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Wirtschaftswissenschaftliche Fakultät

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Diskussionsbeitrag Nr. B-43-20

Betriebswirtschaftliche Reihe ISSN 1435-3539

PASSAUER DISKUSSIONSPAPIERE

Herausgeber:
Die Gruppe der betriebswirtschaftlichen Professoren
der Wirtschaftswissenschaftlichen Fakultät
der Universität Passau
94030 Passau

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Framing and Loss Aversion in Tax Reporting Behavior – Evidence from German Income Tax Return Data

Markus Diller Daniela Kühne

This paper investigates the presence of framing effects and loss aversion in tax reporting behavior of wage earners using a balanced panel of German income tax return data. Reference dependence and loss aversion suggest that individuals in a perceived loss situation attribute higher value to a given amount of positive change in outcome than individuals in a perceived gain situation do. Applied to tax reporting behavior, taxpayers who perceive their tax situation as unfavorable compared to a given reference point are expected to make greater effort or accept higher costs to prevent or reduce that perceived loss than taxpayers perceiving themselves to be in a favorable situation. Greater effort can in turn be associated with higher reporting aggressiveness. We identify a potential reference point in taxpayers' previous year's outcome and examine whether taxpayers claim higher additional tax deductions in a loss situation than in a gain situation. We use a difference-in-difference approach with a one-on-one matching strategy to analyze reporting behavior. We find that taxpayers in a loss situation claim higher income-related deductions than taxpayers in a gain situation.

Keywords: loss aversion, framing, tax avoidance, nonbusiness tax

JEL classification: D91, H24, H26

1 Introduction

According to the predictions of expected utility theory, the presentation of an item of information will not influence taxpayers' reporting decisions as it has no impact on the expected utility of potential outcomes. However, prior tax compliance research suggests that taxpayers frame their tax filings as gains or losses compared to a given reference point. Empirical findings investigating framing effects in reporting behavior indicate that taxpayers in a loss situation adopt riskier filing options than taxpayers in a gain situation. The phenomenon has important policy implications, as risk-seeking filing behavior is associated with tax aggressiveness, which in turn means (on average) less compliant tax returns (Dusenbury, 1994).

The objective of this paper is to empirically investigate whether framing and loss aversion affect the reporting behavior of employees using German income tax return data. Contrary to most prior archival studies, we do not investigate differences in compliance but aim at identifying the influence of framing and loss aversion on line items of a tax return assumed to be open to tax planning or tax avoidance activities, the degree of which may be varied according to the attempt to lower the tax burden. As wage tax is withheld from income from employment, wage-earning taxpayers have virtually no opportunity to legally alter taxable income on the revenue side. A reduction in the tax burden is therefore mostly achieved by an increase in deductions. We focus on the sum of two line items of the tax return referred to as "working materials" and "other expenses related to income from employment", which are assumed to be used by taxpayers to lower their tax burden. We investigate whether taxpayers in an unfavorable situation claim higher amounts of these deductions in order to lower their perceived loss. Our empirical investigation is based on a 5% stratified random sample of the *German Taxpayer Panel* containing information on German taxpayers for the years 2005 to 2010. We make use of a difference-in-difference approach with a one-on-one matching strategy in order to estimate the treatment effect of a loss situation.

The remainder of the paper is organized as follows. Section 2 presents prior research on framing effects and loss aversion in tax compliance behavior. Section 3 identifies gain and loss situations, illustrates taxpayers' options to react through tax planning or tax avoidance and derives the hypothesis. In Section 4 we describe the underlying data set and explain necessary changes leading to the sub-samples used for the analysis. Section 5 presents the empirical design and analyzes the level of additional income-related deductions depending on taxpayers' situations, and aims at providing explanations and interpretation of the results. Several robustness checks aim at providing additional support for our main results suggesting the existence of framing and loss aversion in taxpayers' behavior. Section 6 concludes.

2 Reference Dependence and Loss Aversion in Tax Reporting Behavior

Standard theories of taxpayer compliance behavior suggest that taxpayers behave rationally when making reporting decisions. When deciding whether to take an illegal deduction or not, taxpayers are expected to weigh the tax reduction against the probability of audit and the penalty rate. The decision to engage in tax planning or tax avoidance may as well be considered as a cost-benefit calculation, where the tax saving is weighted against the effort that needs to be made in order to take the legal deduction (recordkeeping, form filing, etc.) (Rees-Jones, 2017). Hence, according to standard economic theory, one would expect that two similar taxpayers who are supposed to pay the same amount of tax show similar reporting behavior. But, several archival and experimental contributions in the area of tax compliance suggest that taxpayers use frames when making their reporting decision. The concept of framing (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981) implies that reactions in a given situation differ depending on the presentation of the decision problem, i.e. whether the framed situation appears in a positive or negative light. Frames in the context of tax compliance may, for example, be attitudes towards taxation (such as norms or social comparisons, feeling of fairness or feeling of government waste, less consumption or contribution to public goods), but they may also provide reference points of outcome, which

help to evaluate financial consequences of decision alternatives (Carroll, 1987). Reference dependence is, in turn, one of the central characteristics of prospect theory (Kahneman & Tversky, 1979): Whereas in expected utility theory, decisions are based on the final wealth state, in prospect theory, the carriers of utility are the changes in outcome, i.e. gains or losses compared to the reference point. That means that the reactions of the two taxpayers mentioned above may differ if one of them perceives themselves to be in a loss situation whereas the other one considers themselves to be in a gain situation.

Besides reference dependence, prospect theory assumes loss aversion, i.e. negative outcomes compared to the reference outcome are weighted more heavily than corresponding positive outcomes. Loss aversion provides an explanation for the observation of endowment effects, which means that individuals adapt to the ownership of a good and experience higher loss of utility when giving up the good than benefit when obtaining it (Kahneman, Knetsch, & Thaler, 1990). Individuals thus invest more energy in avoiding losses than in obtaining gains, as additional gains in the gain domain do not provide the same marginal value as the same amount of a reduction in loss. Whereas standard prospect theory presents a descriptive model of decision-making in risky settings, Tversky and Kahneman (1991) show that reference dependence and loss aversion can also be observed in risk-free settings.

In the context of tax reporting behavior, loss aversion means that taxpayers in a loss situation attribute higher additional value to a favorable change in outcome of a given amount (where outcome may be the amount of tax payable, tax refund, taxable income, etc.) than taxpayers in a gain situation do. Clotfelter (1983a) was the first to draw attention to the observation that taxpayers behave differently depending on whether they are entitled to a refund or have an additional tax payment due at year-end using real-world data. He found that taxpayers who are underwithheld tended to evade more than taxpayers who are overwithheld. Cox and Plumley (1988) find that compliance rates increase with the resulting amount of refund and decrease with increasing amounts of tax payable (cited in Yaniv, 1999). The so-called "withholding phenomenon" is found both for employees and entrepreneurs (cited in Webley, Robben, Elffers, & Hessing, 1991). Chang

and Schultz (1990) also find supporting evidence for the existence of the withholding phenomenon, holding for different filing statuses, income levels and sources of income. Engström, Nordblom, Ohlsson, and Persson (2015) investigate tax returns of Swedish taxpayers using a preliminary balance of zero as the reference point. They find a strong relationship between a preliminary deficit and the probability of claiming potentially dubious deductions called "other expenses for earning employment income".

Several theoretical studies integrated the properties of prospect theory into models of tax evasion (e.g., Elffers & Hessing, 1997; Yaniv, 1999; Bernasconi & Zanardi, 2004; Dhami & al-Nowaihi, 2007). Elffers and Hessing (1997) argue that taxpayers having an additional tax payment due at year end after filing are prone to minimizing the loss by reducing their tax liability "to the verge of or just over the limit of what is permissible" (p. 291). Elffers and Hessing (1997) as well as Engström et al. (2015) argue that compliance might be increased by increasing withholding to guarantee a refund for most taxpayers and thus by deliberately putting them in a gain situation. But, Elffers and Hessing (1997) already point out that a deliberately high level of withholding tax might promote a feeling of being mistreated and thus lead to the opposite effect. Engström et al. (2015) also consider that systematic overwithholding might shift the position of the reference point from a zero preliminary balance to a positive amount of refund.

Taking into account these considerations it becomes clear that the identification of an appropriate reference point is crucial for this investigation. As prospect theory does not specify a precise position of the reference point, there is considerable scope for the potential way that taxpayers frame their reporting decision (Hashimzade, Myles, & Tran-Nam, 2013). While Kahneman and Tversky (1979) generally assume the current asset position to serve as an appropriate reference outcome, they also point out that expectations may determine or affect the position of the reference point. In the context of tax reporting, three possibilities for its location have been discussed (Schepanski & Shearer, 1995; Kirchler & Maciejovsky, 2001; Copeland & Cuccia, 2002): the current asset position, the expected asset position and expectations resulting from context-specific parameters of previous filings.

The current asset position has been defined as the financial situation of a taxpayer after advance tax payments prior to filing the tax return for a potential refund. If the current asset position serves as the reference outcome, taxpayers – after having completed all the necessary line items of their tax return – compare their tax liability to the level of prepayments. If they are entitled to a refund, they find themselves in the gain domain; if an additional payment is due, they find themselves in the loss domain. This perspective implies that taxpayers are hardly aware of their actual tax burden or the level of prepayments, but focus on the change in wealth after filing. They adapt to the current environment (Copeland & Cuccia, 2002), and taxes owed as a change from this status quo are more salient than taxes collected by being withheld at source or prepaid during the fiscal year (Chang & Schultz, 1990). Focusing on the status quo is, in general, explained by the concept of adaptation. But Copeland and Cuccia (2002) rather assume that taxpayers focus on the status quo because obtaining a refund represents a general goal for them. Several laboratory experiments investigate whether the current prepayment position serves as a reference point. Chang, Nichols, and Schultz (1987), Robben et al. (1990), Schepanski and Kelsey (1990), Webley et al. (1991), White, Harrison, and Harrell (1993), and Dusenbury (1994) all report findings consistent with the predictions of prospect theory suggesting that subjects facing an additional payment after filing behave less compliantly than subjects facing a refund. The same is true for the field-data works of Engström et al. (2015) and Rees-Jones (2017), who find behavior consistent with loss aversion around the preliminary tax balance of zero. The setting of Engström et al. (2015) even allows estimation of the coefficient of loss aversion, resulting in a value which is very close to the value estimated by Tversky and Kahneman (1992). Other studies like Schadewald (1989) and Martinez-Vazquez, Harwood, and Larkins (1992) cannot confirm the empirical observation found by Clotfelter (1983a).

It has also been investigated whether an expected asset position serves as a reference point for taxpayers. Thereby, the reference outcome has been defined as the expected asset position after filing, as opposed to the situation after deduction of wage tax. Hence, taxpayers are in a loss situation if they have an additional tax payment higher

than expected or receive a refund lower than expected. As the distribution of general expectations among taxpayers for the current year is unknown, there is, from this perspective, no reason to expect an influence of the visible parameters in tax return data on reporting behavior (Schepanski & Shearer, 1995). Schadewald (1989), Schepanski and Shearer (1995) as well as Kirchler and Maciejovsky (2001) experimentally examine which kind of framing better represents the reference point of taxpayers. While Schadewald (1989) found that neither the prepayment position nor the variance of the tax liability from expectations affects subjects' choices (cited in Dusenbury, 1994), the findings of Schepanski and Shearer (1995) indicate that the reference point is better represented by the current, rather than the expected, asset position. Kirchler and Maciejovsky (2001) find that either the current financial position or the expected financial situation may serve as a reference point: In their experimental setting, self-employed taxpayers tend to base their decisions on the current asset position, whereas business entrepreneurs tend to use the expected asset position.

It is to be noted that expectations in the experiments mentioned were introduced artificially. Copeland and Cuccia (2002) argue that subjects probably have their own expectations and consequently do not adapt to experimental manipulation. They instead assume that taxpayers with experience in filing their annual tax return have expectations regarding the cash flow consequences of the filing that results from previous years' outcomes. If expectations result from previous filings, positive or negative changes in the level of payments or refunds could affect taxpayers' reporting behavior. In this case, the level of payments or refunds of previous years may serve as a reference point. Copeland and Cuccia (2002) thus provide a third possibility for the framing of an outcome: They find that the current prepayment position and the results of prior filings jointly influence taxpayers' reporting behavior.

