^t = \frac{0.65I_H - 2.25(T-t)}{K_m} > 0. \quad (12)$$

As $\partial \hat{\theta}_{BoMa}^t / \partial t > 0$, the fraud probability $\hat{p}_{BoMa}^t = F(\hat{\theta}_{BoMa}^t)$ increases in t . If $K_{Base} = K_{BoMa}$ holds, the fraud probability \hat{p}_{BoMa} is for $t \leq 4$ strictly lower than \hat{p}_{Base} and in $t = 5$ both fraud probabilities are the same ($\hat{p}_{Base} = \hat{p}_{BoMa}$).

In the *low-loss situation* an individual may only defraud by claiming I_H , but she can also claim either I_L or I_0 . In the latter two cases there are no psychological costs for defrauding. It can be shown that in the first two periods that individuals prefer claiming I_0 instead of I_L . Therefore, underreporting may only be relevant for $t \leq 2$. Such a so-called “bonus hunger-strategy” in bonus-malus systems is well-known in insurance markets. Here, individuals do not report incurred losses in order to save on future premium adjustments and get a premium bonus. For $t \leq 2$, the marginal individual is indifferent between claiming I_0 and I_H . Therefore, we get

$$\tilde{\theta}_{BoMa}^{t \leq 2} = \frac{0.65(I_H - I_0) - 2.25(T - t)}{K_m} > 0. \quad (13)$$

In contrast, underreporting is never optimal for $t \geq 3$. The marginal individual with $\tilde{\theta}_m$ is indifferent between claiming I_L and I_H which implies

$$\tilde{\theta}_{BoMa}^{t \geq 3} = \frac{0.65(I_H - I_L)}{K_m} = \tilde{\theta}_{Base} \quad (14)$$

Obviously, as $\tilde{\theta}_{BoMa}^1 < \tilde{\theta}_{BoMa}^2 < \tilde{\theta}_{BoMa}^{t \geq 3}$ holds, the fraud probability for the low loss situation \tilde{p}_{BoMa}^t increases in the first three periods and is subsequently constant. An individual without any psychological costs ($\theta_i = 0$) will obviously always claim I_H in the situation of a low loss.

In a *high loss situation* underreporting is never optimal since $0.75(T - t) < 0.65I_H - 1.5(T - t)$ holds for all t . Thus, individuals always claim I_H .

As before, in the BoMa Treatment an individual without any psychological costs ($\theta_i = 0$) maximizes her expected utility by choosing $s_i^t(\theta_i = 0) = (I_H, I_H, I_H) \forall t$. In contrast an individual with $\theta_i = 1$ would never commit fraud, and therefore, chooses $s_i^t(\theta_i = 1) = (I_0, I_L, I_H) \forall t$.

Proposition 2: *In the no loss situation of the BoMa Treatment the fraud probability is increasing with $\partial \hat{p}_{BoMa}^t / \partial t > 0 \forall t$. In the low loss situation \tilde{p}_{BoMa}^t increases in the first three periods and is subsequently constant with $\tilde{p}_{BoMa}^1 < \tilde{p}_{BoMa}^2 < \tilde{p}_{BoMa}^{t \geq 3}$. For $K_{Base} = K_{BoMa}$ we get*

$$\hat{p}_{BoMa}^{t \leq 4} < \hat{p}_{Base}, \hat{p}_{BoMa}^{t=5} = \hat{p}_{Base}, \tilde{p}_{BoMa}^{t \leq 2} < \tilde{p}_{Base} \text{ and } \tilde{p}_{BoMa}^{t \geq 3} = \tilde{p}_{Base}.$$

Given Propositions 1 and 2, we derive the following predictions.

