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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 how 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, with no psychological costs of committing fraud. While some people always commit fraud, a substantial share of people only occasionally or never defraud. In addition, we find that deductible contracts may be perceived as unfair and thus increase the extent of claim build-up compared to full coverage contracts. In contrast, bonus-malus contracts with variable insurance premiums significantly reduce the filing of fictitious claims compared to both full coverage and deductible contracts. This reduction cannot be explained by monetary incentives. Our results indicate that contract design significantly affects psychological costs and, consequently, the extent of fraudulent behavior of policyholders.

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Key words: insurance fraud, experiment, fairness, contract design, deductible, bonus-malus

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1 Introduction

Practitioners and theorists commonly agree that fraudulent behavior by policyholders is – in addition to classical adverse selection and moral hazard problems – one of the main threats for insurance companies. Important forms of insurance fraud are fictitious claims and claim build-up. People may take advantage of private information and claim losses that never occurred (fictitious claims) or exaggerate the size of an actual insured loss (claim build-up). Insurance firms take this threat very seriously as they spend much effort on fraud detection systems and claim processing (Dionne et al. 2009).[1] Because fraud is difficult to unambiguously verify ex-post, estimates of the total amount of fraud are not undisputed (Derrig, 2002). However, Caron and Dionne (1997) estimate that about 10% of all claims in the Quebec automobile insurance market can be attributed to some form of fraudulent behavior. These claims would add up to about 113.5 million Canadian dollars per year.

While the extent of fraud is hard to measure, it is even harder to examine factors that influence fraudulent behavior. However, these factors are of great importance for insurance companies in the fight against insurance fraud. Up to now, most of the theoretical research that examines optimal ways to abate insurance fraud has been based on standard economic theory. Currently, two main models are considered: Costly State Falsification (Crocker and Morgan, 1998) and Costly State Verification (Townsend, 1979; Picard, 1996). In both models, individuals are assumed to be selfish and amoral such that they only evaluate expected monetary gains and sanctions when deciding to defraud (Becker, 1968). In fact, Dionne and Gagné (2002) provide real-world evidence that the potential gains of fraudulent activities may influence behavior. They show that, in the Canadian auto insurance industry, the probability of theft for contracts with generous two-year replacement coverage is significantly higher near the end of the second year, when potential fraud gains are highest.

However, there is now a great deal of evidence that only some people behave strictly selfishly, while others consider norms or fairness (Ichino and Maggi, 2000; Fehr and Schmidt, 1999). For instance, in line with findings from Falk and Fischbacher (1999), some people would never consider engaging in illegal behavior, like insurance or tax fraud, due to

[1] 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), identify observable characteristics of fraudulent claims, which can improve the detection of insurance fraud and claim processing in general.

norms.[2] Regarding the consequences of fraudulent behavior, the results of Gneezy (2005) indicate that people do not exclusively care about their own gain from lying; they are also sensitive to the harm to others that lying causes. 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 to restore equity. Hence, norms and fairness effects might significantly affect fraudulent behavior. In the context of insurance fraud, the impacts of norms and fairness are hard to measure in the field. Consequently, analyzing these factors in the lab seems to be a promising approach. To the best of our knowledge, the present study is the first experimental work that examines factors influencing insurance fraud.

A closely related problem to the issue of insurance fraud is tax evasion.[3] For example, Alm et al. (1999) show that norms play a crucial role in tax evasion behavior and that voting on fiscal rules or communication can affect these norms. In addition, Gordon (1989) and Myles and Naylor (1996) argue that an individual can derive a psychic payoff from adhering to the standard pattern of reporting behavior in his reference group. With respect to fairness considerations, one can distinguish vertical and horizontal fairness effects. Vertical fairness effects result from individuals' beliefs that they are treated unfairly by the tax system (authority). It has been shown that people holding such beliefs are more likely to evade taxes to restore equity (Spicer and Becker, 1980). Additionally, Fortin et al. (2007) find evidence that taxpayers care about horizontal fairness when comparing their own tax burden with that of their peers. A reduction in the mean tax rate of an individual's peer group leads the individual to report lower income. Hence, perceived unfair taxation may increase tax evasion.

Our setup is closely related to public good experiments. We employ a mutual insurance framework in which participants collectively bear risk in groups. Each group member pays an insurance premium to a group account and can then claim indemnity payments from the latter. As indemnities are associated with transaction costs and both deficits and surpluses are shared equally between group members, our setup resembles a public good (bad) situation. It has been shown that social and/or internalized norms can

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

[3] See, e.g., Andreoni et al. (1998) for a review of major theoretical and empirical findings on tax evasion.

enforce cooperation in public good situations (Arrow, 1971a; Andreoni, 1990). In addition, fairness issues play a prominent role as participants do not want to be exploited by others (Falk and Fischbacher, 1999; Fehr and Gächter, 2000). Thus, non-cooperative behavior can be triggered by expectations of detrimental behavior by others.

There is some real-world evidence that fairness and norms also matter in insurance markets. As shown by Cummins and Tennyson (1996) and Tennyson (1997), claim frequencies in the US auto insurance industry are significantly related to stated attitudes towards dishonest behavior in general (norms). The overall perception of insurance institutions, which can be seen as a proxy for vertical fairness, is another influencing factor. As norms are difficult to influence, insurance-specific factors that affect vertical fairness, like contractual arrangements, are crucial for fighting insurance fraud.