Investigating German taxpayers receiving income from employment, we find that a vast majority of taxpayers obtain a refund after filing. For the year 2010, the German Federal Statistical Office found that a proportion of approximately 87% of taxpayers in receipt of income from employment and capital income filing a tax return obtained

a refund.[1] An exploration of the data shows that the remaining taxpayers mostly neither obtain a refund nor have an additional payment due. In other words, an additional tax payment is extremely rare for German wage earners and only occurs in special circumstances. We thus assume that receiving a refund is considered "normal" in the public perception. Instead of focusing on the mere direction of the compensation payment, we thus expect that taxpayers quickly get accustomed to a certain level of taxes leading to a certain level of refund. In this case, expectations in the sense of prior experiences frame taxpayers' reporting decision, and previous years' level of taxes may serve as a reference point. This perspective can also be interpreted as a status quo adaptation but with a focus on previous years' outcomes. Copeland and Cuccia (2002) compare expectations regarding the current year's outcome to taxpayers' three previous filings and find a strong correlation only for the directly preceding year. Following this approach, we assume that taxpayers' expectations result from their last year's level of taxes. To our knowledge this is the first archival study of framing and loss aversion not to use the preliminary tax balance of zero as the reference point but to focus on previous year's outcome as the reference point to evaluate the current year's outcome.

3 Employees' Tax Reporting Behavior

Contrary to most prior archival studies on framing effects, we do not examine compliance rates or magnitudes of tax evasion. Instead, and like Engström et al. (2015), we investigate whether taxpayers' reactions in the sense of claiming certain kinds of deductions differ depending on their position in relation to the identified reference point. Carroll (1987, 1989) and Webley et al. (1991) describe individuals' reporting behavior as a state of relative inertia, where taxpayers tend to repeat habitual actions when filing their return. Stimuli to change are described as acute financial constraints, friend strategies and outcomes, feeling of inequity, or feelings of being mistreated, for example.

[1] https://www.destatis.de/DE/ZahlenFakten/ImFokus/OeffentlicheFinanzen-Steuern/SteuererklaerungErstattung.html.

But changes in the personal tax situation leading to negative consequences compared to the previous year may also be such a stimulus as to show a different reaction. Triggered reactions may occur either at the end of the fiscal year, when it comes to taking additional steps or increasing the effort to lower taxable income (Webley et al., 1991), or at the beginning of the subsequent year when the annual tax return must (or can) be filed. The technical process of filing a tax return in Germany suggests that a comparison between the current and last year's figures is made, as the commonly used commercial tax software products as well as the official software to file an electronic tax declaration provide forms automatically pre-filled with last year's values, which then only have to be adjusted according to the current year's situation.

Table 1 shows a simplified representation of the assessment of taxable income in Germany, to provide an overview of potential changes in the tax situation and deduction possibilities. First, the German income tax system allows the deduction of all expenses related to the corresponding income-generating activities. Tax-deductible expenses related to income from employment include the commuter allowance (costs for travelling between workplace and domicile), the double household allowance (costs of running two households necessary for employment), costs for victuals and catering (allowance to cover living expenses when travelling for work), etc. In addition, employees can deduct further costs incurred, i.e. expenditure on work-related equipment (such as specialized literature, tools, working clothes, computers, office supplies, bank account fees, etc.). Second, the German Income Tax Code allows deduction of so-called special expenses. Special expenses are incurred privately (but are mostly unavoidable) and mainly include contributions to basic health care and pension insurance, premiums on other private insurance policies, school fees, church tax paid, maintenance payments to divorced spouses and donations to charitable organizations. The third major group of deductible expenses is called exceptional costs and allows the deduction of items such as medical expenses, costs linked to a disability, and other expenses incurred for legal, moral or factual reasons.

Table 1 Representation of assessment of taxable income

	Wages (*W*)
–	Invariable income-related deductions (*ID*)
–	Additional income-related deductions (*AD*)
=	Net income from employment
+	Other income types (*OI*) (income from agriculture and forestry, income from trade and business, income from freelance work, income from renting and leasing, capital income, other income (e.g., income from private sales transactions)) (revenues less expenditure)
=	Gross income
–	Special expenses (*SE*)
–	Exceptional costs (*EC*)
=	Taxable income (*TI*)

Our objective is to study the effect of exogenous shocks worsening taxpayers' situations on their reporting behavior. Therefore, and in order to analyze potential effects in the area of deductions, it is crucial for the investigation to distinguish between components of the tax return assumed to be beyond the control of taxpayers and components that are assumed to be actively used to engage in tax planning or tax avoidance.

In the area of income-related deductions, we first distinguish between non-optional invariable income-related deductions and additional income-related expenses, whereby the latter can be varied by taxpayers – at least to a limited extent – according to their attempt to generate higher deductible expenses. Invariable income-related deductions, the existence and level of which are assumed to be exogenous, mainly consist of the commuting allowance, the double household allowance and costs for victuals and catering. The corresponding expenses are typically not located at the "business-pleasure borderline" (Clotfelter, 1983b, p. 1053) but are clearly job-related. Hence, these non-optional deductions arise from the given working situation of the taxpayers and are not assumed to be generated artificially by means of tax avoidance. (Negative) financial consequences of the existence of these expenses are expected to be more salient to taxpayers than the (positive) tax-reducing effect of their deductibility. In other words, tax avoidance activities leading to increased invariable income-

related deductions would have a greater negative utility on taxpayers' overall situation than the positive tax-reducing effect. For example, taxpayers are not assumed to move further away from their workplace simply to be able to deduct higher travelling costs. Furthermore, the legal provisions for the determination of this type of deductions mostly contain allowances (which are often subject to ceilings), and the provisions are precise and unambiguous. We thus assume that changes in the existence and level of invariable income-related deductions are exogenous.

The same rationale applies for an increase or decrease in special expenses and exceptional costs. Both arise from the invariable private situation of the taxpayer, leading to higher or lower expenses. In the area of special expenses, an exception occurs for donations to charitable organizations, the amount of which can be chosen freely by taxpayers. The legal definition of exceptional costs states that they inevitably arise to taxpayers due to adverse events or circumstances and may therefore be deducted from taxable income. It is neither possible nor desirable for taxpayers to deliberately put themselves in a situation to be able to deduct exceptional costs. However, it cannot be ruled out that deductibility of these types of expenses favors the purchasing of higher-priced products. Finally, changes in wages and changes in other income are considered as exogenous in the tax return as well. We assume that taxpayers experiencing an increase in wage or other income will primarily consider this event to be positive, i.e., the positive effect of higher after-tax income is weighted more heavily than the negative effect of the corresponding increased tax burden. A decrease of labor supply to save taxes is unlikely. Summarizing the above, we identified that an exogenously incurring loss situation may in general be due to (1) higher wages, (2) lower invariable income-related deductions, (3) lower special expenses, (4) lower exceptional costs, (5) higher income from other income sources, or to a combination of the aforementioned causes. The underlying cause of a deterioration in one of these fields may be a change in the personal situation of the taxpayer or a tax law change affecting the taxpayer.

Now turning to line items of the tax return assumed to be used by taxpayers to engage in tax planning or tax avoidance, we define additional income-related deductions as the sum of deductible expenses on

"working materials" (e.g., working tools, specialized books, trade journals or computers) and "other expenses related to income from employment". Due to the difficult differentiation between the private and the work-related life spheres, deductibility of these types of expenses is one of the most controversial fields of an employee's income tax return and leads to the most corrections (Elffers & Hessing, 1997) and legal confrontations between taxpayers and fiscal authorities (Schön, 2002). Increasing additional income-related deductions can, firstly, be achieved by engaging in tax planning activities which consist of making the effort to be aware of deduction possibilities and organizing necessary related evidence. This does not entail the risk of being corrected and punished, but it implies higher monetary and non-monetary effort on the part of the taxpayer (Rees-Jones, 2017). More aggressive approaches towards increasing deductions consist, secondly, in claiming "'gray area' deductions" (Feinstein, 1991, p. 24) that lie near the "business-pleasure borderline". These tax avoidance activities imply the risk of being corrected if deductions are actually private. Taxpayers must provide (at least upon request) documentary proof of their expenses. If no evidence is provided or if the fiscal authority argues that taxpayers' expenses are not job-related, corrections will be made. However, it is unlikely that a fine will be imposed.

Overall, we assume that all figures and line items of the tax return apart from additional deductions (and donations) are predetermined by taxpayers' individual situation and are not influenced by tax planning or tax avoidance. In other words, taxpayers comparing their current year's tax situation to previous year's situation cannot react to adverse events other than by changing the level of additional income-related deductions. We thus use the level of taxpayers' additional income-related deductions as an indicator for their reporting behavior and investigate whether they are used as a strategy to cope with negative changes in other fields of the tax return leading to a higher level of taxes.

Our objective is to investigate whether taxpayers in a loss situation are more inclined to become active compared to taxpayers in a gain situation, and thus whether taxpayers behave in accordance with reference dependence and loss aversion, which would suggest that equiv-

alent situations may lead to different behavior depending on the perception of the situation. To avoid bias from a manual recalculation of the tax liability, we use the change in taxable income to determine whether taxpayers find themselves in the gain or loss domain. We define taxable income in the previous year (t_0) TI_0 as the reference point. $\Delta TI = TI_1 - TI_0$ is the change in taxable income incurred by the taxpayer in t_1. If $\Delta TI > 0$, taxpayers are in the loss domain; if $\Delta TI \leq 0$, taxpayers are in the gain domain. We will use an adjusted level of taxable income for the analysis, i.e. the level of deducted additional income-related expenses will be added to avoid a feedback effect. We follow Engström et al. (2015) and Rees-Jones (2017) and assume a piecewise linear value function. One feature of prospect theory referred to as diminishing sensitivity is thus ignored. It assumes that the sensitivity to further changes in outcome is smaller for outcome levels lying further away from the reference point, i.e. convexity of the value function in losses and concavity in gains. The simplified piecewise linear value function is defined as:

$$V(\Delta TI) = \begin{cases} -\tau \Delta TI & \text{if } \Delta TI \leq 0 \\ -\lambda \tau \Delta TI & \text{if } \Delta TI > 0 \end{cases} \quad (1)$$

whereby τ is the individual tax rate and λ is the coefficient of loss aversion ($\lambda > 1$). Taxpayers face a trade-off between the value of tax reduction achieved through an increase in additional income-related deductions AD and the monetary and/or non-monetary costs to achieve the reduction. Largely following Rees-Jones (2017), we refer to the deductible amount of an individual item as m_j and to the corresponding costs of claiming this item as c_j. Every potentially deductible item is defined by a cost-benefit ratio $\frac{m_j}{c_j} = r_j$ and an item j is generally claimed if the tax reduction it achieves exceeds the costs of claiming, i.e., if $\tau m_j > c_j$, or $\tau r_j > 1$. As with Rees-Jones (2017) we assume that $\tau r_1 > 1$, i.e. there is at least one beneficial item, and $\tau r_k \longrightarrow 0$ if $k \longrightarrow \infty$. Taxpayers are assumed to deduct items with the best ratios in descending order and stop when $\tau r_j \leq 1$. Contrary to Rees-Jones (2017) and Engström et al. (2015) and in order to simplify our model, we do not separately consider the range around zero and thus ignore the possibility of getting from the loss zone into the gain zone by deducting

additional items. Of course, for those items in the gain zone the optimum criteria would change. The basic results of our model, especially the implications for our hypotheses, would still be valid if we integrated this detail.

Consider two taxpayers in t_0 who did not experience a loss situation so far. In t_0, they used all deduction possibilities satisfying $\tau r_j > 1$ and stopped when c_j reached τm_j. By proceeding this way, they ended up claiming the amount of AD_0 and arrived at a taxable income amounting to TI_0. In t_1, taxable income is TI_1 after – in a first step – claiming the same amount of additional income-related deductions as in the previous year, i.e., all deduction possibilities fulfilling $\tau r_j > 1$. We assume that these are the same items with the same cost-benefit ratios as in the previous year. The taxpayers' preliminary situation in t_1 is thus deduction of AD_0. For taxpayer A, this results in $TI_1 \leq TI_0$, classifying them in the gain domain. For taxpayer B, in contrast, due to one or several of the aforementioned causes, $TI_1 > TI_0$. In a second step, both taxpayers decide whether to claim further deductions. They compare the value of their current outcome $V(-\tau\Delta TI)$ to the value of outcome if they deduct one or several additional items m_j satisfying $\tau r_j \leq 1$, which is defined as $V(-\tau\Delta TI + \tau m_j) - c_j$. Since the value function is defined as linear, the deduction is claimed if $V(\tau m_j) > c_j$. The value of τm_j depending on the position of the taxpayer in relation to the reference point is:

$$V(m_j) = \begin{cases} \tau m_j & \text{if } \Delta TI \leq 0 \\ \lambda \tau m_j & \text{if } \Delta TI > 0 \end{cases} \tag{2}$$

Hence, depending on the taxpayer's situation, the item m_j is claimed for all j satisfying:

$$\begin{aligned} &\text{A:} && \tau r_j > 1 \text{ if } \Delta TI \leq 0 \\ &\text{B:} && \tau r_j > \frac{1}{\lambda} \text{ if } \Delta TI > 0 \end{aligned} \tag{3}$$

As all deductions m_j satisfying $\tau r_j > 1$ have already been claimed in the first step, τr_j is smaller than 1 for all remaining deduction possibilities m_j. They will thus not be claimed by taxpayers in the gain domain.