Prediction 1: *In all three treatments we expect to observe three groups of individuals: those who always, those who never, and those who sometimes commit fraud.*

Prediction 2: *In the Base and the Deduct Treatment, the overall probability to defraud is higher in the no loss than in the low loss situation.*

Prediction 3: *In the BoMa Treatment the overall probability to defraud is increasing for the no loss situation. In the low loss situation it is only increasing for the first three periods and subsequently constant.*

3.2. Treatment Effects

3.2.1. Deductible Treatment

In this treatment an insurance contract with a deductible of 5 points per claim is offered. This setup meets two requirements: First, as only losses are increased but indemnities are unchanged, actual gains resulting from fraudulent behavior are the same as in the Base Treatment. Hence, according to Proposition 1 if insurance-specific factors have no impact on the psychological costs of fraud, behavior in this treatment should not be significantly different from the Base Treatment. However, the deductible may trigger additional fraud if it is considered as unfair. Second, a player in the Deduct Treatment who suffers a low loss of 15 points will be fully reimbursed if she reports a high loss and thus claims a high indemnity of 15 points.

In the deductible Treatment the tendency to defraud may be increased by the fact that some people seem to dislike deductibles. For example, Schoemaker and Kunreuther (1979) find that people tend to choose the lowest available deductible. Dionne and Gagné (2001) show that simple deductible contracts may create additional incentives for filing fraudulent claims. In addition, a survey of Miyazaki (2009) reveals that the deductible amount influences perceptions of ethicality and fairness regarding insurance claim build-up. A possible reason for this finding may be that people want to be completely reimbursed in an insurance relationship.

Given the results from Miyazaki (2009) it would be straightforward to assume the psychological cost parameter to be generally lower in the Deductible Treatment ($K_{Deduct} < K_{Base}$). Due to $\partial \hat{\theta}_m / \partial K_m < 0$ and $\partial \tilde{\theta}_m / \partial K_m < 0$, the resulting fraud probabilities in the Deductible Treatment should be significantly higher for the no loss and low loss situation. The psychological effect of the Deductible Treatment may be more pronounced for the low loss situation. Here, the deductible may especially be perceived as unfair, since individuals are not totally reimbursed for an honest claim.

Prediction 4: *Individuals who incur no loss or a low loss in the Deductible Treatment are more likely to commit fraud compared to individuals in the Base Treatment. The increase in the fraud probability is higher for the low loss situation.*

3.2.2. Bonus-Malus Treatment

Moreno et al. (2006) show that bonus-malus contracts in a multi-period model may provide significant incentives against insurance fraud. One main question in the BoMa Treatment is whether or not monetary rewards and punishments mitigate insurance fraud although the contracts are not incentive-compatible in the sense that rational individuals without any psychological costs prefer to defraud. In addition, we want to test whether this insurance arrangement with variable premiums may be perceived as unfair and may therefore trigger fraudulent behavior. To the best of our knowledge there is no evidence about fairness aspects of bonus-malus contracts. In this respect, a comparison with the Base Treatment may lead to further insights.

First of all, the decision problem in period $t = 5$ is equivalent to that of the Base Treatment if $P_i^t = P_{-i}^t$ holds. Consequently, if $K_{BoMa} = K_{Base}$ there should not be any differences in claiming strategies between the BoMa and the Base Treatment in $t = 5$. In addition, as $\tilde{p}_{BoMa}^{t \geq 3} = \tilde{p}_{Base}$ we would expect to find no difference for the low loss situation for $t \geq 3$. However, if $K_{BoMa} < K_{Base}$, individuals perceive the bonus-malus contract as unfair and the fraud probability in period 5 should be significantly higher because there are no future premium adjustments. Furthermore, in this case we would have $\tilde{p}_{BoMa}^{t \geq 3} > \tilde{p}_{Base}$.

In our view, behavior in periods 3-5 can thus give an indication whether or not bonus-malus contracts are perceived as unfair. Given there is no evidence for such fairness effects, we do not expect to find any differences.