In real-world insurance markets, two contractual arrangements are very common. First, deductible contracts specify a fixed amount of money that a policyholder herself must bear in the case of a loss. It can be shown that such a contract form is optimal from a risk allocation perspective in situations with symmetric information and transaction costs (Arrow, 1971b; Raviv, 1979). However, more importantly, deductible contracts have been shown to be optimal in situations with asymmetric information, like adverse selection and moral hazard (Rothschild and Stiglitz, 1976; Shavell, 1979). Second, bonus-malus contracts entail variable premiums based on past claiming behavior. Such contracts may alleviate adverse selection in a multi-period setting, give incentives for loss prevention and impede the filing of fictitious claims (Cooper and Hayes, 1987; Lemaire, 1985; Moreno et al, 2006).

With respect to the impact of these contractual arrangements on vertical fairness, to the best of our knowledge, only limited evidence with respect to deductible contracts exists. Tennyson (2002) and Miyazaki (2009) find that the deductible size negatively influences perceptions of the ethicality and fairness of the insurance arrangement and therefore increases the acceptability of claim build-up. In this respect, Dionne and Gagné (2001) estimate that, in the Canadian auto insurance industry, a deductible increase from $250 to $500 increases the average claim by 14.6%-31.8% (from $628 to $812). Their results indicate that higher deductibles increase fraudulent activities and, in particular, claim build-up. Bonus-malus contracts may also influence insured parties' fairness perception. Intuitively, these contracts could be perceived as unfair because subsequent insurance premiums are increased after a claim is made. 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.

This paper reports the results of a newly developed insurance experiment. Participants are allocated into fixed groups of four. In each of five periods, participants have to insure against potential losses. Insurance is organized in a mutual setup where premiums and indemnity payments are borne collectively by all group members. In each period, participants can freely decide to claim an indemnity irrespective of actual losses. There are no sanctions for fraudulent behavior, but due to transaction costs and the mutual insurance setup, claims negatively affect the group members' payoffs. For a selfish individual, it is rational to claim the highest possible indemnity in each period.

We performed three different treatments. In the Base Treatment, premiums only cover expected actual losses and resulting transaction costs. Available indemnities correspond to possible losses (full coverage). In the Deductible Treatment, indemnities are kept constant in comparison to the Base Treatment, but all losses are increased by a fixed amount. In the Bonus-Malus Treatment, there is full coverage, and premiums depend on prior claiming. If a claim is made, premiums are increased for all subsequent periods; otherwise, they are decreased.

In this paper, we analyze the impacts of the two main contractual insurance arrangements observed in practice. We find that deductible contracts significantly increase claim build-up. In the case of a loss, subjects seem to find it acceptable to recoup deductibles through claim inflation. In addition to this intuitive result, there is also a spill-over effect as deductible contracts also increase the filing of fictitious claims. Taken together, these results confirm that deductibles are perceived as unfair and trigger fraudulent behavior. Our second main research focus is on contracts with claiming-dependent premiums (bonus-malus schemes). In line with theoretical predictions, bonus-malus contracts significantly reduce the filing of fictitious claims in early periods. However, our most important result is that full coverage bonus-malus contracts – which entail an implicit deductible – are seemingly not perceived as unfair: In the last period, when subjects do not have to fear any future premium adjustments, behavior is not significantly different from the Base Treatment.

When addressing problems of adverse selection and moral hazard, results from one-period models suggest the use of deductibles to give policyholders optimal incentives. However, these contracts may lead to serious side effects as they can significantly increase fraudulent behavior. Our findings indicate that, due to behavioral aspects, bonus-malus contracts are superior to deductible contracts in a multi-period setting. These contracts can be designed to give the same incentives as deductibles without causing the same negative side effects. Hence, insurance companies can use bonus-malus contracts as an effective means to address adverse selection and moral hazard problems. In addition, as theoretical models suggest, bonus-malus contracts reduce the filing of fictitious claims in situations where auditing of claims is either too costly or impossible.

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 discussion, and section 6 concludes.

2 Experimental Design

In the experiment, participants are randomly and anonymously allocated into fixed groups of four. All payoffs during the experiment are calculated in the experimental currency "points". After the experiment, points are converted into Euros at the rate of 1 point to 10 cents. Each group plays five periods ($t = 1,...,T = 5$) of the following insurance game: Participants get a period endowment (*W*) and are informed that they have to insure against possible losses x_j with $j = 0, L, H$ and $x_0 = 0 < x_L < x_H$. Losses in each period are 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, in every period, each group member must 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 and equally balanced by all group members. If the insurance account has a negative balance, all group members pay the same additional contribution. On the other hand, a positive balance is equally shared by all group members.

The instructions, and therefore the whole experiment, were framed using insurance-specific wording.[4] All information was common knowledge. The instructions can be found in the Appendix.

With respect to indemnity claiming, we apply the strategy method.[5] Before knowing the actual loss realization in period *t*, each participant is asked which indemnity she is going to claim for each possible loss. In all treatments, participants can only claim one of three possible indemnities, $I_0 = 0$, $I_L = 10$, or $I_H = 15$, 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 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 $1.4 \cdot I$ for each claim. Therefore, the insurance account provides coverage against risk but is a costly means of reallocating premium and claim payments of the four group members.

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 her claiming strategy s_i^t.

Step 3: Players are informed about their 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 conducted three different treatments that are described below.

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[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 structural differences with respect to the insurance-specific wording in our Base Treatment. The respective results are available from the authors upon request.

[5] This approach goes back to Selten (1967). Participants have to state contingent responses for each information set, but only one response will result in an effective action and determine the responder's and other players' payoffs. For example, Hoffmann et al. (1998), Brandts and Charness (2000), and 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 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.

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 the higher expected losses of $0.3 \cdot 1.4 \cdot 5 = 2.1$. That is, when a loss occurs (30% of the time), this loss is 5 points higher than in the Base Treatment, and transaction costs of 40% have to be taken into account.

