Unwilling or Unable to Cheat? Evidence from a Randomized Tax Audit Experiment in Denmark*

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Abstract

This paper analyzes a randomized tax enforcement experiment in Denmark. In the base year, a stratified and representative sample of over 40,000 Danish individual tax filers was selected for the experiment. Half of those tax filers were randomly selected to be thoroughly audited, while the rest were deliberately not audited. The following year, "threat-of-audit" letters were randomly assigned and sent to those tax filers. This experiment allows us to study income tax compliance in Denmark in great detail, as well as the causal effects of (a) prior audits and (b) audit threats on subsequent reporting behavior. We find that tax compliance in Denmark is high overall, but that there is substantial tax evasion on purely self-reported income, i.e. income which is not subject to double reporting by third parties. Our results show that the informational framework is more important than socio-economic variables in explaining tax compliance. We find that prior audits significantly increase the likelihood of self-reporting higher incomes the following year, implying that individuals update their beliefs about audit probability based on experiencing an audit. Threat-of-audit letters also have significant effects on self-reported income adjustments. All those empirical results can be explained using a simple rational model of tax evasion and introducing the key distinction between self-reported and third-party reported incomes.

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1 Introduction

An extensive literature has studied tax evasion and tax enforcement from both the theoretical and empirical perspective. The theoretical literature follows on the work of Allingham and Sandmo (1972), which builds on the Becker (1968) theory of crime and focuses on a situation where a taxpayer decides how much income to report to the government facing a probability of audit and a penalty for cheating. Under low audit probabilities and low penalties, the expected return to evasion is high and the model then predicts substantial noncompliance. However, it has been argued that this prediction is in stark contrast with the observation that compliance levels are high in modern tax systems despite low audit rates and fairly modest penalties. For example, Andreoni, Erard, and Feinstein (1998) conclude at the end of their survey that "the most significant discrepancy that has been documented between the standard economic model of compliance and real-world compliance behavior is that the theoretical model greatly over-predicts noncompliance." This suggests that the standard economic model misses important aspects of the real-world reporting environment. In particular, many have argued that observed compliance levels can only be explained by psychological or cultural aspects of tax compliance such as social norms, tax morale, patriotism, guilt and shame.[1] Whatever the specific mechanism, these arguments are based on the notion that taxpayers, despite having the opportunities and incentives to engage in tax evasion, are unwilling to do so for non-economic reasons.

While psychology and culture may be important in the decision to evade taxes, we note that the standard economic model deviates from the real world in another potentially important aspect: it focuses on a situation with pure self-reporting. By contrast, all advanced economies make extensive use of third-party information reporting whereby institutions such as employers, banks, investment funds, and pension funds report taxable income earned by individuals (employees or clients) directly to the government. Under third-party reporting, the observed audit rate is a poor proxy for the probability of detection faced by a taxpayer contemplating to engage in tax evasion, because systematic matching of information reports to income tax returns will uncover any discrepancy between the two. Thus, taxpayers with only third-party reported in-

[1] Studies advocating the importance of behavioral, psychological, or cultural aspects of tax evasion include Alm, McClelland, and Schulze (1992), Andreoni, Erard, and Feinstein (1998), Cowell (1990), and Feld and Frey (2002, 2006). A recent randomized experiment analyzed by Slemrod, Blumenthal, and Christian (2001) found that normative appeals to social norms and equity had no effect on compliance behavior.

come may be unable to cheat on their taxes. At the theoretical level, Kleven, Kreiner, and Saez (2009) develop an agency model showing that third-party reporting greatly improves compliance and may be able to ensure truthful reporting under low audit rates and low penalties. At the empirical level, the U.S. Taxpayer Compliance Measurement Program (TCMP) has documented that aggregate compliance is much higher for income categories with substantial information reporting than for income categories with little or no information reporting (Internal Revenue Service, 1996, 2006).[2]

In this study, we first extend the standard economic model of tax evasion to incorporate the fact that the probability of detection varies with the type of income being under-reported (third-party reported versus self-reported income). This theory predicts that evasion will be low for third-party reported income items, but substantial for self-reported income items (as in the standard model).