Prediction 5: *In the Bonus-Malus Treatment, behavior in period $t=5$ in general and claiming in the low loss situation for $t \geq 3$ is not significantly different compared to the Base Treatment. In addition, all other probabilities of committing fraud are significantly lower in the Bonus-Malus Treatment as described in Proposition 2.*

Our experimental setup allows us to make another interesting comparison of perceived fairness. As shown by Holtan (2001), the effective indemnity function of a full-coverage bonus-malus contract is equivalent to an indemnity function of an insurance contract with a straight deductible. He shows that the (implicit) deductible in a bonus-malus contract at a point t of time corresponds to the discounted difference of future premiums in periods $\tau > t$. In period $t=5$ the deductible is zero, as there are no future premiums to pay. In period $t=4$ the deductible is $0.75 \cdot 3 = 2.25$ points, because the future premium is for one period increased by 2 points if a claim is made or is decreased by 1 point otherwise and one fourth of each bonus-malus payment will later be reimbursed through the group account. Accordingly, deductibles for the other periods are: 4.5 points ($t=3$), 6.75 points ($t=2$) and 9 points ($t=1$).

In periods 1-4 there is a strictly positive implicit deductible and in $t=5$ there is full coverage. As monetary incentives in the BoMa and Deduct Treatment are similar in $t=2$, we are able to compare both treatments with respect to perceived fairness. The deductible is 5 points in the Deduct Treatment whereas the implicit deductible in the BoMa Treatment is 6.75 points in $t=2$. Therefore, the implicit deductible in the BoMa is slightly higher than in the Deduct Treatment. If a bonus-malus contract is perceived as less unfair than a deductible contract ($K_{BoMa} > K_{Deduct}$), individuals should commit less fraud although they face a slightly higher implicit deductible. More generally, we expect that this effect should also be valid in $t=1-4$.

Prediction 6: *Individuals in periods $t=2$ and more generally in $t=1-4$ of the Bonus-Malus Treatment commit significantly less fraud than individuals in the respective periods of the Deductible Treatment.*

4. Subjects

All computerized experiments were conducted between March and July 2009 at the MELESSA laboratory of the Ludwig-Maximilians-University (LMU) Munich in Germany. Recruitment was done using the system ORSEE (Greiner, 2004) and we employed the experimental software z-tree (Fischbacher, 2007). We conducted three sessions with 24 participants for each of our three treatments. A session took about 50-60 minutes. Subjects were predominantly students from the LMU with a great variety of majors. The fraction of students with a business or economics major was about 16%. All participants received a fixed show-up fee of 4 Euros. Information on treatment earnings excluding show-up fees are reported in Table 1.

Treatment	Average earnings	Earning range
Base	8.85 (2.13)	3.80 – 14.30
Deductible	9.33 (2.52)	3.70 – 16.50
Bonus-Malus	9.50 (2.71)	4.50 – 12.60

Table 1: Average treatment earnings (in Euros, standard deviation in parentheses)

5. Results

First, we present some general results of the experiment. Figure 1 and 2 show the fraudulent behavior of subjects per period and treatment for the no loss and the low loss situation.