Finally, in the Bonus-Malus Treatment (BoMa), losses, the endowment, and indemnities are the same as in the Base Treatment $\left(x_L = 10,\ x_H = 15,\ W^t = 25,\ I_j = \{0,10,15\}\right)$. 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

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

3 Theoretical predictions

3.1 Individual treatments

In order to derive an optimal period strategy, we assume that individuals possess a non-decreasing Bernoulli utility function $u_i(\cdot) > 0$. For the Base and Deduct Treatments, behavior in period $t-1$ does not affect decision making in period t because 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 $U_i = \sum_t E[u_i^t]$.

Related experimental research, like Fischbacher and Heusi (2008), 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 individual according to 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 occur if the individual defrauds, so we define

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

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, which may be correlated with unobservable individual characteristics.

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

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

where I_{-i}^t denotes the expected indemnity payments claimed by all other group members except for individual *i*. The individual thus receives her endowment W^t, pays the premium P^t, may incur a loss x_j^t with probability p_j, receives the indemnity $I_i^t(x_j)$ and might incur psychological costs $\kappa_{im} + \varepsilon_{it}$ for committing fraud. In addition, the effect on the insurance account has to be considered. After the last period, the individual will receive one quarter of the balance of the insurance account after all premium payments are collected and indemnities and transactions costs are paid. As all four group members pay the flat premium to the insurance account and receive one quarter of the account's balance, the insurance premium cancels out. Rearranging (3) and considering the transaction cost parameter $c = 0.4$ gives

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

In a *high loss situation*, there is no possibility to defraud, 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 file fictitious losses by claiming $I_L = 10$ or $I_H^t = 15$. Clearly, claiming I_H strictly dominates I_L because κ_{im} is independent of the claim size for $I_j > 0$. As W^t, x_j^t and $1.05 I_{-i}^t$ are independent of the individual's claiming behavior, there is no strategic interdependence between group members. Here, the optimal action of *i* depends on the individual costs κ_{im}. Consequently, an individual *i* will only make a fictitious claim if

$$0 < 0.65 I_H - \theta_i K_m - \varepsilon_{it}. \tag{5}$$

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

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

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

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

In the Base and the Deduct Treatments, the assumption $K_m > I_H$ directly implies $0 < \hat{\theta}, \tilde{\theta} < 1$. Hence, in the Base and the Deduct Treatments, 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 any fraud and would therefore choose $s_i^t(\theta_i = 1) = (I_0, I_L, I_H)\forall t$.

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 $m = Base, Deduct$. Consequently, in the Base and Deduct Treatments, the fraud probability of fictitious claims is higher than that for claim build-up $(\hat{p}_m > \tilde{p}_m)$. Furthermore, when the psychological cost parameter K_m increases, both 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 Treatments, 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 fraud probabilities are constant for all periods and higher for fictitious claims* $(\hat{p}_m > \tilde{p}_m)$*. When the psychological cost parameter* K_m *increases, the fraud probabilities decrease. 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 only be derived via backwards induction. When deciding whether or not to claim an indemnity, individuals must now 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

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

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

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

Rearranging (8) gives

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

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. For all other periods, an individual has to trade off current indemnity payments and future premium adjustments.

The net-benefit – including the effect on the insurance account – of an indemnity payment in each period is still $0.65 I_i^t\left(x_j\right) - \kappa_{im} - \varepsilon_{it}$. 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

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

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 makes a fictitious claim if

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

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

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

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

In the *low loss situation*, an individual may only engage in claim build-up by filing I_H, but she can also either claim I_L or I_0. In the latter two cases, there are no psychological costs. It can be shown that individuals may prefer claiming I_0 instead of I_L for $t \leq 2$. Therefore, underreporting may be relevant for the first two periods. Such a so-called "bonus hunger-strategy" in bonus-malus systems is well-known in insurance markets (Nini, 2009). Here, individuals do not report (low) losses 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

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

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

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

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

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

As before, in the BoMa Treatment, an individual without any psychological costs $\left(\theta_i = 0\right)$ maximizes her expected utility by choosing $s^t_i\left(\theta_i = 0\right) = \left(I_H, I_H, I_H\right)\forall t$. 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 probability of fictitious claims* $(\hat{p}_{BoMa}^t)$ *is increasing. In the low loss situation, the probability of claim build-up* $(\tilde{p}_{BoMa}^t)$ *increases in the first three periods and is subsequently constant. For* $K_{Base} = K_{BoMa}$, *we get* $\hat{p}_{BoMa}^{t\leq 4} < \hat{p}_{Base}$, $\hat{p}_{BoMa}^{t=5} = \hat{p}_{Base}$, $\tilde{p}_{BoMa}^{t\leq 2} < \tilde{p}_{Base}$ *and* $\tilde{p}_{BoMa}^{t\geq 3} = \tilde{p}_{Base}$.

Given Propositions 1 and 2, we derive the following general predictions for our experiment.

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 Treatment, the probability of fictitious claims is higher than that of claim build-up.*

Prediction 3: *In the BoMa Treatment, the probability of fictitious claims is increasing. The probability of claim build-up is only increasing for the first three periods and subsequently constant.*

3.2 Predictions for 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 do not have any 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 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. Dionne and Gagné (2001) show that simple deductible contracts may create additional incentives for filing fraudulent claims. In addition, a survey by 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 for all losses in an insurance relationship.

Given these results, it is straightforward to assume the psychological cost parameter of committing fraud to be generally lower in the Deductible Treatment $\left(K_{Deduct} < K_{Base}\right)$. 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 situations. The psychological effect of the Deductible Treatment may be more pronounced for the low loss situation. Here especially, the deductible may be perceived as unfair because individuals are not totally reimbursed for an honest claim.