Our paper then provides an empirical analysis of this extended model based on a large randomized field experiment carried out in collaboration with the Danish tax collection agency (SKAT). The experiment imposes different audit regimes on randomly selected taxpayers, and has been designed to provide evidence on the total extent of noncompliance and the behavioral effects of tax enforcement under different information environments. Unlike previous studies—including the above-mentioned TCMP studies—our data allow us to distinguish precisely between income items subject to third-party reporting and income items subject to self-reporting for each individual in the sample, and to measure treatment effects of tax enforcement on those two forms of income separately.

The experiment was implemented on a stratified random sample of about 42,800 individual taxpayers (employees and self-employed individuals) during the tax filing and auditing seasons of 2007 and 2008. In the first stage, taxpayers were randomly selected for *unannounced* tax audits of tax returns filed in 2007. These tax audits were comprehensive and any detected misreporting was corrected and penalized as appropriate according to Danish law. The selected taxpayers were not aware that the audits were part of a special study. For taxpayers not selected for these audits, tax returns were not examined under any circumstances. In the second stage, employees in both the audit and no-audit groups were randomly selected for *pre-announced* tax audits of tax returns filed in 2008. One group of taxpayers received a letter telling them that

[2]The main findings of the U.S. TCMP studies have been recently surveyed by Slemrod (2007).

their return would certainly be audited, another group received a letter telling them that half of everyone in their group would be audited, while a third group received no letter. The second stage therefore provides exogenous variation in the probability of being audited, with the audit probability being 100% for the first group, 50% for the second group, and equal to the current perceived probability in the third group.

The empirical analysis can be divided into two main parts. The first part studies the anatomy of tax compliance based on the misreporting uncovered by tax inspectors in the first-stage audits. We find that the overall tax evasion uncovered by audits is modest: about 1.8% of total reported income. But there is considerable variation across income items depending on the information environment. For self-reported income, tax evasion as a share of income is about 37%, whereas the tax evasion rate for third-party reported income is only about 0.3%. Hence, the low evasion rate overall reflects that almost all of taxable income (95% to be exact) is subject to third-party information reporting where the probability of detection is very high. These results suggest that overall tax evasion is low, not because taxpayers are *unwilling* to cheat, but because they are *unable* to cheat successfully due to the widespread use of third-party reporting. We also study the impact of non-economic factors such as gender, age, marital status, and place of residence that may serve as proxies for social and cultural factors. Consistent with earlier studies, we find that some of these variables are correlated with tax evasion. However, our empirical analysis shows that the impact of these social variables is very modest in comparison to variables that capture information and incentives to evade, namely the presence and size of self-reported income or losses.

The second part of the analysis studies the impact of tax enforcement on compliance. We first consider the effect of audits on future reported income by comparing the full-audit and no-audit groups in the following year. Audits may affect future reported income by making taxpayers adjust their perceived probability of detection when engaging in tax evasion, either through adjustments of the audit probability or through adjustments of the detection probability conditional on audit. We find that audits have a positive impact on reported income in the following year, which is consistent with the standard economic model if audit experiences induce upward adjustments of the perceived probability of detection. Audits increase total net income in the following year by about 1.1%, with the effect driven almost entirely by self-reported income. We find that the increase in tax payments due to prior audits is more than 50% of the

original (mechanical) increase in collected tax due to the baseline audit adjustments. This shows that audits have substantial positive effects on tax collection because of behavioral responses due to a higher perceived probability of detection.

We then consider the effect of the probability of being audited on reported income by comparing the threat-of-audit letter and no-letter groups. Because taxpayers received the threat-of-audit letters shortly after receiving a pre-populated return containing third-party information, we focus on the effect of letters on self-reported adjustments to the pre-populated return. We find that individuals receiving a threat-of-audit letter were more likely to adjust incomes on the pre-populated return in an upward direction, consistent with the predictions of the standard economic model. At the same time, we find that the letters made taxpayers more likely to adjust the pre-populated return in a *downward* direction, although this effect is weaker than on upward adjustments and is statistically insignificant for almost all income components. We discuss a possible explanation for the presence of downward adjustments based on transaction costs associated with tax return filing and auditing.