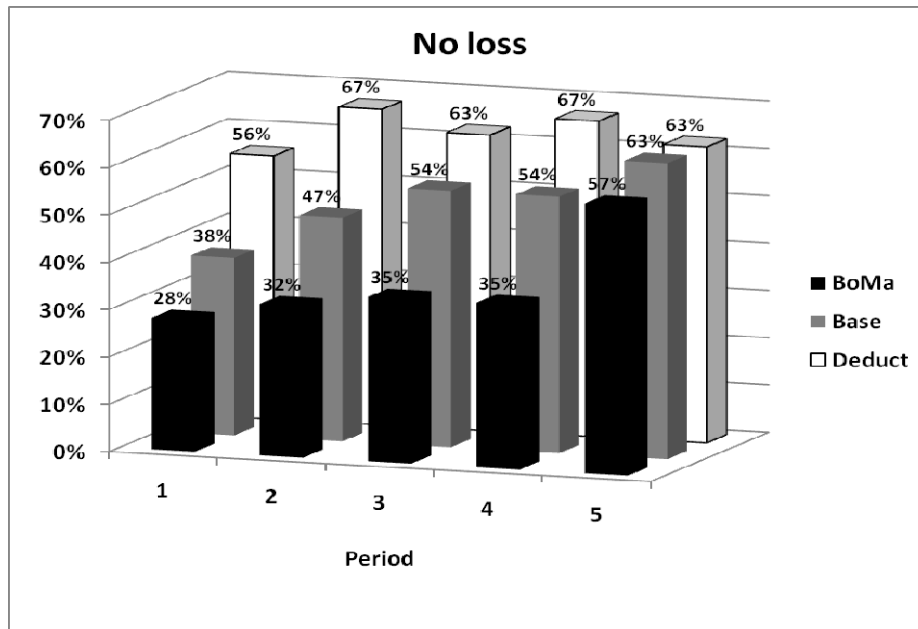


Figure 1: Fraudulent behavior per period and treatment for no losses

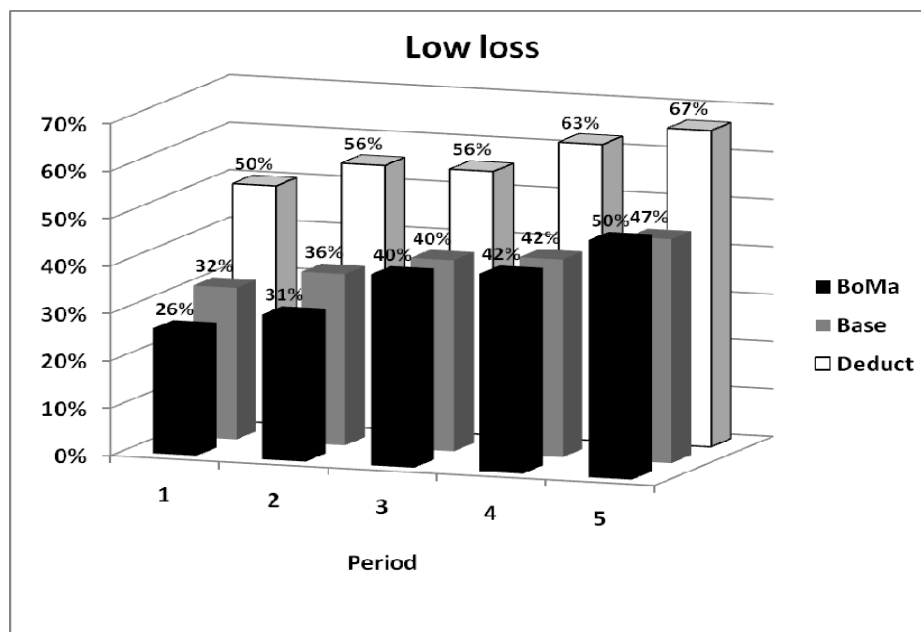


Figure 2: Fraudulent behavior per period and treatment for low losses

Figure 3 presents a summary of behavior over all periods.

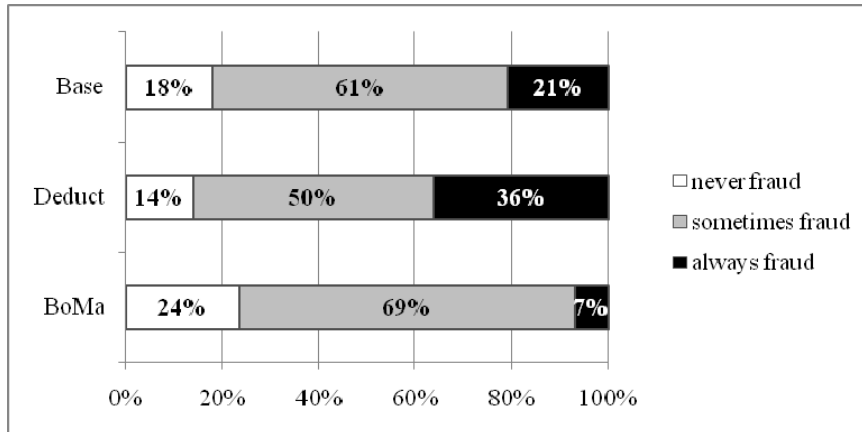


Figure 3: Fraudulent behavior per treatment

In each period, subjects have two possibilities of committing fraud: They can claim a low/high indemnity when they have incurred no loss and/or they can claim a high indemnity when they have incurred a low loss (due to the strategy method both choices are known). Over all treatments, 14% to 24% of subjects never commit any kind of fraud whereas 7% to 36% always commit fraud. 50% to 69% of subjects only sometimes commit fraud. This confirms our Prediction 1.