Prediction 4: *The probabilities both for claim build-up and fictitious losses are significantly higher in the Deductible Treatment than in the Base Treatment.*

With respect to Proposition 1 and Prediction 2, one could expect that differences between the two fraud probabilities should also be significant in the Deductible Treatment. However, due to fairness effects resulting from the deductible, we expect the psychological costs for claim build-up to be lower compared to fictitious claims such that the effect on the difference is ambiguous.

3.2.2 Bonus-Malus Treatment

Moreno et al. (2006) show that bonus-malus contracts may provide significant incentives against insurance fraud in a multi-period model. One main question in the BoMa Treatment is whether or not monetary rewards and punishments reduce the probability of fictitious claims, although the contracts are not incentive compatible in the sense that rational individuals with no 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, no evidence exists about fairness aspects of bonus-malus contracts. 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 be no 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 claim build-up in $t \geq 3$. However, if $K_{BoMa} < K_{Base}$, individuals perceive the bonus-malus contract as unfair, and the probability of claim build-up 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 indicates whether or not bonus-malus contracts are perceived as unfair. Given the lack of evidence for such fairness effects, we do not expect to find any differences.

Prediction 5: *In the Bonus-Malus Treatment, behavior in* $t = 5$ *is not significantly different compared to the Base Treatment. In addition, the probability of claim build-up in* $t \geq 3$ *is also not significantly different. All other fraud probabilities (for fictitious claims in* $t \leq 4$*, for build-up in* $t \leq 2$*) 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 in time *t* 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 increased by 2 points for one period if a claim is made or decreased by 1 point otherwise, and one fourth of each bonus-malus payment will later be reimbursed through the group account.

Accordingly, implicit deductibles for the other periods are: 4.5 points ($t=3$), 6.75 points ($t=2$) and 9 points ($t=1$).

During periods $t \le 4$, there is a strictly positive implicit deductible, and in $t=5$, there is full coverage. As monetary incentives in the BoMa and Deduct Treatments 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 that 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 be valid when $t \le 4$.

Prediction 6: *In the Bonus-Malus Treatment, the probability of fictitious claims is significantly lower in* $t=2$*, and more generally when* $t \le 4$*, than in the corresponding periods of the Deductible Treatment.*

3.3 Control variables

In a questionnaire after the experiment, several questions concerning the participants' gender, general risk attitude, insurance experience (measured by the number of actual insurance contracts they have), and major were asked. These variables are controlled for in our empirical analysis. Prior studies offer some evidence of the impact of these variables on fraudulent behavior.

First of all, in economic experiments, women often behave significantly differently than men (Croson and Gneezy, 2009). Tennyson (2002) reports that women are less likely to accept fraudulent behavior. More specifically, Dean (2004) finds that women find claim build-up less ethical. Both studies indicate that women should both file fewer fictitious claims and engage less in claim build-up. Additionally, Tennyson (2002) also finds that questionnaire respondents with more insurance experience (more policies and more claims) are less accepting of insurance fraud. As we only asked about the number of insurance policies held by each participant, we would expect that people with a higher number of contracts commit less fraud.

In line with Dohmen et al. (2009), we asked participants about their general willingness to take risk. As shown by these authors, this method is a good predictor of risky behavior and respondents' risk attitudes. Croson and Gneezy (2009) report that women are generally less willing to take risks. However, based on our theoretical model above, we do not expect any significant impact of the willingness to take risks on fraudulent behavior. However, findings from Gosh and Crain (1995) indicate that risk attitudes and ethical standards are correlated such that less risk-averse people have lower ethical standards. Consequently, fraud probabilities may increase in the willingness to take risk. Finally, students with a business or economics major have been shown to behave less pro-socially (Frey and Meier, 2004) and more corruptly in experimental settings (Frank and Schulze, 2000) than students with other majors. Consequently, we expect that economics and business students are more likely to commit insurance fraud.

4 Subjects

All computerized experiments were conducted between March and July 2009 at the MELESSA laboratory of the Ludwig-Maximilians-University (LMU) in Munich, Germany. Recruitment was done using the ORSEE system (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 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 is 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 deviations in parentheses)

5 Results

First, we present some general results of the experiment. Figures 1 and 2 show the probabilities of fictitious claims and claim build-up, respectively, per period and treatment.