Taxpayers in the loss domain are assumed to claim the additional item m_j if $\tau r_j > \frac{1}{\lambda}$. Hence, two thresholds $L = \max\{j: \tau r_j > 1\}$ and $H = \max\{j: \tau r_j > \frac{1}{\lambda}\}$ are defined. Taxpayers in the gain domain claim $AD_0 = \sum_{j=1}^{L} m_j$, taxpayers in the loss domain claim $\sum_{j=1}^{H} m_j$, hence they additionally claim $\sum_{j=L+1}^{H} m_j$ (defined as δ), resulting in a deduction amounting to $AD_0 + \delta$. Items satisfying $\tau r_j < \frac{1}{\lambda}$ are not claimed neither by taxpayers in the gain nor by taxpayers in the loss domain. Additionally, we assume an overall trend in the level of *AD* which affects taxpayers experiencing either a gain or a loss. Concerning taxpayers in the gain domain, they are assumed to claim the same amount of *AD* over time. But it is likely that changes in the tax law or in the general economic development give rise to a trend in the overall level of *AD*. Hence, we assume changes in *AD* in the group of taxpayers not experiencing a loss to be the general time trend which also applies to the group of taxpayers experiencing a loss.

$$AD_1(\Delta TI) = \begin{cases} AD_0 + Trend & \text{if } \Delta TI \leq 0 \\ AD_0 + Trend + \delta & \text{if } \Delta TI > 0 \end{cases} \quad (4)$$

We analyze the level of additional income-related deductions for taxpayers finding themselves in a loss situation compared to taxpayers who do not experience such a loss, regardless of the underlying causes for the deterioration. We use the overall change in taxable income as the treatment variable. Our hypothesis is that taxpayers in the gain domain are satisfied with the *AD* that result from claiming all items fulfilling $\tau r_j > 1$, and just aim at collecting their perceived gain. They are less inclined to take any further steps in order to achieve a reduction in their tax burden, as an additional tax saving resulting from deducting items $\tau r_j \leq 1$ does not provide additional positive value to them (Carroll, 1992). By contrast, taxpayers experiencing a loss are disappointed and attempt to prevent this perceived loss by reducing their tax burden "to the verge of or just over the limit of what is permissible" (Elffers & Hessing, 1997, p. 291). They are more willing to make a great amount of effort, to take the risk of being corrected when claiming additional, potentially dubious deductions or when spending

money on additional items that are actually private but pass for working materials. In the case of illegal tax evasion, they even take the risk of being punished. The final amount of additional *AD* claimed by taxpayers in the loss domain may thus consist of expenses deducted as a result of tax planning, expenses for "tax-privileged consumer goods" deducted as a result of tax avoidance and potentially even fabricated expenses deducted as a result of tax evasion. Hence, we aim at estimating the sum of these additional $AD - \delta$ – which is assumed to be positive. The hypothesis is formulated as follows:

Taxpayers experiencing a loss in the sense of higher taxable income compared to the previous year (the comparison being made before deduction of additional income-related expenses) claim higher additional income-related deductions than taxpayers in a gain situation.

The considerations above also revealed the potential exogenous causes of a negative change of the tax situation providing stimuli to potentially induce a reaction. We identified five major events directly leading to a loss: (1) higher *W*, (2) lower *ID*, (3) lower *SE*, (4) lower *EC*, or (5) higher *OI*. Concerning higher wages, a reaction in the sense of higher *AD* may not (only) be a result of loss aversion, but it is also likely that an increase in wages results in higher expenses related to the income-generating activity as the general complexity of the working situation tends to increase with higher wages. In this case, higher *AD* as a result of increased wages might be a necessary reaction and not due to loss aversion. Concerning a loss due to higher income from other income sources, this reasoning does not apply in the same way, as, for instance, increased income from renting and leasing is not likely to induce higher *AD,* which are by definition related to income from employment. In this case, it is thus assumed that an observed reaction is the result of loss aversion. The same is true for decreased other deductions: A decrease in invariable income-related deductions is often due to the loss of a double household allowance or a home office, or to lower costs for travelling between home and workplace. Leaving loss aversion aside, we would expect that decreasing *ID* lead to declining *AD* as the taxpayer's working situation tends to become less complex. Observing an increase in *AD* as a result of lower *ID* would provide support for the existence of loss aversion in taxpayers'

behavior. Similarly, there is no reason to expect an increase in *AD* as a result of declining *SE* or *EC*, as there is typically no connection between these fields of a tax return. Therefore, reactions in accordance with our hypotheses are assumed to be caused by loss aversion.

Hence, in Section 5.4, we investigate whether those different causes of a loss lead to a reaction among taxpayers in the sense of claiming higher *AD*. In Section 5.5, we investigate different levels of losses and gains and their effect on the level of *AD*. The main hypothesis in this context is that levels of gain do not induce a significant positive effect on the level of *AD* and that a change in behavior is observable at the zero point $\Delta TI = 0$, which constitutes our reference outcome.

4 Data Set and Preparation

4.1 Data Set

The subsequent analysis of taxpayers' reporting behavior is based on the years 2005–2010 of the *German Taxpayer Panel* provided by the German Federal Statistical Office.[2] The panel structure is necessary to identify groups of taxpayers in a loss situation or a gain situation compared to the previous year's outcome. The balanced panel available for the years 2001–2010 is based on the data of the annual German wage and income tax statistics and uses taxpayers' individual tax ID numbers and indirect identifiers to link annual cross-section income tax returns. Taxpayers whose tax returns are only available for a subset of the years from 2001 to 2010 are removed from the data. The entire panel contains annual income tax return data of approximately 14.5 million observations. The data set contains information collected from tax returns of German taxpayers, including detailed information about income structure, deductions and tax liability as well as socio-economic information such as gender, age and origin (federal state). The scientific-use version available for research purposes consists of a 5% stratified random sample of the panel. With the data, the Federal Statistical Office provides information on the stratas and sampling weights. Using them for our analysis allows us to draw conclusions

[2] Data Source: Research Data Centres of the Federal Statistical Office and the statistical offices of the Länder, Taxpayer Panel 2005–2010.

regarding the whole panel data set and to avoid biased estimates due to the survey design. Due to anonymization purposes, analyzing the data is only possible through controlled remote data access. The sample contains approximately 725,000 observations, where one observation either represents one taxpayer in the case of single filing or two married taxpayers in the case of joint filing. For each observation, around 985 variables are available. Due to the detailed itemization of income sources and deductible expenses, the data set is perfectly suited for the analysis of the level of income-related deductions. We use data from 2005 to 2010, which is the latest available year.

4.2 Sub-Samples

For the analyses we focus on sub-samples of taxpayers who (1) mainly earn income from employment and (2) claim invariable income-related expenses exceeding the standard amount. Firstly, we exclude taxpayers for whom earnings from dependent employment do not constitute their main income source: As we aim at investigating the effect of a negative deviation from a reference outcome on reporting behavior concerning additional income-related deductions, it is appropriate to only include taxpayers for whom those deductions represent the main opportunity of lowering their tax burden. Taxpayers mainly receiving other types of income are, in contrast, expected to focus on these other income types to lower their tax burden by increasing the corresponding deductions. Therefore, it is not necessarily expected that a deterioration of their tax situation affects the level of deductions from employment income. Taxpayers mainly earning income from employment are, in contrast, expected to focus on this most important income source and to try to achieve a reduction in the tax burden by increasing the corresponding deductions. As for business income, only net earnings are provided in the data; we are not able to assess reporting behavior by using the level of deductions for these income types.

Secondly, the analysis focuses on taxpayers claiming invariable income-related deductions above the standard amount. Besides the general possibility of unlimited deduction of income-related expenses, German tax law provides a standard deduction amounting to EUR 1,000 (EUR 920 for years prior to 2011). Employees having less than

EUR 1,000 of (invariable and additional) income-related expenses or no expenses at all can deduct this amount without having to prove or itemize their expenses. The deduction of higher expenses, in contrast, requires itemization and (at least upon enquiry) confirmation through submission of receipts and other supporting documents. As a result, taxpayers can choose to either deduct the standard allowance or to declare their higher income-related expenses actually incurred. Taxpayers with low invariable deductions (e.g., costs for travelling between home and workplace of EUR 300), have, on the one hand, no incentive to claim additional income-related deductions if the sum of all deductible income-related expenses does not exceed the standard deduction. On the other hand, those taxpayers have no incentive to even claim their invariable deductions, as entering the amount in the tax return does not lead to a reduction in the tax burden. In this range of values, the data set thus lacks certain values. The integration of these taxpayers would lead to a distorted picture of the level of invariable and additional income-related deductions. By restricting our subsamples to taxpayers claiming at least EUR 920 of invariable income-related deductions, we focus on taxpayers (1) who generally engage in tax planning activities and (2) for whom every additional EUR of *AD* leads to a reduction in the tax burden. For single filed returns we thus arrive at sub-samples of taxpayers having wage as their main income source and claiming invariable income-related deductions above the standard deductions.

Concerning jointly filed returns, the data set provides separate information on each of the spouses. That is, for jointly filed returns, we have two variables, A and B, for each line item in the tax return that is not cumulated for the spouses, i.e. also for wage and income-related deductions. In the tax return form, the variable with suffix A indicates the value of the husband or registered partner A, the variable with suffix B stands for the wife or registered partner B. For married couples, we proceed as follows: If only one of the spouses earns income from employment, the observation is removed from the sub-samples if wage is not the main income source of the spouses or the wage-earning spouse does not claim invariable income-related deductions above the standard deduction. For a married couple with one wage earner we thus expect that if the couple experiences a deterioration of

their tax situation from one year to the next, irrespective of which one of the spouses experiences the deterioration, the wage-earning spouse will react by increasing his or her additional income-related deductions to lower the perceived loss. If both spouses earn income from dependent employment, the observation is removed from the sub-samples if wage is not the main income source of the spouses or if neither of the wage-earning spouses claims invariable income-related deductions above the standard deduction. The values for both spouses are added. We assume that if the couple experiences a deterioration of their tax situation from one year to the next, then either the spouse with invariable income-related deductions above the standard amount or one of the spouses or both (if they both have invariable income-related deductions above the standard amount) claims higher additional income-related deductions.

We use four different sub-samples, each of them considering a period of three consecutive years to test our hypotheses for all possible treatment years available in our data. Hence, we use 2007, 2008, 2009 and 2010 as treatment years and, in each case, include two preceding years in the sub-sample used. Observations that are not used in the final sub-samples are not deleted but simply excluded from the sub-samples in order to correctly account for the survey design of the data set.

5 Estimation and Results

5.1 Estimation Strategy

We investigate whether taxpayers in a perceived loss situation compared to previous year's outcome make a greater effort to lower their tax burden using a difference-in-differences setting. In our first setting, we identify treatment groups to investigate the main effect of a loss situation. As described in the model in Section 3, we compare taxable income of the taxpayer (or the married couple) i in the post-treatment period t_1 to taxable income in the pre-treatment period t_0. In both years, we add the respective value of additional income-related deductions and donations to avoid a feedback effect. This procedure allows a comparison between the current year's (t_1) and previous year's (t_0)

tax situation regardless of the amount of claimed *AD*. Hence, we capture negative changes in the tax situation arising from events other than a change in *AD* and donations (*Don*). If taxpayers would in t_1 claim the same amount of *AD* as in the previous year, they would still experience the deterioration. This results in the following binary variable:

$$D_i = \begin{cases} 1 & \text{if } (TI_{i,1} + AD_{i,1} + Don_{i,1}) - (TI_{i,0} + AD_{i,0} + Don_{i,0}) > 0 \\ 0 & \text{otherwise} \end{cases} \quad (5)$$

D_i is denoted as 1 if taxable income before deduction of *AD* and donations in t_1 exceeds taxable income before deduction of *AD* and donations in t_0. D_i accordingly takes the value 0 if a taxpayer's situation has improved compared to the previous year or has stayed at the same level. Taxpayers in a gain situation thus have a taxable income which is the same as or lower than the previous year when claiming the same amount of additional income-related deductions as in the previous year. Taxpayers in a loss situation have a higher tax burden if they do not claim any further additional income-related deductions. The dependent variable is the level of additional income-related deductions. The individual treatment effect is $AD^1_{i,1} - AD^0_{i,1}$ where $AD^1_{i,1}$ represents the outcome of a taxpayer i in the post-treatment period t_1 when exposed to the treatment of a deteriorated situation, $AD^0_{i,1}$ represents the outcome of the same taxpayer in the post-treatment period otherwise. As we cannot observe the same taxpayer's outcome for both a loss and gain situation, we make use of the existence of a comparison group not experiencing a loss in order to estimate the causal effect of the treatment. One way of estimating the effect of the intervention would be to evaluate the difference in outcomes between AD^1_1 and AD^1_0, i.e. the difference in the average level of *AD* between t_1 and t_0 for taxpayers experiencing a loss in t_1. This approach assumes that, in absence of the treatment, *AD* would have remained at the same level. But, if there is an overall time-trend in *AD* independent of group membership as we assumed in Section 3, the estimator is biased as we confound the treatment effect with this time effect. Another approach would be to evaluate the difference in outcomes AD_1 for taxpayers experiencing a loss ($D = 1$) and taxpayers experiencing a gain ($D = 0$).