To summarize, we find that the level of noncompliance and the behavioral response to tax enforcement are consistent with the standard model of tax evasion once we consider the information environment captured by that model. The observation of a high compliance rate overall and the lack of a strong behavioral response to tax audits reflect, not that taxpayers do not respond to the economic return to evasion, but that the widespread use of third-party reporting has made this return sufficiently small to deter most tax evasion. The fact that third-party reporting by employers and financial institutions has such drastic effects on compliance and is so widespread in modern tax systems suggest the need for building a tax enforcement theory that centers on third-party reporting by firms (Kleven, Kreiner, and Saez, 2009) and to explore the role of firms in tax systems more generally (Gordon and Li, 2005; Kopczuk and Slemrod, 2006).

The paper is organized as follows. Section 2 reviews the existing empirical literature. Section 3 presents a simple economic model of tax evasion with third-party reporting. Section 4 describes the Danish income tax context, experimental design, and data. Section 5 presents our empirical results on the anatomy of tax compliance, while Section 6 presents the causal empirical effects of prior audits and audit threats on reported income. Finally, Section 7 concludes.

2 Empirical Literature Review

Over the past few decades, a blossoming empirical literature has studied the link between tax evasion and tax rates, penalties, audit probabilities, prior audit experiences, and socio-economic characteristics. Most of this literature relies on observational and non-experimental data, which creates a number of problems with regard to measurement and identification. The first problem is that the dependent variable—evasion—is not observed accurately, because taxpayers go to great lengths to conceal their evasion and because tax authorities do not make audit records publicly available except in aggregate form. The second problem is that the independent variables—audits, threat of audits, penalties—are difficult to capture at the individual level, because enforcement strategies are confidential information and inaccessible to researchers in most cases. The third problem is that, even where reasonable measures of evasion and its various determinants have been available (mostly macro-data studies at the district or state level), the variation in tax rates and enforcement efforts is not exogenous but rather an endogenous response to compliance. This poses an important threat to identification and requires the use of instrumental variables.[3] Andreoni, Erard, and Feinstein (1998) and Slemrod and Yitzhaki (2002) provide critical reviews of this literature and argue that none of the available instruments are likely to satisfy the assumptions for IV-estimation to be consistent.[4]

These generic problems motivate the use of an experimental approach to estimate evasion. There are three sources of experimental data that have been explored in the literature. The first source is the Taxpayer Compliance Measurement Program (TCMP) of the Internal Revenue Service in the United States. The household TCMP is a program of thorough tax audits conducted on a stratified random sample of personal income tax returns approximately every third year from 1963 to 1988. A less detailed version of the household TCMP, called the National Research Program (NRP), was implemented for the 2001 tax year. The TCMP and NRP studies have provided very useful information regarding the extent of evasion and the size of the *tax gap*, the difference between taxes owed and taxes paid voluntarily and on a timely basis. As pointed out by Andreoni, Erard, and Feinstein (1998), Bloomquist (2003),

[3]Studies using district-level or state-level data on evasion and audit rates, and where an IV-strategy was adopted to control for the endogeneity of the audit rate, include Beron, Tauchen, and Witte (1992), Dubin, Graetz, and Wilde (1990), Dubin and Wilde (1988), and Pommerehne and Frey (1992).

[4]Recently, Feldman and Slemrod (2007) use charitable contributions to proxy for real incomes and evaluate indirectly tax evasion across income components.

and Slemrod (2007), studies of TCMP and NRP data have shown that under-reporting is much higher for income categories with "little or no" third-party reporting (such as business income) than for income categories with "substantial" third-party reporting (such as wages and salaries).[5] However, to our knowledge, no TCMP-based study has precisely and systematically compared compliance rates for third-party reported income items and self-reported income items as we do in this paper.[6] Furthermore, TCMP does not provide useful exogenous variation in enforcement variables. Because audits are not pre-announced, there is no variation in the audit probability. Moreover, because audited taxpayers are told that they are participating in a special study and that audit selection is random, TCMP cannot be used to study the effects of audits on future reporting.