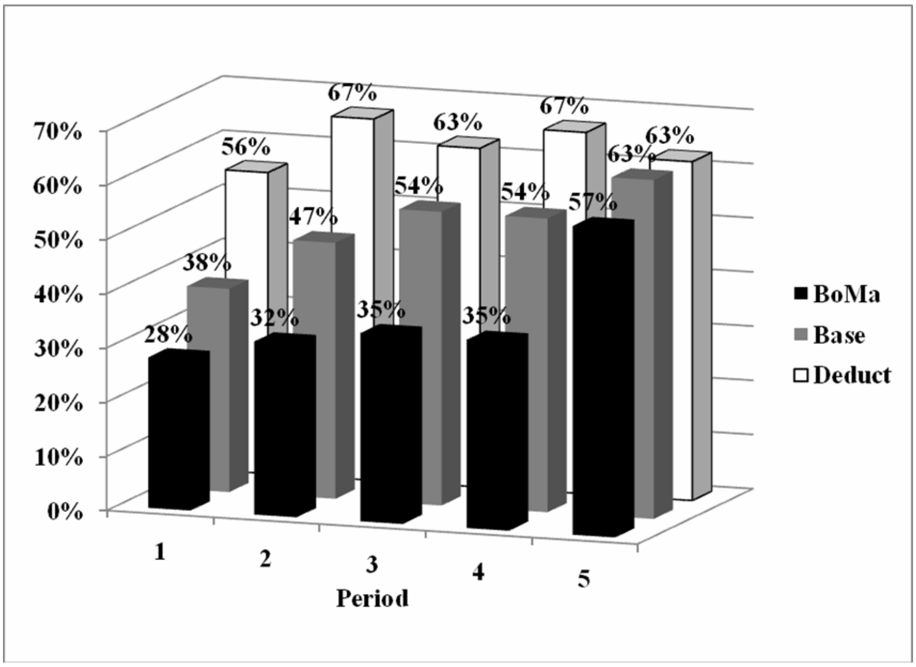

Figure 1: Fictitious claims per period and treatment

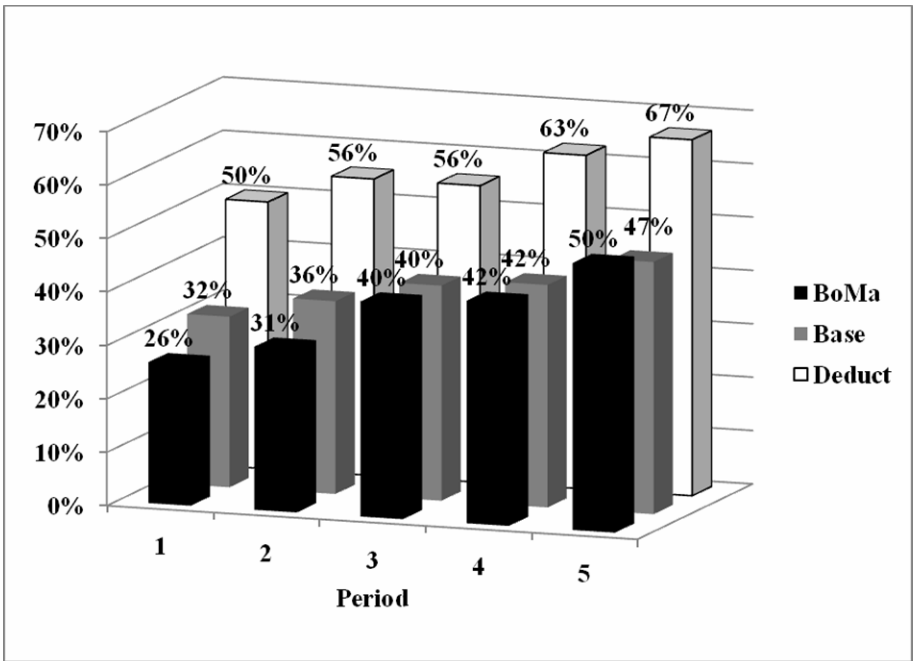

Figure 2: Claim build-up per period and treatment

Figure 3 presents a summary of behavior per treatment over all periods.

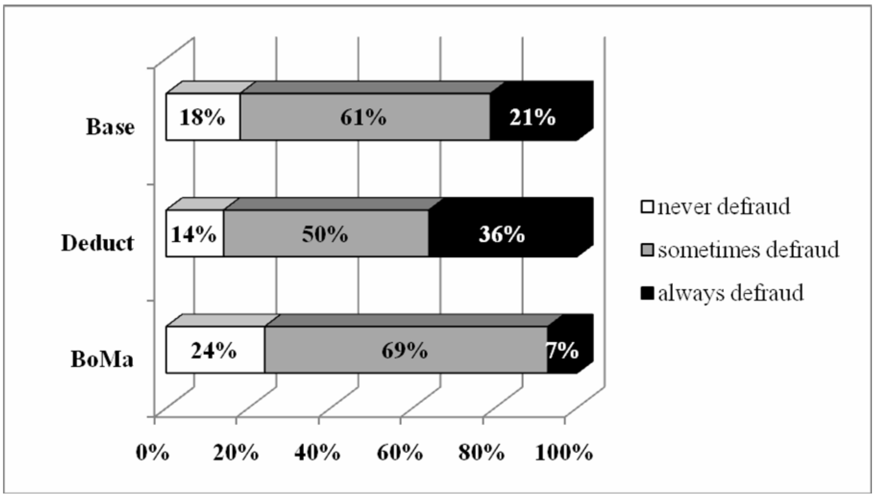

Figure 3: Fraudulent behavior per treatment

In each period, subjects have two possible ways 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. The remaining 50% to 69% of subjects only sometimes commit fraud. This finding confirms Prediction 1.

Result 1: *Prediction 1 is confirmed.*

In the Base Treatment, we expected to find a higher probability of fictitious claims than of claim build-up. Comparing the respective fraud probabilities for all periods of 51% (fictitious claims) and 39% (build-up) gives some evidence for a significant difference between the two. A Pearson's chi-square test shows that the difference is statistically significant, $\chi^2 = 9.888$ ($p = 0.002$, two-sided).

Result 2: *Prediction 2 is confirmed.*

Visual inspection of Figures 1 and 2 reveals that both fraud probabilities are generally increasing over time. Even though there is no feedback in our Base Treatment, subjects tend to commit more fraud in later periods. This behavior is in contrast to Proposition 1. However, it is a common finding in experiments. For example, Fischbacher and Heusi (2008) find that participants who took part in their experiment a second time lied more often than they did the first time. More generally, Sonnemans et al. (1998) show in their public bad experiment that cooperative behavior declines over time.