But, if there are permanent differences between the treatment and control group influencing the level of *AD* independent of the treatment, the difference between AD_1^1 and AD_1^0 does not reflect the causal effect of the treatment. Therefore, we make use of a difference-in-differences (DID) approach allowing for unobserved but time-invariant heterogeneity in participation and overall time-trends independent of group membership. We identify the treatment effect by comparing four sample means, whereby only the post-treatment treated is affected by the treatment. It is thus:

$$\delta = \Delta AD^1 - \Delta AD^0 = (AD_1^1 - AD_0^1) - (AD_1^0 - AD_0^0) \qquad (6)$$

The trend observed in the control group is used to identify the change that would have been experienced for the treatment group in absence of the treatment. The main assumption of DID is thus that in the absence of the treatment, the average outcome would have followed parallel paths over time. Differing reactions between the two groups in the post-treatment period should only be due to group membership. Results may thus be biased if the two groups differ in a way that affects their trends over time (Abadie, 2005; Imbens & Wooldridge, 2009). We use a twofold strategy to cope with concerns regarding the parallel trend assumption in our setting.

Firstly, the DID approach generally assumes that observations are untreated in the pre-treatment period. But, in our setting, the treatment can apply to observations each year and taxpayers are not necessarily – as in standard DID settings – untreated in t_0. Instead, they will have potentially already experienced a loss in earlier years (i.e., in or before t_0). On the one hand, taxpayers classified in the treatment group in t_1 may already have experienced a loss in t_0. In that case, they possibly do not show the same behavior as taxpayers experiencing a loss for the first time. If they have already reacted to last year's loss according to our hypotheses by increasing the level of *AD*, they are not able to increase *AD* again to the same extent. On the other hand, taxpayers in the control group might be classified in this group precisely because they have been in a loss situation in the previous year. Taxpayers experiencing a loss in t_0 (compared to t_{-1}) may automatically be classified in the control group in t_1 if this loss is due to a one-

off negative event. If the taxpayer adjusted reporting behavior in order to cope with this loss and claimed higher AD in t_0, they might adjust AD downwards again in t_1. These considerations show that group membership is not unaffected by group membership in previous years, but that it may be predetermined even without a change originally stemming from t_1. As we aim at investigating the effect of a negative event occurring in the treatment period t_1 on reporting behavior, it is appropriate to exclude taxpayers whose situation is biased by a loss experience happening in the previous year. Taxpayers whose taxable income increased in t_1 are removed from the sub-samples. This approach allows us to create better conditions for the fulfillment of the parallel path assumption: It ensures that all taxpayers in the sample are untreated in t_0 and placed in either the treatment or control group by comparing taxable income in t_0 with taxable income in t_1. The procedure leads to reduced sub-sample sizes of 65,174 observations for treatment year 2007, and 54,739, 58,616 and 86,385 observations for treatment years 2008, 2009 and 2010. Table 2 presents the procedure of constructing the sub-samples used and Table 3 shows the preliminary distribution of the treatment variable D for the treatment years 2007–2010.

Table 2 Construction of the sub-samples

	2005–2007	2006–2008	2007–2009	2008–2010
5% TPP	727,368	727,368	727,368	727,368
Single filed return				
W < 50% of total income	93,686	95,238	96,424	96,840
$ID \leq 920$	67,455	66,037	65,608	64,081
Jointly filed return				
W < 50% of total income	217,176	223,713	225,863	229,649
$ID \leq 920$ (only A is wage earner)	83,182	80,193	78,095	75,593
$ID \leq 920$ (only B is wage earner)	9,573	9,471	9,603	9,617
Both $ID \leq 920$ (both are wage earners)	76,599	74,973	74,409	70,403
Subtotal	179,697	177,743	177,366	181,185
Loss in previous year	114,523	123,004	118,750	94,800
Final sub-sample	65,174	54,739	58,616	86,385

Table 3 Distribution of treatment variables

	$D_{i,2007}$	$D_{i,2008}$	$D_{i,2009}$	$D_{i,2010}$
0	0.3079	0.3064	0.4046	0.4777
1	0.6921	0.6936	0.5954	0.5223

Secondly, in order to avoid group differences affecting the evolution of *AD* after treatment, we use propensity score matching to create groups of treated and control observations with similar pre-treatment characteristics before performing the DID analysis. The propensity score is defined as the probability of receiving the treatment conditional on pre-treatment characteristics. We conduct a one-on-one matching without replacement to select taxpayers whose ex ante probability of experiencing the treatment is closest to that of the actual treated observations. The rationale behind this approach is that taxpayers are similar before treatment and only differ by their group membership in the post-treatment year. To estimate propensity scores, we run a logit model of the treatment variable *D* on the variables listed in Table A.1 in the appendix, chosen to capture the probability of treatment.

In principle, one could expect that treatment occurs randomly to taxpayers as we assume it to be exogenous. Nevertheless, there may be several baseline characteristics that promote or impede classification in the treatment group. We assume that the probability of receiving the treatment increases with a taxpayer's reporting aggressiveness as well as with the complexity of their tax situation. The rationale is that taxpayers who are aggressive take higher risks in order to achieve tax savings. Taxpayers who take higher risks are in turn at higher risk of 'losing'. Also, it is expected that taxpayers in complex situations, i.e., several different income sources and many different types of deductions, are at higher risk, for example, of losing one of these deductions. That is, covariates are chosen that signal complexity of a tax situation and aggressiveness of the taxpayer.

First, we use several socio-economic characteristics of the pre-treatment year t_0, which have partly been associated with reporting aggressiveness in previous studies on tax compliance (see, e.g., Hasseldine, 1999; see Hofmann, Voracek, Bock, & Kirchler, 2017 for a

meta-analysis of survey studies). Second, we assume that the starting levels of the five identified sources of deterioration of the tax situation will influence group membership in the post-treatment period, as taxpayers with several different income sources and high income-related or special expenses or exceptional costs are at higher risk of finding themselves in the treatment group. Natural logarithms of those variables of the two years preceding the treatment are used as covariates. Additionally, the marginal tax rate, as well as a wide range of dummy variables signaling complexity, is used in the matching procedure. Finally, to cope with the survey design of the data, sampling weights are incorporated as a covariate in the logistic regression (DuGoff, Schuler, & Stuart, 2014). The regression itself is unweighted (Zanutto, 2006).

Based on estimated propensity scores, we use nearest neighbor matching without replacement to combine treated and control observation using the Stata module psmatch2 (Leuven & Sianesi, 2003). Results of the logistic regressions are reported in Table A.2 in the appendix and Table A.3 displays the results of balancing tests indicating the success of the matching procedure. The procedure results in two equally large groups of treated and untreated taxpayers with similar pre-treatment characteristics for each treatment year. Matching reduces the sub-sample sizes to 35,480 taxpayers for t_1 = 2007, 31,806 for t_1 = 2008, 45,640 for t_1 = 2009, and 69,896 for t_1 = 2010. Summary statistics of the matched samples are provided in Table A.4 in the appendix.

5.2 Preliminary Results and Graphical Evidence

In order to provide a first insight into the development of additional deductions depending on gain or loss status, we illustrate the DID results in 2x2 tables and graphical representations for all possible treatment years available in our data. In each setting we observe two pre-treatment periods and can thus take a look at the pre-treatment trend to gather information on the fulfillment of the parallel trend assumption. Besides graphically checking the assumption, we perform t-tests of the difference in average change of *AD* in the treatment and control group from t_0 to t_1 as well as from t_{-1} to t_0 assuming significant positive trend differences for the former and no significant differences in

trends for the latter. But it is to be noted that even equality of pre-treatment trends does not ensure that the parallel path assumption for the treatment year is fulfilled, because the parallel path assumption cannot be tested (Stuart et al., 2014).

Looking at the first column of the 2x2 tables shown in Tables 4–7, a stable or negative trend in the overall level of *AD* is visible in the data. When the treatment occurs, the level of deductions develops differently for both groups, and the Figures 1–4 show a positive treatment effect for all specified sequences of years: e.g., for t_1 = 2009 (Table 6 and Figure 3), the average level of *AD* increases by EUR 0.94 from t_0 to t_1 for the whole sample. In t_1, taxpayers in the treatment group claim on average *AD* EUR 35.23 higher than in the previous year, whereas taxpayers in the control group on average claim deductions EUR 33.35 lower than in the previous year. If the main assumption of DID holds, the development of *AD* in the treatment group without occurrence of the treatment would be equivalent to the development of *AD* in the control group, i.e., a decrease by EUR 33.35 to EUR 501.36. The difference in trends amounting to EUR 65.58 is attributed to the treatment. The corresponding graphical representation indicates that the average level of *AD* for the treatment and control group follow a similar path for the pre-treatment year 2008.

Table 4 DID table (t_1 = 2007)
This table presents the average levels of *AD* for the treatment and control group for the treatment occurring in 2007. Standard errors are given in parentheses.

	All	AD^0	AD^1	Δ
2005	839.17 (15.91)	1005.49 (28.48)	672.85 (14.02)	−332.64 (31.74)
2006	767.86 (12.19)	927.77 (20.89)	607.95 (12.35)	−319.82 (24.27)
2007	749.35 (11.34)	856.16 (18.92)	642.54 (12.41)	−213.62 (22.63)
Δ	−18.51 (8.18)	−71.61 (14.38)	34.60 (7.79)	**106.21** **(16.35)**

Figure 1 DID graph (t_1 = 2007)
The figure plots average *AD* for the treatment group (black line) and the control group from 2005 to 2007.

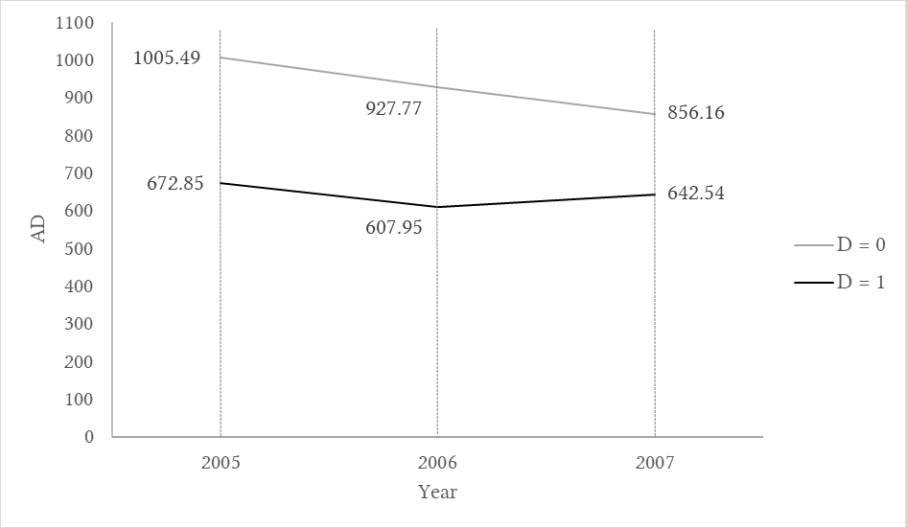


Table 5 DID table (t_1 = 2008)
This table presents the average levels of *AD* for the treatment and control group for the treatment occurring in 2008. Standard errors are given in parentheses.

	All	AD^0	AD^1	Δ
2006	904.05 (25.13)	1225.95 (48.45)	582.15 (12.47)	−643.80 (50.03)
2007	812.20 (17.37)	1090.02 (32.39)	534.39 (11.84)	−555.63 (34.49)
2008	687.65 (14.43)	858.01 (26.31)	517.28 (11.56)	−340.74 (28.74)
Δ	−124.56 (9.94)	−232.00 (18.28)	−17.11 (7.68)	**214.89** **(19.83)**

Figure 2 DID graph (t_1 = 2008)
The figure plots average *AD* for the treatment group (black line) and the control group from 2006 to 2008.