A second source of experimental data has been generated by laboratory experiments. These are multi-period reporting games involving participants (mostly students) who receive and report income, pay taxes, and face risks of being audited and penalized. Lab experiments have consistently shown that penalties, audit probabilities, and prior audits increase compliance (e.g., Friedland, Maital, and Rutenberg, 1978; Becker, Buchner, and Sleeking, 1987; Alm, Jackson, and McKee, 1992a,b, 2008). But Alm, Jackson, and McKee (1992a,b) show that, when penalties and audit probabilities are set at realistic levels, their deterrent effect is quite small and the laboratory therefore tends to predict more evasion than we observe in practice. The key problem is that by its nature the lab environment is artificial, and therefore likely to miss important aspects of the real-world reporting environment. In particular, we are not aware of studies that incorporates third-party institutions into laboratory experiments.

The third source of data concerns a small but unique randomized field experiment involving about 1700 taxpayers in Minnesota. Like the experiment we consider in this paper, the Minnesota experiment sent threat-of-audit letters to taxpayers, thereby providing exogenous variation in the audit probability. This experiment was studied by Slemrod, Blumenthal, and Christian (2001), who considered the effect of the audit threat on reported income. They found that the treatment effects are heterogeneous with respect to income level and opportunities to

[5] See Klepper and Nagin (1989), Long and Swingden (1990), Christian (1994), and the Internal Revenue Service (1996, 2006).

[6] This is because TCMP studies are based solely on individual income tax data and do not use information returns. Most income lines on the individual tax return can include both third party reported and self-reported income. For example, wages and salaries include earnings reported on W2 information returns but also tips that are often never reported through information returns.

evade, and surprisingly that a higher auditing probability lead to a *reduction* in reported income at the top of the distribution (although this effect was not statistically significant).

Our paper adopts the randomized field trial approach of Slemrod, Blumenthal, and Christian (2001), but our study is based on a richer set of treatments and a much larger sample size. Moreover, we have benefitted from essentially full access to tax and audit records at the Danish tax administration, allowing us to carry out a much more detailed empirical analysis. In particular, our data allow us to distinguish precisely between income items subject to third-party reporting and income items subject to self-reporting for each individual in the sample, and to measure treatment effects of tax enforcement on those two forms of income separately.

3 A Simple Economic Model of Tax Evasion

3.1 Basic Model

The standard economic model of tax evasion is due to Allingham and Sandmo (1972)—henceforth AS—who applied the economic theory of crime by Becker (1968) to the case of tax evasion. We consider a version of the AS-model with risk neutral taxpayers and an endogenous audit probability that depends on reported income.[7] The basic model is similar to models that have been considered in the previous literature, but we will present the condition determining tax evasion in a slightly different manner in order to demonstrate that a high degree of tax compliance is potentially consistent with a low audit probability and a low, or even zero, penalty for evasion. We then introduce third-party information reporting into the model and discuss its implications for the structure of the (endogenous) audit probability and tax compliance behavior. Notice that the assumption of risk neutrality, besides simplifying the analysis, makes our case harder because risk-averse taxpayers are more inclined to comply other things being equal.

We denote by $\bar{y}$ the true income and by y the reported income of a representative taxpayer. The probability that the government detects undeclared income $\bar{y} - y$ through a tax audit is given by p. The probability of detection will typically be lower than the probability of audit, because tax audits may be unsuccessful in uncovering hidden income.[8] We assume that the

[7] A number of previous studies have considered an endogenous audit probability, including the original paper by Allingham and Sandmo (1972), Yitzhaki (1987), and the recent surveys by Slemrod and Yitzhaki (2002), and Sandmo (2005).

[8] As in the original AS-model, we make the simplifying assumption that a tax audit either uncovers everything or nothing; there is no middle ground where tax evasion is partially uncovered.

probability of detection is a decreasing function of reported income, $p = p(y)$ where $p'(y) < 0$.[9] The intuition for $p'(y) < 0$ is that, the more income the individual evades, the more likely is the tax administration to suspect under-reporting or to obtain evidence that evasion took place and hence carry out an audit. This fits well with the actual practices of professional tax preparers, who calibrate the audit probability to the wishes of their clients by deciding how aggressively to pursue a tax minimization strategy.[10]

When evasion is detected, the taxpayer is forced to pay the evaded tax plus a penalty. The tax rate is proportional to income and given by τ, and the penalty is proportional to the evaded tax and given by θ. The risk-neutral taxpayer maximizes expected net-of-tax income, i.e.