For the BoMa Treatment, we expect that the probability of fictitious claims is increasing. In addition, the probability of claim build-up is expected to increase only for the first three periods and then subsequently be constant. As Figure 1 shows, the positive period effect in the no loss situation is mainly driven by the last period. A random effects logit regression (Table A1, column 1) shows a highly significant period effect for periods 1-5. However, when considering only periods $t \leq 4$, it can be shown that this effect is no longer significant. This result indicates that – irrespective of the potential gain from fraudulent behavior – premium adjustments have a significant deterrent effect on the filing of fictitious claims. 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 $t \leq 3$, there is a significantly positive period effect ($p < 0.008$). Although the period effect is weakly significant for $t \geq 4$ ($p < 0.085$), the overall regression results are no longer significant.

Result 3: *Prediction 3 is mostly confirmed. In the BoMa Treatment, the probability of fictitious claims is only increasing between periods 4 and 5. The probability of claim build-up is, as predicted, only significantly increasing for the first three periods.*

When comparing behavior in the Base and the Deduct Treatments, Figure 2 shows that, for all periods, people commit less fraud in the Base Treatment. In order to assess the significance of these differences, we conducted a pooled random effects logit regression for panel data. Our regression results (Table A2) show that, in the build-up regression, the dummy for the Deductible Treatment is significant ($p < 0.042$). For the filing of fictitious claims, results are weaker. The treatment dummy is only significant for $t \leq 4$ ($p < 0.074$).

Result 4: *Prediction 4 is mostly confirmed. In the Deductible Treatment, the probability of claim build-up is significantly higher than in the Base Treatment. The probability of fictitious claims is only higher when considering the first four periods.*

Subsequently, we want to check whether or not participants might perceive the BoMa arrangement as unfair and choose to retaliate. Therefore, we compare claiming behavior in the Base and BoMa Treatments 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 committing fraud. The estimates of the pooled random effects logit regression are displayed in Table A3, columns 1 and 2, in the Appendix. We find no significant differences between treatments. In addition, when comparing the build-up behavior for periods $t \geq 3$ (Table A3, columns 3), 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 retaliate by committing fraud in the last period(s).

In a second step, we examine the probabilities of filing fictitious claims in periods $t \leq 4$ (Table A4). As expected, subjects file fewer fictitious claims in the BoMa Treatment, and the treatment difference is highly significant ($p < 0.014$). Although Figure 1 shows a difference in the probabilities of claim build-up for $t \leq 2$, this difference is not statistically significant.

Result 5: *Prediction 5 is mostly confirmed. Behavior in t=5 is not significantly different between the Bonus-Malus and the Base Treatments. For $t \geq 3$, probabilities of claim build-up are also not significantly different. For $t \leq 4$, probabilities for fictitious claims are significantly lower in the BoMa Treatment. However, for $t \leq 2$, probabilities for claim build-up are lower in the BoMa Treatment, but the difference is not statistically significant.*

Finally, we compare behavior in the Deduct and the BoMa Treatments. 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) to 6.75 points (t = 2), 4.5 points (t = 3) and finally 2.25 points (t = 4). Although the deductibles in t = 2 are at 5 points (Deduct Treatment) and 6.75 points (BoMa Treatment), similar - and even higher in the BoMa Treatment - individuals commit significantly less fraud in the BoMa Treatment. Table A5 in the Appendix displays the pooled random effects logit regression estimates for the Deduct and BoMa Treatments in t = 2.[6]

Comparing both treatments for $t \leq 4$ suggests that there is significantly less claim build-up in the BoMa Treatment. 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 fictitious claims and $p < 0.011$ for build-up).

[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.

Result 6: *Prediction 6 is confirmed.*

When comparing all three treatments, we find that bonus-malus contracts are seemingly not perceived as being 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 compared to full coverage contracts with fixed premiums and are perceived as less unfair than deductible contracts. This contract type therefore seems to be preferable to reduce the extent of fraudulent claims.

6 Conclusions

The goal of our experimental study was to evaluate the impact of contractual arrangements on insurance fraud. Our results indicate that contract design may affect claiming behavior considerably. Even if filing a fraudulent claim is a dominant strategy for selfish individuals, a significant share of people does not defraud. One important 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 seemingly not perceived as unfair. In fact, these contracts significantly reduce the extent of fictitious claims compared to a situation with fixed premiums. This effect is mainly due to the decreased net benefit of a fraudulent claim. Most notably, the fraud-reducing effect of bonus-malus contracts with full coverage is surprising from a theoretical point of view as these contracts are payoff-equivalent to deductible contracts. Our analysis implies that bonus-malus contracts are a good means of reducing the filing of fictitious claims. One can presume that bonus-malus contracts reduce monetary fraud benefits but do not imply the same negative consequences from fairness effects as equivalent deductible contracts.

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Appendix

The probabilities of filing a fictitious claim (in the state of no loss) or engaging in claim build-up (in the state of a low loss) are considered as the dependent variables. Both variables equal 1 if that specific kind of fraud is committed and 0 otherwise.

	Dep. variable: fictitious claim, periods 1-5 (1)			**Dep. variable: claim build-up, periods 1-3** (2)			**Dep. variable: claim build-up, periods 3-5** (3)		
Period	0.399	***	(0.101)	0.896	***	(0.339)	0.452	*	(0.262)
Gender (Female = 1)	-0.611		(0.499)	-1.444		(1.267)	-1.383		(0.970)
Risk	0.205		(0.154)	0.033		(0.380)	-0.163		(0.296)
Econ or business major	1.971	**	(0.882)	4.671	**	(2.315)	3.051	*	(1.731)
Insurance contracts	0.086		(0.202)	0.051		(0.502)	0.412		(0.394)
Constant	-2.374	***	(0.756)	-3.579	*	(1.906))	-1.645		(1.661)
Number of observations	360			216			216		
Log-likelihood	-202			-98			-116		
Wald chi-squared	22.73	***		10.94	**		8.29		

Notes: Random effects logit regression.