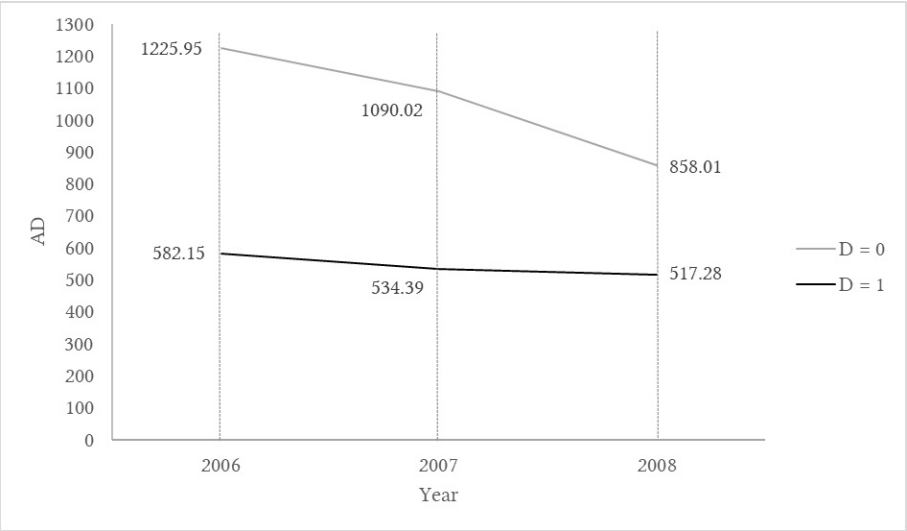


Table 6 DID table (t_1 = 2009)
This table presents the average levels of *AD* for the treatment and control group for the treatment occurring in 2009. Standard errors are given in parentheses.

	All	AD^0	AD^1	Δ
2007	930.25 (13.74)	1137.39 (23.61)	723.12 (13.79)	−414.28 (27.34)
2008	712.42 (11.10)	890.13 (19.55)	534.71 (10.23)	−355.42 (22.07)
2009	713.36 (10.37)	856.78 (17.82)	569.94 (10.43)	−286.84 (20.65)
Δ	0.94 (7.00)	−33.35 (12.15)	35.23 (6.92)	**68.58** **(13.98)**

Figure 3 DID graph (t_1 = 2009)
The figure plots average *AD* for the treatment group (black line) and the control group from 2007 to 2009.

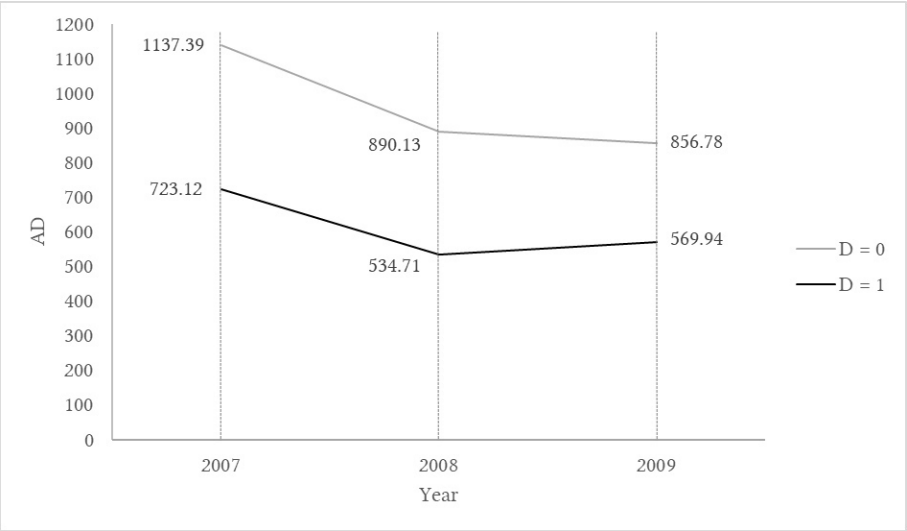
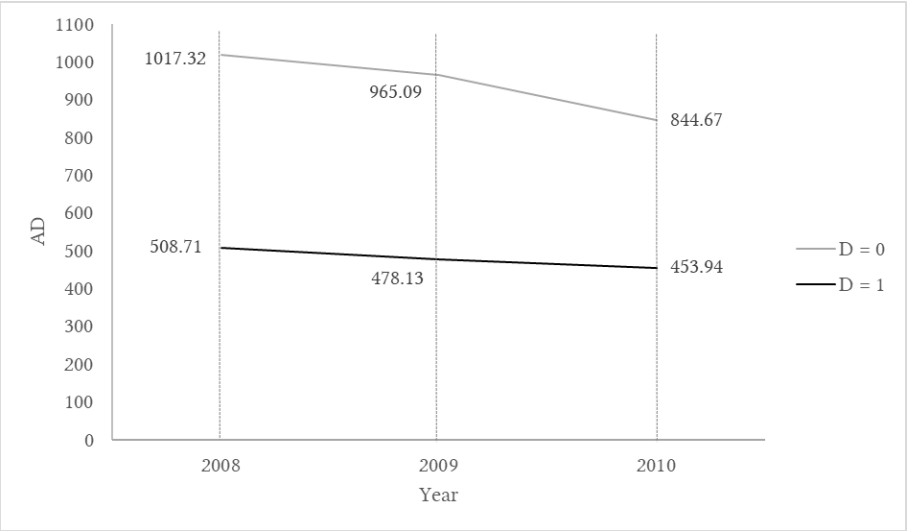


Table 7 DID table (t_1 = 2010)
This table presents the average levels of *AD* for the treatment and control group for the treatment occurring in 2010. Standard errors are given in parentheses.

	All	AD^0	AD^1	Δ
2008	763.01 (15.62)	1017.32 (30.07)	508.71 (7.95)	−508.61 (31.10)
2009	721.61 (12.72)	965.09 (24.31)	478.13 (6.99)	−486.95 (25.29)
2010	649.31 (13.54)	844.67 (26.14)	453.94 (6.68)	−390.73 (26.98)
Δ	−72.31 (7.32)	−120.42 (13.85)	−24.20 (4.70)	**96.22** **(14.63)**

Figure 4 DID graph (t_1 = 2010)
The figure plots average *AD* for the treatment group (black line) and the control group from 2008 to 2010.



T-tests on the trend differences from pre- to post-treatment year as well as from the second to the first pre-treatment years provide initial support for the existence of framing and loss aversion in the data. Significant positive trend differences are found for the post-treatment year in each specification: Firstly, a differing trend is visible when the treatment occurs, suggesting that the previous year's amount of tax serves as a reference point that leads to differences in reporting behavior. Secondly, the direction of these differing trends points to the occurrence of loss aversion, as taxpayers in a loss situation claim on average higher deductions than taxpayers in a gain situation. T-tests on pre-treatment trends show insignificant results for all specified treatment years, providing initial support for the fulfillment of the parallel path assumption.

5.3 Fixed Effects Regression Results

The following regression equation is used to test the hypotheses comparing the level of claimed *AD* before and after experiencing a loss:

$$\begin{aligned} AD_{it} = \alpha_0 + \beta_1 Pre_t + \beta_2 D_i \times Pre_t + \beta_3 Post_t \\ + \beta_4 D_i \times Post_t + \alpha_i + \varepsilon_{it} \end{aligned} \tag{7}$$

The dependent variable is the level of *AD*. The dummy variable D is 1 if a taxpayer is in the treatment group, and 0 otherwise. *Post* is 1 in the post-treatment period and 0 in the pre-treatment periods. The interaction term $D_i \times Post_t$ captures the level of *AD* of taxpayers in a loss situation after experiencing this negative change and is thus the independent variable of interest: According to the hypothesis, the level of *AD* should increase for those taxpayers experiencing a loss. The estimated coefficient of $D_i \times Post_t$ is thus expected to be positive. In each specification we use a panel of three years and include taxpayer and year fixed effects to control for unobserved individual characteristics that do not vary over time. As group membership D_i is constant over time in our sub-samples, the main effect of group membership D_i is perfectly collinear with the taxpayer fixed effects. For the same reason, time-invariant socio-demographic variables are not added in the model. Year fixed effects are included to capture general trend effects identical for each taxpayer in the year in question: The

main coefficient of $Post_t$ representing the time trend for t_1, and the coefficient of the first pre-treatment year Pre_t representing the time trend for t_0 are displayed, whereas the year fixed effect for the second pre-treatment year (t_{-1}) is left out. Time-variant sociodemographic variables (such as number of children or church membership) and other potential controls are not integrated in the regression model, as a change in one of these variables has a direct impact on group membership. For instance, an increase in wage can be the reason for group membership in the treatment group. Even though we assume that the general level of wage is likely to have an effect on the level of *AD*, and integrating the variable would increase power of the statistical test, it is not used as a control variable in the fixed effects regression model as it is highly correlated with D_i. The DID setting implies that general group differences do not affect the coefficient of the variable of interest. The same is true for all other variables which might be the reason for a loss and therefore for classification in the treatment group. Finally, a variable $D_i \times Pre_t$ is included, represented by the interaction of the treatment variable D_i and the pre-treatment time dummy Pre_t, to analyze the pre-treatment trend. The coefficient of this interaction term is expected to be zero.

Table 8 shows the results of the fixed effects regression model for all specifications, i.e. for all possible years of treatment available in the data. A significant negative time effect, represented by the coefficient of $Post_t$, is visible for each specification of the model, i.e. for each treatment year. This suggests a declining trend for *AD* in the control group, which may be due to changes in the tax law or a worsened economic situation leading to lower expenses over the whole observed period. This negative time trend is also reflected by the coefficient of Pre_t showing a declining level of *AD* also for the pre-treatment period in each specification. The coefficient of $D_i \times Pre_t$, included to check for the parallel trend assumption, shows mixed results. For the treatment years $t_1 = 2007$ and $t_1 = 2010$, the difference in pre-treatment trends between the treatment and control group is – as expected – small and does not significantly differ from zero. For treatment years $t_1 = 2008$ and $t_1 = 2009$, a positive and significant (at least at the 5% level) pre-

treatment trend difference is visible in the data. For these specifications, the results thus suggest that the parallel trend assumption may be violated.

Table 8 Effect of a loss situation on the level of additional income-related deductions

Regression results for taxpayers' additional income-related deductions analyzing taxpayers' reactions to a loss in the years 2007, 2008, 2009, or 2010. The table presents coefficients including taxpayer and year fixed effects. Taxpayers experiencing a loss in the pre-treatment year are excluded from the data. Dependent variable is *AD* in each case. Standard errors (presented in brackets) are clustered at the individual level. P-values are presented in square brackets.

	$t_1 = 2007$	$t_1 = 2008$	$t_1 = 2009$	$t_1 = 2010$
	Coeff. (SE) [p-value]	Coeff. (SE) [p-value]	Coeff. (SE) [p-value]	Coeff. (SE) [p-value]
Pre	−77.7181 (17.5723) [0.000]	−135.9379 (34.4028) [0.000]	−247.2645 (17.4506) [0.000]	−52.2292 (18.5356) [0.005]
$D \times Pre$	12.8183 (19.87) [0.519]	88.1691 (35.2128) [0.012]	58.8554 (20.0273) [0.003]	21.6555 (19.2113) [0.26]
Post	−149.327 (23.6194) [0.000]	−367.9392 (36.9281) [0.000]	−280.6097 (18.1942) [0.000]	−172.6446 (20.0969) [0.000]
$D \times Post$	119.0245 (25.7105) [0.000]	303.0605 (38.0637) [0.000]	127.4344 (21.2701) [0.000]	117.8756 (20.9988) [0.000]
Intercept	839.1677 (7.1574) [0.000]	904.054 (11.7667) [0.000]	930.2543 (6.4795) [0.000]	763.0118 (6.2494) [0.000]
Taxpayer FE	Yes	Yes	Yes	Yes
Obs.	106,440	95,418	136,920	209,688
Prob > F	0.000	0.000	0.000	0.000
Within R^2	0.0025	0.0068	0.014	0.0029

The estimated coefficient of the main variable of interest $D_i \times Post_t$ is positive and significant at the 0.1% level for all specified treatment years. Controlling for group differences and an overall time-trend,

taxpayers in a loss situation claim *AD* EUR 119.02 for $t_1 = 2007$, EUR 303.06 for $t_1 = 2008$, EUR 127.43 for $t_1 = 2009$ and EUR 117.88 for $t_1 = 2010$ higher than taxpayers who do not experience a loss. The empirical results thus suggest that taxpayers behave in accordance with our hypothesis. We are not able to identify the origin of this increase in deductions, i.e. whether it occurs as a result of tax planning, tax avoidance or undetected tax evasion. But we assume that the observed treatment effects result from a combination of all three (legal and illegal) methods of lowering taxable income.