Result 1: Prediction 1 is confirmed.

Figure 4 shows the percentage of subjects who commit fraud if they have incurred no loss or a low loss for all periods.

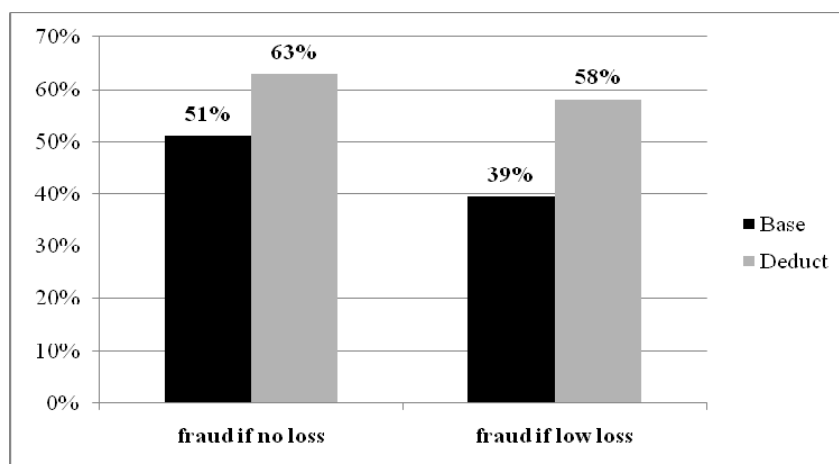


Figure 4: Percentage of subjects who commit fraud

Figure 4 suggests that for both treatments, the probability to defraud is higher in the no loss than in the low loss situation. However, a Pearson's chi-square test shows that the differences are not statistically significant.

Result 2: *Prediction 2 is rejected.*

Visual inspection of Figures 1 and 2 reveals that the overall fraud probabilities are increasing over time. Even though there is no feedback in our Base Treatment, subjects tend to commit more fraud in later periods. This is in contrast to Proposition 1. It indicates that learning was taking place although participants did not get any information about other peoples' behavior.

As Figures 1 shows, the positive period effect in the no loss situation is mainly driven by the last period. A random effects probit regression (Table A1, column 1) shows a highly significant period effect for the periods 1-5. However, when considering only periods 1-4, this effect is no longer significant. This result indicates that – irrespective of the potential gain from fraudulent behavior – premium adjustments have a significant deterrence effect when no loss occurs. In the no loss situation premium increases are somehow sunk when underreporting is no option. Here, the results (Table A1, columns 2 and 3) are mostly in line with Prediction 3. For $t=1-3$ there is a significantly positive period effect ($p < 0.007$), whereas the latter is only weakly significant for $t=3-5$ ($p < 0.082$).

Result 3: *Prediction 3 is partly confirmed. In the no loss situation of the BoMa Treatment the overall probability to defraud is only increasing between periods 4 and 5. In the low loss situation it is, as predicted, significantly increasing for the first three periods. For periods 3 to 5 it is also weakly significantly increasing.*

When comparing the behavior in the Base and the Deduct Treatment, Figure 2 shows that for all periods people commit significantly less fraud in the Base Treatment. In the no loss situation this difference is less pronounced, especially for $t=5$. In order to assess the significance of these differences, we conducted a pooled random effects probit regression for panel data. Our regression results (Table A2) confirm that the dummies for the Deductible Treatment are highly significant for low losses ($p < 0.012$) and weakly significant for no losses ($p < 0.083$).