$$u = (1 - p(y)) \cdot [\bar{y} - \tau y] + p(y) \cdot [\bar{y}(1 - \tau) - \theta\tau(\bar{y} - y)]. \tag{1}$$

An interior optimum for reported income y satisfies the first-order condition $du/dy = 0$, which can be written as

$$[p(y) - p'(y)(\bar{y} - y)](1 + \theta) = 1. \tag{2}$$

The second-order condition to this problem puts a restriction on the second-order derivative of $p(y)$.[11] If we denote undeclared income by e so that reported income is given by $y = \bar{y} - e$, we may define the elasticity of the detection probability with respect to undeclared income as $\varepsilon \equiv \frac{dp}{de}\frac{e}{p} = -p'(y)\frac{\bar{y}-y}{p} \geq 0$.[12] The first-order condition determining reported income can then be written as

$$p(y) \cdot (1 + \theta) \cdot (1 + \varepsilon(y)) = 1. \tag{3}$$

The right-hand side of the first-order condition is the marginal benefit of an extra dollar of tax evasion, while the left-hand side is the expected marginal cost of an extra dollar of tax evasion. Under $\varepsilon = 0$ as in the simplest model of evasion, the expected marginal cost equals the probability of detection p times the evaded tax plus penalty, $1+\theta$. The presence of the elasticity ε in the formula reflects that the taxpayer by evading one more dollar incurs a higher probability

[9] Allingham and Sandmo (1972) also considered the case where $p(.)$ depends on reported income y, whereas Yitzhaki (1987) considered a case where $p(.)$ depends on undeclared income $\bar{y} - y$. The results we show below hold under either formulation.

[10] Even tax preparation software offers estimates of audit probabilities based on the contents of the income tax return.

[11] The second-order condition is given by $2p'(y) - p''(y)(\bar{y} - y) < 0$. A sufficient condition for this to hold is that $p(.)$ is convex so that $p''(y) > 0$.

[12] We could alternatively define the elasticity with respect to reported income y, but it simplifies the expression slightly to define the elasticity with respect to undeclared income $e \equiv \bar{y} - y$.

of detection on all the infra-marginal units of tax evasion. Interestingly, this simple model is consistent with less than full tax evasion even in the case of a zero penalty, i.e. $\theta = 0$. In this case, partial evasion may be better than full evasion because it involves a lower probability of being detected and having to pay the full statutory tax (but no penalty). To our knowledge , this property of the AS-model with endogenous audit probability has not received attention in the literature.

The comparative statics of this type of model have been analyzed in the literature (see e.g., Yitzhaki, 1987). A higher penalty and a positive shift of the detection probability are both associated with lower tax evasion. Moreover, as can be seen directly from (3), the marginal tax rate has no impact on tax evasion. This result relies on the assumptions of risk-neutrality, linear taxation, and the penalty being proportional to the evaded tax.[13] By extending the model to allow for a nonlinear income tax, it can be shown that an increase in the marginal tax rate holding constant the total tax liability can increase tax evasion. This is true only under an endogenous audit probability, not under a fixed probability as in the basic AS-model.

The strongest critique of the economic model of tax evasion centers on its predictions of the level of non-compliance. Condition (3) implies that the taxpayer should increase evasion as long as

$$p\left(y\right) < \frac{1}{1+\theta}\frac{1}{1+\varepsilon\left(y\right)}. \tag{4}$$

The fact that the observed p and θ are very low is often argued to imply that it is privately optimal for taxpayers to increase evasion and that they are therefore complying too much from the perspective of the standard economic model. This reasoning ignores the important role of $\varepsilon\left(y\right)$, and this is particularly important in a tax system using third-party information reporting. As we shall see, the presence of third party reporting puts specific structure on the functions $p(y)$ and $\varepsilon(y)$.