5.4 Causes of a Loss and Taxpayer Reactions

The considerations in Section 3 revealed the potential exogenous causes of a negative change in the tax situation providing stimuli to potentially induce a reaction to loss averse behavior. We identified that events leading to a loss situation may be due to (1) higher *W*, (2) lower *ID*, (3) lower *SE*, (4) lower *EC* or (5) higher *OI*. We considered that an increase in *AD* which is due to higher wages might not be a result of loss averse behavior, but an inevitable consequence of higher expenses, along with a more sophisticated working situation. Hence, a reaction in this area cannot be attributed to loss aversion. In order to investigate the observed effect in more detail, the main treatment variable D_i is subdivided into smaller groups to determine whether the experienced loss is due to one of the five aforementioned causes or to (6) other – not further specified – causes or to (7) a combination of the aforementioned causes.

The five major treatment variables are defined in such a way that the different causes of a loss are mutually exclusive; for example, we may capture taxpayers experiencing a loss which is exclusively due to decreased *ID* and not to a combination of different causes. Hence, as an example, the treatment variable for a loss due to decreased *ID* ($D_{ID,i}$) is defined as one if $D_i = 1$ (i.e., the taxpayer experiences a loss according to the definition used in the previous sections) and $ID_{i,0} - ID_{i,1} > 0$ (i.e., the taxpayer claims lower *ID* than in the previous year) and the four other variables indicating a direct source of a loss are not present. We thus investigate whether taxpayers who "lose" *ID* engage in tax planning or tax avoidance to compensate their loss by an increase in

AD. Additionally to the five major treatment variables operationalized in this way, we define a treatment variable $D_{OTH,i}$ indicating that a loss occurs which is due to none of the aforementioned causes and finally, a variable $D_{COMB,i}$, indicating that a combination of all possible causes of a loss is present. By proceeding this way, we arrive at seven treatment variables which add up to the main treatment variable used in the previous sections.

Table 9 presents mean values of the treatment variables again for all possible treatment years available in the data and accounting for survey selection. The figures show that taxpayers experiencing an increase in wage and taxpayers experiencing a combination of different causes of a loss constitute the largest proportion of the overall 50% of taxpayers in a loss situation in the matched sub-samples. By contrast, taxpayers in a loss situation due to increased *SE*, increased *EC* and for reasons other than the identified causes account for only a very small share.

Table 9 Distribution of treatment variables

Var.	$t_1 = 2007$	$t_1 = 2008$	$t_1 = 2009$	$t_1 = 2010$
$D_{W,i}$	0.1339	0.1496	0.1354	0.1927
$D_{ID,i}$	0.0078	0.0054	0.0092	0.0036
$D_{SE,i}$	0.0016	0.0016	0.0041	0.0008
$D_{EC,i}$	0.0018	0.0017	0.0024	0.0018
$D_{OI,i}$	0.0095	0.0076	0.0093	0.0074
$D_{OTH,i}$	0.0031	0.0019	0.0063	0.0008
$D_{COMB,i}$	0.3424	0.3322	0.3333	0.2929
Σ	0.5000	0.5000	0.5000	0.5000

The following regression equation is used to test which causes lead to a reaction of the taxpayers. The main effect of a loss due to increased taxable income is not integrated in the model.

$$\begin{aligned} AD_{it} = {} & \alpha_0 + \beta_1 Pre_t + \beta_2 D_i, \times Pre_t + \beta_3 Post_t \\ & + \beta_4 D_{W,i} \times Post_t + \beta_5 D_{ID,i} \times Post_t \\ & + \beta_6 D_{SE,i} \times Post_t + \beta_7 D_{EC,i} \times Post_t \\ & + \beta_8 D_{OI,i} \times Post_t + \beta_9 D_{OTH,i} \times Post_t \\ & + \beta_{10} D_{COMB,i} \times Post_t + \alpha_i + \varepsilon_{it} \end{aligned} \tag{8}$$

Regression results are displayed in Table 10. Except for the coefficient of $D_{ID,i} \times Post_t$ for treatment year 2009, all coefficients of the interaction terms of interest are positive. The figures show significant treatment effects for a loss due to increased wage for all of the four specified treatment years. As we assume that this increase might also be due to increased costs going hand in hand with increased wage, we do not attribute this positive treatment effect exclusively to loss-averse behavior. Nevertheless, it is possible that the observed effect is due to a combination of loss aversion and an unavoidable increase in deductions. This conclusion is supported by the results shown for $D_{OI,i} \times Post_t$. As we assume that an increase in other types of income has no direct influence on expenses leading to higher additional deductions from income from employment, the positive treatment effect observed for this interaction term (which is significant at the 0.1% level for $t_1 = 2007$, $t_1 = 2008$, and $t_1 = 2009$) is attributed to loss averse behavior. The same rationale applies for loss situations due to decreased deductions. Concerning a loss due to lower *SE*, a positive treatment effect significant at the 0.1% level is observed for all specifications, whereas for lower *EC* and for lower *ID*, we find a significant positive treatment effect in three out of four and two out of four specifications, respectively. Other causes of a loss do not seem to have a large influence as the coefficient of $D_{OTH,i} \times Post_t$ is not significant in three out of four specifications. Finally, and as the combination of different causes of a loss constitutes a large share of the sample, the results suggest that taxpayers experiencing a loss due to several different causes tend to behave in a loss-averse manner, as the coefficient

of $D_{COMB,i} \times Post_t$ is positive and significant at the 0.1% level for each of the investigated treatment years. The results of this supplemental analysis rule out that the treatment effect observed in Section 5.3 might be explained by increased complexity of a taxpayer's situation correlated with the deterioration of their tax situation. Hence, the positive treatment effects might thus be seen as a further confirmation of the existence of reference dependence and loss aversion in taxpayers' behavior.

Table 10 Effect of different causes of a loss on the level of additional income-related deductions

Regression results for taxpayers' additional income-related deductions analyzing taxpayers' reactions to a loss due to one of six possible causes or to a combination of these causes in the years 2007, 2008, 2009, or 2010. The table presents coefficients including taxpayer and year fixed effects. Taxpayers experiencing a loss in the pre-treatment year in the sense of higher taxable income are excluded from the data. The dependent variable is *AD* in each case. Standard errors (presented in brackets) are clustered at the individual level. P-values are presented in square brackets.

	$t_1 = 2007$	$t_1 = 2008$	$t_1 = 2009$	$t_1 = 2010$
	Coeff. (SE) [p-value]	Coeff. (SE) [p-value]	Coeff. (SE) [p-value]	Coeff. (SE) [p-value]
Pre	−77.718	−135.9379	−247.2645	−52.2292
	(17.5728)	(34.4038)	(17.451)	(18.5359)
	[0.000]	[0.000]	[0.000]	[0.005]
$D \times Pre$	12.8183	88.1691	58.8554	21.6555
	(19.8705)	(35.2139)	(20.0277)	(19.2116)
	[0.519]	[0.012]	[0.003]	[0.26]
Post	−149.327	−367.9392	−280.6097	−172.6446
	(23.6201)	(36.9293)	(18.1946)	(20.0972)
	[0.000]	[0.000]	[0.000]	[0.000]
$D_W \times Post$	103.9854	280.437	120.4869	99.4105
	(27.2118)	(39.8608)	(23.9894)	(21.5198)
	[0.000]	[0.000]	[0.000]	[0.000]
$D_{ID} \times Post$	233.8926	298.4975	−95.2742	181.6615
	(71.0584)	(76.7366)	(68.862)	(109.585)
	[0.001]	[0.000]	[0.167]	[0.097]
$D_{SE} \times Post$	108.1528	277.2061	130.3735	218.0564
	(40.2357)	(90.5205)	(34.4404)	(61.4902)
	[0.007]	[0.002]	[0.000]	[0.000]

$D_{EC} \times Post$	61.1038	315.5794	179.7475	128.5307
	(58.4845)	(61.4198)	(33.515)	(28.5403)
	[0.296]	[0.000]	[0.000]	[0.000]
$D_{OI} \times Post$	87.5951	217.3947	203.5335	48.236
	(33.3567)	(72.3149)	(45.5925)	(39.5557)
	[0.009]	[0.003]	[0.000]	[0.223]
$D_{OTH} \times Post$	69.5771	158.9147	85.2727	184.7382
	(73.0570)	(107.8794)	(69.0985)	(40.4691)
	[0.341]	[0.141]	[0.217]	[0.000]
$D_{COMB} \times Post$	123.9778	316.1858	134.6455	130.475
	(26.6241)	(38.4574)	(22.1967)	(21.5293)
	[0.000]	[0.000]	[0.000]	[0.000]
Intercept	839.1677	904.054	930.2543	763.0118
	(7.1575)	(11.7670)	(6.4784)	(6.2496)
	[0.000]	[0.000]	[0.000]	[0.000]
Taxpayer FE	Yes	Yes	Yes	Yes
Obs.	106,440	95,418	136,920	209,688
Prob > F	0.000	0.000	0.000	0.000
Within R^2	0.0026	0.0068	0.0141	0.0029

5.5 Reactions Depending on the Size of Gain or Loss

As an additional robustness check, we investigate taxpayers' reaction in more detail studying the effect for different magnitudes of experienced loss. Therefore, we split the main treatment variable according to the size of the overall deterioration of the tax situation. Simultaneously, we assess the effect of different degrees of improvement of the situation. In order to assess the magnitude of a gain or loss, we again compare taxable income of the taxpayer i in the post-treatment period t_1 to taxable income in the pre-treatment period t_0 after adding the respective value of AD and donations in each year. We generate the continuous variable $\Delta TI_i = (TI_{i,1} + AD_{i,1} + Don_{i,1}) - (TI_{i,0} + AD_{i,0} + Don_{i,0})$ and define the binary treatment variables used as displayed in Table 11. We use six treatment variables in the loss domain (L_1 to L_6) and six treatment variables in the gain domain (G_1 to G_6). For instance, we define $L_{1,i} = 1$ for a taxpayer if they experience a loss between EUR 1 and EUR 1,000. The size class boundaries are oriented roughly on the quantiles of ΔTI observed in the data which cannot be displayed for anonymization purposes. Again, taxpayers whose tax liability

changed in the year prior to the post-treatment year are excluded from the data and observations are matched as described in Section 5.1. Table 11 shows the operationalization and distribution of the variables used in this analysis. We perform the analysis for the treatment year $t_1 = 2008$ as an example. The following regression equation is used:

$$\begin{aligned} AD_{it} = {} & \alpha_0 + \beta_1 Pre_t + \beta_2 D_i \times Pre_t + \beta_3 Post_t + \beta_4 L_{1,i} \times Post_t \\ & + \beta_5 L_{2,i} \times Post_t + \beta_6 L_{3,i} \times Post_t + \beta_7 L_{4,i} \times Post_t \\ & + \beta_8 L_{5,i} \times Post_t + \beta_9 L_{6,i} \times Post_t + \beta_{10} G_{1,i} \times Post_t \\ & + \beta_{11} G_{2,i} \times Post_t + \beta_{12} G_{3,i} \times Post_t + \beta_{13} G_{4,i} \times Post_t \\ & + \beta_{15} G_{6,i} \times Post_t + \alpha_i + \varepsilon_{it} \end{aligned} \tag{9}$$

Table 11 Definition of treatment variables and distribution for the treatment year $t_1 = 2008$

Var.	Operationalization	Mean
$L_{1,i}$	1, if $0 < \Delta TI \leq 1{,}000$	0.093
$L_{2,i}$	1, if $1{,}000 < \Delta TI \leq 2{,}000$	0.084
$L_{3,i}$	1, if $2{,}000 < \Delta TI \leq 3{,}000$	0.066
$L_{4,i}$	1, if $3{,}000 < \Delta TI \leq 4{,}000$	0.048
$L_{5,i}$	1, if $4{,}000 < \Delta TI \leq 5{,}000$	0.039
$L_{6,i}$	1, if $\Delta TI > 5{,}000$	0.171
$G_{1,i}$	1, if $-1{,}000 < \Delta TI \leq 0$	0.101
$G_{2,i}$	1, if $-2{,}000 < \Delta TI \leq -1{,}000$	0.058
$G_{3,i}$	1, if $-3{,}000 < \Delta TI \leq -2{,}000$	0.041
$G_{4,i}$	1, if $-4{,}000 < \Delta TI \leq -3{,}000$	0.032
$G_{5,i}$	1, if $-5{,}000 < \Delta TI \leq -4{,}000$	0.025
$G_{6,i}$	1, if $\Delta TI \leq -5{,}000$	0.243

Concerning taxpayers in the loss domain we expect, again, a significant positive treatment effect, potentially increasing in magnitude for increasing losses as the incentive to lower the perceived loss is assumed to increase with an increase in the magnitude of loss. On the other hand, we expect no significant treatment effect for taxpayers in the gain domain as the additional tax saving is expected not to exceed the costs associated with claiming the deductions.