Table A1: Logit Estimates for the BoMa Treatment

	Dep. variable: fictitious claim, periods 1-5 (1)			**Dep. variable: fictitious claim, periods 1-4** (2)			**Dep. variable: claim build-up, periods 1-5** (3)		
Treatment (Deduct = 1)	0.754		(0.593)	1.169	*	(0.653)	2.068	**	(1.015)
Period	0.337	***	(0.085)	0.434	***	(0.124)	0.531	***	(0.111)
Gender (Female = 1)	-1.256	*	(0.641)	-1.467	**	(0.703)	-0.201		(1.070)
Risk	0.602	***	(0.209)	0.633	***	(0.230)	0.963	***	(0.347)
Econ or business major	0.759		(0.863)	0.843		(0.945)	2.501	*	(1.332)
Insurance contracts	-0.631	***	(0.230)	-0.734	***	(0.258)	-0.169		(0.387)
Constant	-1.004		(0.867)	-1.277		(0.960)	-5.387	***	(1.521)
Number of observations	720			576			720		
Log-likelihood	-342			-277			-289		
Wald chi-squared	36.49	***		33.28	***		37.79	***	

Notes: Pooled random effects logit regression.

Table A2: Logit Estimates for the Base and Deduct Treatments

	Dep. variable: fictitious claim, period 5 (1)			**Dep. variable: claim build-up, period 5** (2)			**Dep. variable: claim build-up, periods 3-5** (3)		
Treatment (BoMa = 1)	-0.250		(0.343)	0.137		(0.338)	0.205		(0.787)
Period							0.462	**	(0.203)
Gender (Female = 1)	0.115		(0.370)	-0.129		(0.364)	-0.405		(0.860)
Risk	0.108		(0.120)	0.041		(0.118)	0.220		(0.277)
Econ or business major	0.323		(0.654)	0.471		(0.628)	1.602		(1.499)
Insurance contracts	-0.074		(0.141)	0.196		(0.143)	0.283		(0.331)
Constant	0.221		(0.512)	-0.400		(0.507)	-3.443	**	(1.484)
Number of observations	144			144			432		
Log-likelihood	-96			-98			-222		
LR chi-squared	1.79			2.97					
Wald chi-squared							7.94		

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

Table A3: Logit Estimates for the Base and BoMa Treatments

	Dep. variable: fictitious claim, periods 1-4 (1)			**Dep. variable: claim build-up, periods 1-2** (2)		
Treatment (BoMA = 1)	-1.213	**	(0.493)	-0.854		(0.985)
Period	0.327	***	(0.109)	0.627		(0.470)
Gender (Female = 1)	-0.916	*	(0.522)	-0.515		(1.094)
Risk	0.345	**	(0.169)	0.613	*	(0.358)
Econ or business major	1.242		(0.903)	2.691		(2.255)
Insurance contracts	-0.148		(0.205)	-0.376		(0.410)
Constant	-1.226		(0.766)	-4.418	**	(1.749)
Number of observations	576			288		
Log-likelihood	-308			-141		
Wald chi-squared	23.39	***		8.42		

Notes: Pooled random effects logit regression.

Table A4: Logit Estimates for the Base and BoMa Treatments

	Dep. variable: fictitious claim, period 2 (1)			Dep. variable: claim build-up, period 2 (2)		
Treatment (BoMa = 1)	-1.460	***	(0.382)	-0.932	***	(0.362)
Gender (Female = 1)	-0.528		(0.407)	-0.350		(0.390)
Risk	0.230	*	(0.128)	-0.012		(0.122)
Econ or business major	0.371		(0.547)	0.963	*	(0.522)
Insurance contracts	-0.327	**	(0.159)	-0.079		(0.145)
Constant	0.690		(0.597)	0.361		(0.575)
Number of observations	144			144		
Log-likelihood	-84			-90		
LR chi-squared	30.13	***		15.65	***	

Notes: Pooled logit regression.

Table A5: Logit Estimates for the Deduct and BoMa Treatments (t=2)

	Dep. variable: fictitious claim, periods 1-4 (1)			Dep. variable: claim build-up, periods 1-4 (2)		
Treatment (BoMa = 1)	-2.047	***	(0.525)	-2.141	**	(0.844)
Period	0.232	**	(0.112)	0.581	***	(0.144)
Gender (Female = 1)	-1.412	***	(0.546)	-1.623	*	(0.896)
Risk	0.457	***	(0.171)	0.209		(0.274)
Econ or business major	1.728	**	(0.752)	3.351	***	(1.182)
Insurance contracts	-0.310		(0.198)	-0.014		(0.334)
Constant	-0.002		(0.833)	-1.037		(1.374)
Number of observations	576			576		
Log-likelihood	-285			-254		
Wald chi-squared	40.25	***		36.14	***	

Notes: Pooled random effects logit regression.

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

General instructions (all instructions translated from German)

Welcome to the experiment. Please read through the instructions carefully. They are identical for all participants. In this experiment, you and the other participants have to make decisions. At the end of the experiment, you will receive a payment depending on your own decisions and the decisions of the other participants. In addition, you will receive a fixed show-up fee of 4 Euro.

During the whole experiment, you may not talk to other participants, use your mobile phone, or start any programs on the computer. Should you break this rule, we unfortunately have to exclude you from the experiment and from receiving any payments. Whenever you have a question, please raise your hand. The experimenter will come to your seat to answer your question. If the question is relevant for all participants, the experimenter will repeat the question and answer it aloud.