3.2 Introducing Third-Party Reported Income

Third-party reporting can be embedded in the model in the following way. Let true income be given by $\bar{y} = \bar{y}_t + \bar{y}_s$, where $\bar{y}_t$ is subject to third-party reporting (wages and salaries,

[13] As first demonstrated by Yitzhaki (1974), under a linear tax system and assuming that the penalty is proportional to the evaded tax, the marginal tax rate has no substitution effect on evasion, only a potential income effect. Under risk-neutrality, the income effect is zero. Under risk aversion and assuming decreasing absolute risk aversion, Yitzhaki (1974) showed that the income effect of the marginal tax rate on evasion is negative.

interest income, mortgage payments, etc.) and $\bar{y}_s$ is self-reported (self-employment income, various deductions, etc.). For third-party reported income, assuming that there is no collusion between the taxpayer and the third party, the probability of detection will be close to 1 as systematic matching of tax returns and information reports will uncover any evasion.[14] By contrast, the detection probability for self-reported income is very low because there is no smoking gun for tax evasion and tax administrations have very limited resources to carry out blind audits.

Based on these observations, it is natural to assume that the probability of detection $p(y)$ is very high for $y < \bar{y}_t$, very low for $y > \bar{y}_t$, and decreases rapidly around $y = \bar{y}_t$. Notice that these properties rely on a specific sequence of income declaration for the taxpayer: as reported income y is increased from 0 to $\bar{y}$, the taxpayer first declares income with a high detection probability and then declares income with a low detection probability. Given that the tax rate and penalty are the same across different income items, this is the optimal sequence for the taxpayer. These remarks imply that the detection probability has a shape like the one shown in Figure 1, where $p(y)$ is initially very close to 1 and then decreases rapidly towards zero around the threshold $\bar{y}_t$.

The figure assumes that the last units of third-party reported income (i.e., y slightly below $\bar{y}_t$) have detection probabilities significantly lower than 1, and that the first units of self-reported income (i.e., y slightly above $\bar{y}_t$) have detection probabilities significantly larger than zero. It is realistic that there is this some variability in the detection probability within self-reported and third-party reported income, respectively: self-reported income items will vary with respect to the accessibility of evidence that income has been earned, while third-party reported income items will vary with respect to the reliability of the information reports.[15] A microfoundation of the p-shape in the figure would allow for many income items, some of which are third-party reported and some of which are self-reported. In general, let there be N third-party reported items with true incomes $\bar{y}_t^1, ..., \bar{y}_t^N$, and let there be M self-reported items with true incomes $\bar{y}_s^1, ..., \bar{y}_s^M$. The N third-party reported items have higher detection probabilities than the M self-reported items, but there is heterogeneity in the probability across items in each group.

[14] Kleven, Kreiner, and Saez (2009) study the issue of collusion and third-party reporting in detail, and demonstrate that collusion cannot be sustained in large firms using verifiable business records even with low audit rates and penalties. However, collusion may be sustainable for sufficiently small firms and for firms off the books.

[15] For example, collusion between the taxpayer and the third party may occur for incomes earned in small firms (Kleven, Kreiner, and Saez, 2009).

As argued above, an optimizing taxpayer choosing total reported income y will include income items sequentially such that the detection probability is decreasing in declared income. In this case, it is natural to assume that the detection probability has a shape like the one showed in Figure 1. The assumption that $p(y)$ is continuous and differentiable is made for analytical convenience. In practice, $p(y)$ would display discontinuities, in particular around $\bar{y}_t$ as all self-reported items will have discretely lower detection probabilities than third-party reported items. All that matters for our qualitative conclusions is that $p(y)$ follows a stylized profile like the one shown in the figure.

In this model, the taxpayer's optimum will be at a point to the right of $\bar{y}_t$ as shown in the figure. At this equilibrium, the detection probability $p(y)$ is much lower than $\frac{1}{1+\theta}$, but the elasticity $\varepsilon(y)$ is very high as evasion is close to the level where third-party reporting binds. For modern tax systems based on extensive use of information reporting ($\bar{y}_s/\bar{y}$ is low), this model predicts a low overall evasion rate ($(\bar{y}-y)/\bar{y} \leq \bar{y}_s/\bar{y}$ is low), a high evasion rate for self-reported income ($(\bar{y}-y)/\bar{y}_s$ is high), and a low detection probability $p(y)$ at the equilibrium. The model also predicts that the deterrence effect of increased enforcement is small overall, but significant for self-reported income. We show below that this simple model captures most the empirical findings we obtain from the randomized tax audit experiment.