Table 12 Effect of different magnitudes of a gain or loss on the level of *AD*
Regression results for taxpayers' additional income-related deductions analyzing taxpayers' reactions to a gain or loss of different magnitudes in the year 2008. The table presents coefficients including taxpayer and year fixed effects. Taxpayers experiencing a loss in the pre-treatment year in the sense of higher taxable income are excluded from the data. The dependent variable is *AD* in each case. Standard errors are clustered at the individual level.

	Coeff.	SE	p-value
Pre	−135.9397	34.4046	0.000
$D \times Pre$	88.1691	35.2146	0.012
Post	−251.7671	50.3325	0.000
$L_1 \times Post$	167.6473	53.8467	0.002
$L_2 \times Post$	178.4326	52.0939	0.001
$L_3 \times Post$	213.6667	52.7850	0.000
$L_4 \times Post$	206.9107	53.6508	0.000
$L_5 \times Post$	167.1981	56.8258	0.003
$L_6 \times Post$	190.0151	53.1965	0.000
$G_1 \times Post$	5.9140	75.5993	0.938
$G_2 \times Post$	−29.6138	54.7229	0.588
$G_3 \times Post$	−162.0992	75.7393	0.032
$G_4 \times Post$	−20.0246	90.9636	0.826
$G_5 \times Post$	(omitted)	–	–
$G_6 \times Post$	−204.6298	60.5321	0.001
Intercept	904.054	11.7661	0.000
Taxpayer FE	Yes		
Observations	95,418		
Prob > F	0.0000		
Within R^2	0.0074		

The regression results displayed in Table 12 show positive treatment effects for taxpayers in the entire loss domain that are significant at the 0.1% level. Concerning the magnitude of a loss, the results show that taxpayers experiencing losses up to EUR 1,000 claim higher *AD* amounting to approximately EUR 168. For the next higher magnitudes of losses, we can see an increase in the magnitude of the treatment effects, the coefficients of $L_2 \times Post$ and $L_3 \times Post$ amounting to approximately EUR 178 and EUR 214, suggesting that higher losses lead to higher willingness to react by means of tax planning, tax avoidance or even tax evasion. But, taking a look at the coefficients for still higher magnitudes of loss, the size of the effect seems to stagnate and even

decrease. For taxpayers experiencing a loss between EUR 3,000 and EUR 4,000, we identify a treatment effect amounting to EUR 207, which decreases to EUR 167 and EUR 190 for the still higher magnitudes of loss. The observed decreasing slope may be explained by one of the central features of prospect theory, i.e. diminishing sensitivity. It implies the utility of individuals being concave over gains and convex over losses. Kahneman and Tversky (1979) describe it as follows: The difference between a loss of 100 and a loss of 200 appears greater than the difference between a loss of 1,100 and 1,200. Thus, the negative impact of an additional Euro of loss falls as the overall loss increases. That said, the observed stagnation or decrease in the effect size might stem from a certain resignation in taxpayers' behavior. Taxpayers experiencing high losses may not even try (to the same extent as taxpayers experiencing smaller losses) to reduce their losses by additional tax planning or tax avoidance, as a small reduction in taxable income provides little additional value to them. Furthermore, and as claiming *AD* is only possible to a limited extent and comes with increasing effort, the observed stagnation might be due to the fact that the taxpayers concerned already claim high amounts of *AD* and further increasing this amount would exceed the level of effort which is still reasonable.

Concerning taxpayers in the gain domain, the results show non-significant coefficients for most of the interaction terms indicating a gain situation. The most important finding of this robustness check is that a fundamental change in behavior is observable around the zero point separating the domain of small losses and the domain of small gains up to EUR 1,000. This suggests that taxpayers experiencing a gain do not adapt their behavior in the same way as taxpayers experiencing a loss, providing additional support for the existence of framing effects and loss aversion. Taxpayers in the gain domain neither claim higher nor lower *AD* in the post-treatment period. For higher magnitudes of gains, we can observe negative, but insignificant treatment effects. Only for taxpayers experiencing a very high gain amounting to at least EUR 5,000 is a significant negative treatment effect observable, suggesting that taxpayers refrain from making the effort to claim *AD* when they already have high tax advantages resulting from other sources.

6 Conclusion

We study whether taxpayers demonstrate behavior in accordance with the concept of framing and loss aversion in riskless choice. Therefore, we investigate whether taxpayers claim higher additional income-related deductions if they find themselves in a loss domain compared to a given reference point. We identify the reference point in previous year's tax burden. Taxpayers are classified as being located in the loss domain if they have a higher taxable income compared to the previous year when claiming the same amount of additional deductions as in the previous year. A difference-in-difference setting with a one-on-one matching strategy is used to assess the reporting behavior of taxpayers when experiencing a loss situation using income-tax return data for the years 2005–2010 from the *German Taxpayer Panel*. The empirical tests show significant treatment effects. Taxpayers with increased tax liability claim higher additional income-related deduction and thus seem to use the investigated line items of the tax return to lower taxable income. We conclude that taxpayers in a loss situation make greater effort to search for further deduction possibilities or spend additional money on items that pass for working materials and potentially also behave less compliantly in order to lower their perceived loss. The positive treatment effects suggest that expectations resulting from prior filings, i.e. the status quo in the sense of previous year's outcome, serves as a reference point to frame the reporting decision and that taxpayers adopt loss-averse behavior. The results contribute to our understanding of taxpayers' reporting behavior.

Investigating the underlying causes of a loss situation in more detail, we find that the reaction is not only observable as a result of increased wages, which could alternatively be explained by increased complexity of the working situation, but also as a result of increased income from other types or decreased other deductions, for which this alternative explanation does not apply. Investigating the effect of different levels of gains and losses, we find that taxpayers in the gain domain do not claim significantly higher *AD*. Rather, our results suggest a fundamental change in behavior between taxpayers experiencing gains (up to EUR 1,000) and taxpayers experiencing losses (up to

EUR 1,000), providing additional support for the existence of framing effects and loss aversion.

Prior studies investigating loss aversion consider financial constraints as an alternative explanation of the observed behavior (Engström et al., 2015; Rees-Jones, 2017). But, in contrast to our investigation, these studies examine whether the current asset position before filing the tax return serves as a reference point. This means that taxpayers have direct financial consequences from filing, hence, a refund or an additional payment due. In our case, taxpayers behave differently depending on the relation of this year's taxable income to previous year's taxable income. As mentioned in Section 2, most taxpayers in Germany receive a refund after filing. Liquidity constraints promoting noncompliance or taxpayer aggressiveness can therefore be ruled out as an alternative explanation.

Prior empirical and experimental results finding that the direction of the compensation payment frames the reporting decision conclude that the existence of framing effects could be used to enhance taxpayer compliance. Specifically, Elffers and Hessing (1997) suggest that prepayments deliberately set too high may improve compliance behavior as most taxpayers would be placed into the gain domain. Engström et al. (2015) already point out a potential drawback of this approach. Besides the fact that taxpayers might feel mistreated by deliberately being put into a situation where they are forced to 'lend' an unnecessary high amount of money to the authorities during the fiscal year, they point out that systematic overwithholding could lead to a shift of the reference point from zero to a positive amount of refund. Even though we do not investigate tax evasion such as Elffers and Hessing (1997), our results suggest that artificially manipulating taxpayers into a refund situation might not be a useful measure to eliminate incentives for noncompliance or taxpayer aggressiveness. We find that the level of taxable income, which also means the level of refund compared to the previous year, frames the reporting decision. In other words, taxpayers seem to adapt their reporting behavior to real changes in their tax situation and not (only) to the mere amount of the compensation payment.

Another potential implication for tax policy is to provide a fixed deductible amount for additional income-related expenses. For our

study, we assume that additional income-related deductions are the only line item of a tax return that wage-earning taxpayers can use to behave more or less aggressively. This possibility could be removed by fiscal authorities through specifying an amount typically incurring to taxpayers as additional work-related expenses. But, this also means a decrease in individual fairness, potentially leading to detrimental effects concerning taxpayers' willingness to comply. Furthermore, our results may provide practical implications concerning tax authorities' audit strategies. Besides other indicators, authorities could condition their audit decisions on whether the taxpayer is in a loss or gain zone compared to the year before, since in the former his willingness to cheat is higher.

This study is not without limitations. First, our results are only valid for German taxpayers earning wage income. We are not able to estimate reactions to a loss situation for taxpayers mainly receiving other types of income, e.g., business income. Unfortunately, the German income tax return data available for this study does not allow this investigation. Future research could thus focus on investigating whether other types of taxpayers show different or the same reactions. In addition, due to the standard allowance we were only able to analyze taxpayers with relatively high work-related deductions. We are not able to estimate whether our results would change if we integrated taxpayers with small amounts of deductions. Furthermore, our results suggest that taxable income from the directly preceding year serves as a reference point within prospect theory. As a variety of studies showed that the current situation before filing or a combination of the current status and expectations may serve as a reference point, future research may wish to focus on the question of how these different reference points interact, or which of these reference points dominates.

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Appendix

Table A.1 Matching covariates

Group	Variable	Description and Operationalization
Socio-economic	$GENDER_0$	Binary variable, one if taxpayer is a single-filing female
	$ORIGIN_0$	Binary variable, one if taxpayer is domiciled in eastern states
	$JOINTFILING_0$	Binary variable, one if observation consists of two married taxpayers
	AGE_0	Age in years
	$CHILDREN_0$	Number of children
	$CHURCH_0$	Binary variable, one if taxpayer is a church member
	$DOUBLEWAGE_0$	Binary variable, one if observation consists of two married taxpayers and both earn employment income
Sources of Loss	W_0, W_{-1}	Natural logarithm of gross wage
	ID_0, ID_{-1}	Natural logarithm of the sum of invariable income-related deductions
	SE_0, SE_{-1}	Natural logarithm of the sum of special expenses
	EC_0, EC_{-1}	Natural logarithm of the sum of exceptional costs
	OI_0, OI_{-1}	Natural logarithm of the sum of other income
Tax rate	MTR_0	Marginal tax rate
Complexity	$INC_{Agr,0}$	Binary variable, one if income from agriculture and forestry exists
	$INC_{Bus,0}$	Binary variable, one if income from trade and business exists
	$INC_{Free,0}$	Binary variable, one if income from freelance work exists
	$INC_{Rent,0}$	Binary variable, one if income from renting and leasing exists
	$INC_{Other,0}$	Binary variable, one if other income exists
	$INC_{Cap,0}$	Binary variable, one if capital Income exists
	$INC_{Surrogate,0}$	Binary variable, one if taxpayer receives surrogate income (e.g., due to unemployment)

	$INC_{Extraord,0}$	Binary variable, one if taxpayer receive extraordinary income (e.g., severance payment, sale of a business
	$ID_{House,0}$	Binary variable, one if taxpayer claims expenses for running two households necessary for employment
	$ID_{Victuals,0}$	Binary variable, one if taxpayer claims expenses for victuals and catering
	$ID_{Travel,0}$	Binary variable, one if taxpayer claims expenses for travelling between home and work place
	$ID_{Office,0}$	Binary variable, one if taxpayer claims costs of a home office
	$ID_{Org,0}$	Binary variable, one if taxpayer claims costs for membership in a professional association
	$ID_{Children,0}$	Binary variable, one if taxpayer claims work-related childcare costs
	$SE_{Alimony,0}$	Binary variable, one if taxpayer claims alimony expenses
	$SE_{Annuity,0}$	Binary variable, one if taxpayer claims annuity expenses
	$SE_{Education,0}$	Binary variable, one if taxpayer claims education costs
	$SE_{Insurance,0}$	Binary variable, one if taxpayer claims insurance expenses
	$EC_{General,0}$	Binary variable, one if taxpayer claims general exceptional costs
	$EC_{Alimony,0}$	Binary variable, one if taxpayer claims exceptional costs from alimony
	$EC_{Disability,0}$	Binary variable, one if taxpayer claims exceptional costs linked to a disability
Sampling weight	SW	Sampling weight

Table A.2 Results of the logistic regression

Logistic regression results with treatment status D as the dependent variable. ***, **, and * indicate significance at the 0.1%, 1%, and 5% levels, respectively.