During the experiment, we calculate payments in points instead of Euros. At the end of the experiment, the total number of points will be converted into Euros at the rate of 10 points = 1 Euro. Before we start the experiment, you will have to answer 6 written questions regarding the experiment to make sure that you correctly understand the instructions.

The experiment is confidential, meaning that no other participant will receive any information regarding your answers, decisions, or final payment.

The experiment consists of two parts: In the first part, you will have to make decisions that will determine your success in the experiment and, consequently, your final payment. In the second part, you will have to answer several questions that have no influence on your success in the experiment. Your answers to these questions will be treated as strictly confidential.

Specific instructions [D: Deductible Treatment; B: Bonus-Malus Treatment]

The experiment consists of 5 periods. Before period 1, you will be randomly and anonymously allocated into fixed groups of four. The group composition remains unchanged during the whole experiment.

At the beginning of each period, each participant receives an endowment of 25 [Deduct: 27] points, thus totaling 125 [D: 135] points over 5 periods. In each period, each participant runs the risk of losing a part of his or her endowment. The following losses can occur with the following probabilities in each period:

Loss	**Probability**
0 points (no loss)	70 %
10 [D: 15] points (low loss)	20 %
15 [D: 20] points (high loss)	10 %

In each period, given the above probabilities, a computer randomly determines for each participant independently if any of the above losses occurs. The amounts of the potential losses and the probabilities remain constant over all periods. Your decisions or losses in earlier periods thus have no influence on the probabilities or the amounts of future losses.

In order to compensate for potential losses, the 4 group members together build a mutual insurance group. This setup implies that each group member at the beginning of each period automatically pays an insurance premium of 5 points [BoMa: no points mentioned here] on a joint group account ("insurance account").

In order to receive payments from the insurance account, group members can retrieve indemnities from the insurance account. [D: There is a deductible of 5 points.] Each group member only has the possibility to retrieve 0 points, 10 points or 15 points from the insurance account. If a group member retrieves an indemnity, he or she receives the corresponding amount from the insurance account. The other group members have no influence on this payment; it will be made automatically.

[BoMa: The insurance premium of each participant is 5 points in the first period. The insurance premium in periods 2-5 is dependent on whether indemnities have been retrieved in earlier periods. If, in a given period, an indemnity is retrieved from the insurance account, then the insurance premium in the next period increases by 2 points. If no indemnity is retrieved, the insurance premium in the next period decreases by 1 point. The following table summarizes this relation for the first 3 periods:

<table>
<tr><th colspan="2">Period 1</th><th colspan="2">Period 2</th><th colspan="2">Period 3</th><th>…</th></tr>
<tr><th>Premium</th><th>Indemnity</th><th>Premium</th><th>Indemnity</th><th>Premium</th><th>…</th><th>…</th></tr>
<tr><td rowspan="4">5 points</td><td rowspan="2">yes</td><td rowspan="2">7 points</td><td>yes</td><td>9 points</td><td>…</td><td>…</td></tr>
<tr><td>no</td><td>6 points</td><td>…</td><td>…</td></tr>
<tr><td rowspan="2">no</td><td rowspan="2">4 points</td><td>yes</td><td>6 points</td><td>…</td><td>…</td></tr>
<tr><td>no</td><td>3 points</td><td>…</td><td>…</td></tr>
</table>

end of insertion for BoMa]

Any indemnity payment from the insurance account results in additional transaction costs of 40 percent. Therefore, if a group member retrieves an indemnity of 10 points, the insurance account will be debited with 4 additional points (14 points overall). If 15 points are retrieved, the insurance account will be debited with 6 additional points. The following table summarizes this relation:

Retrieved indemnity	**Transaction costs**	**Total debit to the insurance account**
0 points	0 points	0 points
10 points	4 points	14 points
15 points	6 points	21 points

Potential credit and debit balances of the insurance account are summed up over all 5 periods. During the experiment, you will receive no information regarding the balance of the insurance account. After the last period, the insurance account is automatically and equally balanced by all group members. If the insurance account has a negative balance, each group member has to pay one fourth of the balance from his or her winnings up to that point. On the other hand, if the insurance account has a positive balance, each group member receives one fourth of the balance in addition to his or her winnings up to this point.

The timing of your decisions in each period is as follows:

Step 1: At the beginning of each period, you receive your period endowment of 25 [D: 27] points.

Step 2: You must acknowledge the payment of the insurance premium of 5 points [B: no points mentioned] to the insurance account.

Step 3: You will make 3 decisions in each period: For each potential loss situation, you will have to decide how many points you will retrieve from the insurance account. Thus, for a situation in which you have not incurred a loss, you have to decide whether you want to retrieve 0 points, 10 points, or 15 points from the insurance account. You must make the same decision twice more for the situations in which you have incurred a low loss or a high loss, respectively.

Step 4: Only after you have made all three decisions will you find out whether you have indeed incurred a loss in this period. If you have incurred a loss, you will also learn whether it was a low or a high loss. You will then automatically receive the indemnity from the insurance account that you requested in step 3 for this particular situation. [B: If an indemnity is retrieved from the insurance account in this period, then the insurance premium in the next period increases by 2 points. If no indemnity is retrieved, the insurance premium in the next period decreases by 1 point.]

After the last period, the second part of the experiment will start, and you will have to answer several questions. After you have filled in the questionnaire on the computer, you will receive detailed information regarding the balance of the insurance account, your earned points and your payment in Euros.

Please pack up your personal belongings after the experiment and sit quietly in your seat. We will call you in a random order to collect your payment outside the lab room. Thank you for your participation.

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