4 Context, Experimental Design, and Data

4.1 The Danish Income Tax and Enforcement System

The Danish income tax system is fairly complex. Rather than applying a progressive rate structure to a single measure of taxable income, it is based a number of different income concepts that are taxed differently. This system implies, for example, that labor income, capital income, and deductions are associated with different marginal tax rates, and that the tax rate on capital depends on whether net capital income is positive or negative. The main income concepts of the individual income tax system are described in Table 1, while the tax rates and tax brackets associated with the different income concepts are shown in Table 2. The tax system in these two descriptive tables apply to all individual tax filers (transfer recipients, employees, and the self-employed), but there are additional provisions for the self-employed that will be described below.

Taxable labor income includes all types of earnings, and is taxed directly by a proportional

labor market tax equal to 8%. All other taxes on labor income apply to tax bases net of the labor market tax, implying that the effective tax rate is only 92% of the statutory tax. Personal income includes labor income plus social transfers, pensions, and other personal income items minus the labor market tax and some pension contributions. Capital income includes all taxable capital income items except dividends and realized capital gains from stock, which are taxed on a separate schedule. Capital income is a *net* income concept, and is in fact negative for the majority of Danish taxpayers mainly due to interest payments on mortgages. The tax system allows for a number of deductions such as expenditures associated with earning income (commuting, union fees, other work expenditures, etc.) and charitable contributions. So-called taxable income can then be defined as personal income plus capital income minus deductions.

Taxes are divided into national taxes and regional taxes at the municipal and county level, but the two types of taxes are enforced and administered in an integrated system. At the national level, the labor market tax mentioned above as well as an Earned Income Tax Credit (EITC) at 2.5 percent (capped at an income equal to DKK 300,000) applies directly to the basic measure of labor income.[16] A progressive three-bracket system is then imposed on a tax base equal to personal income plus capital income *if* capital income is positive. The so-called Bottom Tax of 5.5% applies to income above a standard exemption of DKK 38,500, the Middle Tax of 6.0% applies income above DKK 265,500, and the Top Tax of 15.0% applies income above DKK 318,700.[17] At the regional level, taxation is based on taxable income above the standard exemption at a flat rate that varies by municipality and is equal to 32.6% on average. Finally, at the national level, stock income (dividends plus realized capital gains from shares) is taxed separately by a progressive two-bracket system with rates equal to 28% and 43%.

Taxpayers liable to pay the Top Tax may be affected by a tax ceiling, which specifies that the marginal tax rate can never exceed 59% not counting the labor market tax, and therefore that the effective marginal tax rate can never exceed $8\% + 0.92 \times 59\% = 62.3\%$. A high-income taxpayer living in a municipality with the average regional tax of 32.6% would indeed be affected by this ceiling, because the sum of the bottom, middle, top, and regional taxes is then slightly above 59%. When the tax ceiling is binding, the top tax of 15% is adjusted downwards to satisfy

[16] At current exchange rates (as of October 19, 2009), we have approximately \$1 US = 5.0 DKK, 1 GBP UK = 8.1 DKK, 1 Euro = 7.4 DKK.

[17] Note that those taxes are cumulative, so that top bracket taxpayers face a marginal tax rate of 5.5+6+15=26.5%.

the ceiling.

The Danish income tax is a dual income tax in the sense that labor and capital income are treated differently. However, the system is more complex than the textbook dual income tax, both because the taxation of capital in itself has a dual structure with different rates on income from shares and other forms of capital income, and because the degree of duality depends on whether capital income is negative or positive. As described above, a high-income individual paying the average regional tax is affected by the tax ceiling, and his effective marginal tax rate on labor income equals 62.3%. The marginal tax rate on capital is always lower, because the proportional labor market tax is never levied on capital. If the taxpayer has positive net capital income, the marginal tax rate is given by the tax ceiling at 59%. If the taxpayer has negative net capital income, the marginal tax rate is given by the regional tax of 32.6%. If the taxpayer also has income from shares, this is taxed progressively at either 28% or 43% at the margin.