Variables	t_1 = 2007	t_1 = 2008	t_1 = 2009	t_1 = 2010
$GENDER_0$	−0.1683***	−0.0736	0.2008***	−0.2332***
	(0.0421)	(0.0460)	(0.0426)	(0.0360)
$ORIGIN_0$	−0.0607**	−0.0267	0.0715*	0.0908***
	(0.0278)	(0.0297)	(0.0276)	(0.0229)
$JOINTFILING_0$	0.1148***	0.1157**	0.0038	0.1130***
	(0.0377)	(0.0388)	(0.0347)	(0.0288)
AGE_0	−0.0162***	−0.0128***	−0.0084***	−0.0277***
	(0.0013)	(0.0014)	(0.0013)	(0.0011)
$CHILDREN_0$	0.0395***	0.0587***	0.1285***	0.0145
	(0.0101)	(0.0109)	(0.0098)	(0.0081)
$CHURCH_0$	−0.0156	0.0095	0.0809***	0.0456**
	(0.0209)	(0.0222)	(0.0201)	(0.0166)
$DOUBLEWAGE_0$	−0.193***	−0.1221***	0.0485*	−0.2360***
	(0.0243)	(0.0254)	(0.0227)	(0.0188)
W_0	−0.1156	−0.3397***	−0.5386***	−0.5455***
	(0.0614)	(0.0593)	(0.0523)	(0.0499)
ID_0	0.0467	0.0950**	0.1060***	−0.0297
	(0.0356)	(0.0338)	(0.0277)	(0.0268)
SE_0	0.0471***	0.0247	−0.0008	0.0264
	(0.0161)	(0.0173)	(0.0180)	(0.0157)
EC_0	0.1180***	0.0721**	0.0564**	0.0878***
	(0.0217)	(0.0220)	(0.0198)	(0.0157)
$NoEC_0$	0.5157***	0.3121*	0.1964	0.4930***
	(0.1415)	(0.1446)	(0.1319)	(0.1055)
OI_0	−0.0682***	−0.0573***	−0.0823***	−0.0461***
	(0.0053)	(0.0051)	(0.0046)	(0.0035)
W_{-1}	−0.1976***	−0.0382	0.1924***	0.5434***
	(0.0511)	(0.0491)	(0.0443)	(0.0422)
ID_{-1}	−0.0114	−0.0888**	−0.0372	−0.0109
	(0.0344)	(0.0323)	(0.0276)	(0.0260)
SE_{-1}	−0.0453***	−0.0274	−0.0705***	−0.0401**
	(0.0166)	(0.0177)	(0.0163)	(0.0140)
EC_{-1}	−0.0351	0.0173	0.0059	−0.0480**
	(0.0234)	(0.0246)	(0.0218)	(0.0174)
$NoEC_{-1}$	−0.1475	0.1778	0.0598	−0.2804*
	(0.1560)	(0.1643)	(0.1478)	(0.1175)

OI_{-1}	0.0174***	0.0144**	0.0167***	−0.0020
	(0.0049)	(0.0048)	(0.0041)	(0.0030)
MTR_0	−1.3971***	0.0091	−0.9822***	−3.7562***
	(0.2418)	(0.2400)	(0.2093)	(0.2028)
$INC_{Agr,0}$	−0.1373	0.0373	−0.0307	0.0652
	(0.0751)	(0.0782)	(0.0687)	(0.0570)
$INC_{Bus,0}$	0.0070	0.0009	0.0777**	0.1688***
	(0.0269)	(0.0275)	(0.0236)	(0.0195)
$INC_{Free,0}$	0.0463	0.1619***	0.4481***	0.2261***
	(0.0313)	(0.0329)	(0.0283)	(0.0235)
$INC_{Rent,0}$	0.0258	−0.0211	0.1096***	0.1416***
	(0.0212)	(0.0223)	(0.0198)	(0.0162)
$INC_{Other,0}$	−0.1431**	−0.2377***	0.0458	−0.0261
	(0.0421)	(0.0425)	(0.0396)	(0.0332)
$INC_{Cap,0}$	0.2029***	0.0688*	−0.2376***	0.1304***
	(0.0289)	(0.0278)	(0.0236)	(0.0205)
$INC_{Surrogate,0}$	−0.2214***	−0.3280***	−0.2646***	0.0314
	(0.0255)	(0.0256)	(0.0231)	(0.0175)
$INC_{Extraord,0}$	−0.6875***	−0.4622***	−0.3095***	−0.3162***
	(0.0482)	(0.0487)	(0.0446)	(0.0348)
$ID_{House,0}$	0.1205**	0.0114	0.1115**	0.1427***
	(0.0452)	(0.0453)	(0.0388)	(0.0321)
$ID_{Victuals,0}$	−0.0800**	−0.1642***	0.0621*	−0.1274***
	(0.0284)	(0.0306)	(0.0247)	(0.0203)
$ID_{Travel,0}$	0.1530**	0.1869**	0.0935	−0.0010
	(0.0562)	(0.0570)	(0.0486)	(0.0368)
$ID_{Office,0}$	0.1759***	−0.1124	0.1754***	0.0435
	(0.0306)	(0.0601)	(0.0322)	(0.0237)
$ID_{Org,0}$	0.0542**	0.088***	0.1259***	0.0346*
	(0.0191)	(0.0202)	(0.0184)	(0.015)
$ID_{Children,0}$	0.0835*	0.1079**	0.1521***	0.0445
	(0.0396)	(0.0408)	(0.0347)	(0.0287)
$SE_{Alimony,0}$	−0.0817	0.0273	0.2706**	0.1225
	(0.0870)	(0.0928)	(0.0849)	(0.0715)
$SE_{Annuity,0}$	0.0584	−0.1170	−0.0157	0.1042
	(0.0757)	(0.0763)	(0.0687)	(0.0582)
$SE_{Education,0}$	−0.0109	0.0041	0.0530	0.0080
	(0.0452)	(0.0452)	(0.0379)	(0.0309)
$SE_{Insurance,0}$	0.0335	−0.0245	0.0387*	0.1359***
	(0.0191)	(0.0202)	(0.0181)	(0.0155)

$EC_{General,0}$	0.1082	0.1355*	0.0171	0.1996***
	(0.0571)	(0.0605)	(0.0540)	(0.0454)
$EC_{Alimony,0}$	−0.2134***	−0.0802	−0.0710	−0.0696
	(0.0579)	(0.0612)	(0.0544)	(0.0458)
$EC_{Disability,0}$	−0.2519***	0.1163*	−0.1219*	−0.0838*
	(0.0532)	(0.0563)	(0.0501)	(0.0421)
SW	−0.0212***	−0.0145***	−0.0080***	−0.0168***
	(0.0008)	(0.0008)	(0.0007)	(0.0006)
Cons	5.6348***	5.5259***	4.6782***	3.2578***
	(0.4071)	(0.4151)	(0.3607)	(0.3017)
Pseudo-R^2	0.0297	0.0206	0.0371	0.0345
No. of obs.	65,174	54,739	58,616	86,385

Table A.3 Matching quality

	t_1 = 2007	t_1 = 2008	t_1 = 2009	t_1 = 2010
	Pseudo-R^2	Pseudo-R^2	Pseudo-R^2	Pseudo-R^2
	Mean bias	Mean bias	Mean bias	Mean bias
Before	0.030	0.021	0.037	0.034
Matching	0.050	0.038	0.078	0.046
After	0.000	0.001	0.000	0.000
Matching	0.005	0.007	0.005	0.005

Table A.4 Summary statistics
The long panel matched sub-samples used for the analyses consist of 106,440 taxpayers for t_1 = 2007, 95,418 for t_1 = 2008, 136,920 for t_1 = 2009, and 209,688 for t_1 = 2010. Maximum and minimum values cannot be displayed due to anonymization purposes.

Variable	Mean (SD)			
	t_1 = 2007	t_1 = 2008	t_1 = 2009	t_1 = 2010
GENDER	0.0985	0.0814	0.0847	0.0805
	(0.0751)	(0.0752)	(0.0878)	(0.1004)
ORIGIN	0.1827	0.1851	0.1716	0.1659
	(0.0974)	(0.1068)	(0.1189)	(0.1373)
JOINTFILING	0.7417	0.7644	0.7513	0.7456
	(0.1103)	(0.1167)	(0.1363)	(0.1607)
AGE	46.8041	46.2341	44.5839	44.8166
	(2.2189)	(2.4165)	(2.7197)	(3.1118)
CHILDREN	0.9011	0.9257	1.0253	0.8912
	(0.2537)	(0.2784)	(0.3333)	(0.3759)
CHURCH	0.6171	0.6119	0.6284	0.6186
	(0.1225)	(0.1341)	(0.1524)	(0.1793)
DOUBLEWAGE	0.49	0.5051	0.4676	0.4888
	(0.126)	(0.1375)	(0.1573)	(0.1845)
W	68.7416	80.5221	80.6379	88.6849
	(20.4833)	(27.9819)	(26.5813)	(40.8891)
ID	2949.46	3095.5	3141.65	3163.66
	(471.35)	(569.36)	(691.26)	(824.53)
SE	5061.47	5513.25	5754.35	6858.77
	(985.72)	(1226.13)	(1216.97)	(1814.00)
EC	408.5799	387.0702	453.2473	453.367
	(315.2837)	(330.5674)	(452.0487)	(555.7261)
OI	1.3692	1.9703	1.6953	3.4979
	(13.7354)	(6.2117)	(6.2789)	(11.4992)
MTR	0.3037	0.3105	0.3123	0.3221
	(0.0203)	(0.0232)	(0.0277)	(0.0317)
INC_{Agr}	0.0220	0.0202	0.0204	0.0206
	(0.0369)	(0.0387)	(0.0446)	(0.0524)
INC_{Bus}	0.1170	0.1366	0.1454	0.1392
	(0.081)	(0.0945)	(0.1112)	(0.1277)

INC_{Free}	0.0781	0.0790	0.0916	0.0842
	(0.0676)	(0.0742)	(0.0910)	(0.1025)
INC_{Rent}	0.2467	0.2775	0.2759	0.2768
	(0.1086)	(0.1232)	(0.1410)	(0.1651)
INC_{Other}	0.0728	0.0771	0.0610	0.0628
	(0.0655)	(0.0734)	(0.0755)	(0.0896)
INC_{Cap}	0.1541	0.1870	0.1927	0.2375
	(0.0910)	(0.1073)	(0.1244)	(0.1570)
$INC_{Surrogate}$	0.2481	0.2414	0.2449	0.2890
	(0.1088)	(0.1177)	(0.1356)	(0.1673)
$INC_{Extraord}$	0.0405	0.0515	0.0473	0.0520
	(0.0497)	(0.0608)	(0.0670)	(0.0819)
ID_{House}	0.0365	0.0469	0.0494	0.0465
	(0.0473)	(0.0582)	(0.0684)	(0.0777)
$ID_{Victuals}$	0.1612	0.1717	0.1740	0.1687
	(0.0927)	(0.1037)	(0.1196)	(0.1382)
ID_{Travel}	0.9716	0.9669	0.9674	0.9639
	(0.0419)	(0.0492)	(0.0560)	(0.0688)
ID_{Office}	0.0479	0.0534	0.0588	0.0806
	(0.0538)	(0.0618)	(0.0742)	(0.1005)
ID_{Org}	0.3663	0.3496	0.3478	0.3535
	(0.1214)	(0.1312)	(0.1502)	(0.1764)
$ID_{Children}$	0.0495	0.0541	0.0681	0.0603
	(0.0547)	(0.0622)	(0.0794)	(0.0879)
$SE_{Alimony}$	0.0098	0.0078	0.0080	0.0069
	(0.0248)	(0.0241)	(0.0280)	(0.0306)
$SE_{Annuity}$	0.0181	0.0193	0.0182	0.0167
	(0.0336)	(0.0378)	(0.0422)	(0.0473)
$SE_{Education}$	0.0340	0.0369	0.0433	0.0427
	(0.0456)	(0.0519)	(0.0642)	(0.0746)
$SE_{Insurance}$	0.5130	0.4857	0.4451	0.2949
	(0.1259)	(0.1375)	(0.1567)	(0.1683)
$EC_{General}$	0.0592	0.0549	0.0639	0.0541
	(0.0594)	(0.0626)	(0.0771)	(0.0834)
$EC_{Alimony}$	0.0969	0.0915	0.0976	0.0951
	(0.0745)	(0.0793)	(0.0936)	(0.1083)
$EC_{Disability}$	0.1586	0.1522	0.1409	0.1384
	(0.0920)	(0.0988)	(0.1097)	(0.1274)

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