As Figure 4 shows, the difference between both treatments is 19% in the low loss situation and thus higher compared to the difference of 12% in the no loss situation. Overall, the amount of fraud is higher in the no loss situation compared to the low loss situation

Result 4: *Prediction 4 is confirmed.*

Subsequently, we want to check whether or not participants perceive the BoMa arrangement as unfair. Therefore, we compare claiming behavior in the Base and BoMa Treatment for $t = 5$ where fraudulent behavior has no future payoff-consequences given the bonus-malus scheme. Subjects in the BoMa Treatment could thus wait until the last period before they start committing fraud. The estimates of the pooled random effects probit regression with the dependent variable *fraud noloss* and *fraud lowloss* are displayed in Table A3, columns 1 and 2, in the Appendix. We find no significant differences between treatments. This result is supported by a Pearson's chi-square test which leads to the values $\chi^2 = 0.113$ ($p = 0.866$, two-sided) for the no loss and $\chi^2 = 0.111$ ($p = 0.111$) for the low loss situation. In addition, when comparing behavior for periods 3-5 in the low loss situation, we also find no significant treatment effects. Thus, in our experiment subjects seem not to consider the bonus-malus scheme as unfair, as they do not take advantage of the opportunity to defraud in the last period(s).

In a second step, we examine the probabilities for committing fraud for periods 1-4 in the no loss situation (Table A4). As expected, subjects commit less fraud in the BoMa Treatment and the treatment difference is highly significant ($p < 0.021$). Although Figure 1 shows a difference in the fraud probabilities for periods 1 and 2 in the low loss situation, this difference is not statistically significant.

Result 5: *Prediction 5 is mostly confirmed. Fraud probabilities for periods 1 and 2 in the low loss situation are lower in the BoMa Treatment, but the difference is not statistically significant.*

Finally, we compare behavior in the Deduct and the BoMa Treatment. While there is a constant deductible of 5 points in the Deduct Treatment, the implicit deductible decreases in the BoMa Treatment from 9 points ($t = 1$), 6.75 points ($t = 2$) over 4.5 points ($t = 3$) to 2.25 points ($t = 4$). Although deductibles in $t = 2$ are with 5 points (Deduct Treatment) and 6.75 points (BoMa Treatment) similar and even higher in BoMa, individuals do significantly

commit less fraud in the BoMa Treatment. Table A5 in the Appendix displays the pooled random effects probit regression estimates for the Deduct and BoMa Treatment in $t = 2$.⁶

Comparing both treatments for the low loss situation in periods 1-4 suggests that there is significantly less fraud in the BoMa Treatment. This finding is in line with results from the corresponding pooled random effects probit regressions for panel data that only considers periods 1-4. Estimates for these regressions are displayed in Table A6 in the Appendix. In both regressions the dummy variables for the BoMa Treatment are negative and significant ($p < 0.000$ for no loss and $p < 0.002$ for a low loss).

Result 6: *Prediction 6 is confirmed.*

When comparing all three treatments, we find that bonus-malus contracts are not perceived as unfair as deductible contracts. Furthermore, when comparing these contracts to full insurance contracts we find that contracts with claim-dependent premiums also lead to a lower fraud extent with respect to fictitious claims. Thus, bonus-malus contracts combine the advantage of a lower net-benefit of fraud of the deductible contract and are not perceived as unfair as full coverage contracts. This contract type seems therefore to be preferable in order to reduce the extent of fraudulent claims.

6. Conclusions

The goal of our experimental study was to evaluate the impact of social norms and fairness effects on insurance fraud. Our results indicate that social norms and fairness considerably affect claiming behavior. Even if filing a fraudulent claim is a dominant strategy for selfish individuals, a significant share of people does not defraud. One important but not so surprising finding is that deductible insurance contracts are seemingly perceived as unfair, because the extent of fraudulent claims is significantly higher compared to a full insurance contract.

Our results further indicate that bonus-malus contracts with a variable claim-dependent premium are not perceived as unfair. In fact, these contracts significantly reduce the extent of fictitious claims compared to a situation with fixed premium even in those periods in which it is the dominant strategy to defraud. This effect is mainly due to the

⁶ We find similar results for $t = 3$ where the implicit deductible in the BoMa Treatment is 4.5 points and thus slightly lower than in the Deduct Treatment.

decreased net-benefit of a fraudulent claim. Most notably, this result is surprising as bonus-malus contracts with full coverage are payoff-equivalent to deductible contracts. Our analysis implies that bonus-malus contracts are a good means to reduce insurance fraud. One can presume that bonus-malus contracts reduce the net-benefit of insurance fraud, but do not imply the same negative consequences from fairness effects as equivalent deductible contracts.

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Appendix

As a dependent variable we considered the probability of committing fraud in a given period in a situation of no loss (*fraud no loss*) and low loss (*fraud low loss*). Both variables equal 1 if any kind of fraud is committed, 0 otherwise.

	Dep. variable: fraud no loss periods 1-5 (1)	Dep. variable: fraud low loss periods 1-3 (2)	Dep. variable: fraud low loss periods 3-5 (3)
Period	0.231 *** (0.057)	0.512 *** (0.188)	0.260 * (0.149)
Constant	-1.160 *** (0.237)	-2.330 *** (0.619)	-1.362 ** (0.667)
Number of observations	360	216	216
Log-Likelihood	-207	-111	-119
Wald Chi-squared	15.91 ***	7.40 ***	3.03 *

Notes: Random effects probit regression.

Table A1: Probit Estimates for the BoMa Treatment

	Dep. variable: fraud no loss (1)	Dep. variable: fraud low loss (2)
1 if Deduct Treatment	0.630 * (0.363)	1.645 ** (0.651)
Period	0.193 *** (0.048)	0.301 *** (0.061)
Constant	-0.486 * (0.290)	-1.716 *** (0.499)
Number of observations	720	720
Log-Likelihood	-354	-294
Wald Chi-squared	18.53 ***	28.30 ***

Notes: Pooled random effects probit regression.

Table A2: Probit Estimates for the Base and Deduct Treatment

	Dep. variable: fraud no loss period 5 (1)		Dep. variable: fraud low loss periods 5 (2)		Dep. variable: fraud low loss periods 3-5 (3)	
1 if BoMa Treatment	-0.143	(0.211)	0.069	(0.208)	0.088	(0.460)
Period					0.265 **	(0.115)
Constant	0.318 **	(0.150)	-0.069	(0.147)	-1.524 ***	(0.579)
Number of observations	144		144		432	
Log-Likelihood	-96		-99		-224	
LR Chi-squared	0.46		0.11			
Wald Chi-squared					5.32 *	

Notes: Pooled probit regression (column 1) and pooled random effects probit regression (column 2).

Table A3: Probit Estimates for the Base and BoMa Treatment

	Dep. variable: fraud no loss period 1-4 (1)		Dep. variable: fraud low loss periods 1-2 (2)	
1 if BoMa Treatment	-0.688 **	(0.297)	-0.485	(0.617)
Period	0.189 ***	(0.062)	0.367	(0.269)
Constant	-0.560 **	(0.261)	-1.960 ***	(0.678)
Number of observations	576		288	
Log-Likelihood	-313		-144	
Wald Chi-squared	13.93 ***		2.44	

Notes: Pooled random effects probit regression.

Table A4: Probit Estimates for the Base and BoMa Treatment

	Dep. variable: fraud no loss period 2 (1)	Dep. variable: fraud low loss period 2 (2)
1 if BoMa Treatment	-0.899 *** (0.216)	-0.648 *** (0.214)
Constant	0.430 *** (0.152)	0.139 (0.148)
Number of observations	144	144
Log-Likelihood	-90	-93
LR Chi-squared	17.73 ***	9.29 ***

Notes: Pooled probit regression.

Table A5: Probit Estimates for the Deduct and BoMa Treatment (t=2)

	Dep. variable: fraud no loss periods 1-4 (1)	Dep. variable: fraud low loss periods 1-4 (2)
1 if BoMa Treatment	-1.440 *** (0.332)	-1.656 *** (0.536)
Period	0.132 ** (0.064)	0.328 *** (0.080)
Constant	0.314 (0.276)	-0.336 (0.409)
Number of observations	576	576
Log-Likelihood	-300	-261
Wald Chi-squared	22.22 ***	23.98 ***

Notes: Pooled random effects probit regression.

Table A6: Probit Estimates for the Deduct and BoMa Treatment (t=1-4)