A dual income tax system may create income shifting across tax bases so as to minimize tax liability. This issue is particularly pertinent in the case of the self-employed, because it can be difficult to draw the line between labor income and capital income in businesses. Moreover, a dual income tax that restricts the deductibility of negative capital income would tax the self-employed at a much higher rate than corporations by not allowing for the deductibility of interest payments on business debt. To deal with these issues, special tax provisions for the self-employed ensure the deductibility of interest payments and provide rules for the allocation of business profits into labor income and capital income. Moreover, these tax provisions include an income equalization scheme allowing the self-employed to transfer taxable income across periods so as to flatten their marginal tax rate.

About 88% of the Danish population is liable to pay income tax, and all tax liable individuals are required to file a return [18] Income tax filing occurs in the Spring of year $t+1$ with regard to income earned in year t. For ordinary taxpayers, the timing of the filing process is as follows. By the end of January in year $t+1$, SKAT will have received most information reports from third parties. Notice that such information reporting includes, but is not limited to, income where taxes have been withheld at source during year t. Based on the third-party report, SKAT constructs pre-populated tax returns that are sent to taxpayers in mid-March. Other than third-party information, the pre-populated return may contain additional 'hard' information

[18] The group of citizens who are not tax liable and therefore not required to file a return consists mostly of children under the age of 16 who have not received any taxable income over the year.

that SKAT possesses such as an estimated commuting allowance based on knowledge of the taxpayer's residence and work address. Upon receiving the pre-populated return, the taxpayer has the option of making adjustments and submit a final return before May 1. New returns can be submitted by phone, internet, or mail, and the taxpayer may keep filing new returns all the way up to the deadline, only the last return counts. If no adjustments are made, the pre-populated return counts as the final return.

This filing system implies that, for most tax filers, the difference between income items on the final return and the pre-populated return is a measure of item-by-item self-reported income. However, there are some exceptions where the pre-populated return contains certain elements of self-reporting or where third-party reporting arrives too late to be included on the pre-populated return.

After each tax return has been filed, a computer-based system generates audit flags based on the characteristics of the return. Audit flags do not involve any randomness element and are a deterministic function of the computerized tax information available to SKAT. Flagged returns are looked at by a tax examiner, who decides whether or not to instigate an audit based on the severity of flags, local knowledge, and resources. The audit rate for the entire population of individual tax filers is 4.2%.[19] Audits may generate adjustments to the final return and a tax correction. In the case of underreporting, the taxpayer has the option of paying taxes owed immediately or postponing the payment at an interest. If the underreporting is viewed by the tax examiner as attempted fraud, a fine may be imposed. In practice, such fines a rare because it is difficult to draw the line between honest mistakes and deliberate fraud. Repeated underreporting for the same item increases the penalty applied. An audit may alternatively find over-reporting, in which case excess taxes are repaid with interest.

4.2 Experimental Design

The experiment we analyze was implemented by SKAT on a stratified random sample of 25,020 employees and 17,764 self-employed.[20] The sample of employees was stratified according to tax return complexity, with a group of employees having low-complexity returns ('light' employees)

[19] These audits vary with respect to their breadth and depth, and the audit rate may therefore overstate the intensity of auditing. This is important to keep in mind when comparing the Danish audit rate to audit rates in other countries such as the United States where the audit rate is lower.

[20] The 'employee' category include transfer recipients such as retired and unemployed individuals, and would therefore be more accurately described as 'not self-employed'.

and lower sampling rate and another group having high-complexity returns ('heavy' employees) and higher sampling rate.[21] For employees, the experimental treatments and their timing are shown in Figure 2. As will be explained below, only a subset of the experimental treatments were implemented for the self-employed.

The experiment was implemented in two stages during the filing and auditing seasons of 2007 and 2008. In the first stage, taxpayers were randomly assigned to a 100% audit group and a 0% audit group. All taxpayers in the 100% audit group were subjected to *unannounced* tax audits of tax returns filed in 2007 (for 2006 income), meaning that taxpayers were unaware at the time of filing that they had been selected for an audit. These tax audits were comprehensive in the sense that every item on the return was examined, and the audits used up 21% of all resources devoted to tax audits in 2007.[22] Audited taxpayers were not told that the audits were part of a special study. In the case of detected misreporting, the tax liability was corrected and a penalty possibly imposed depending on the nature of the error and as appropriate according to Danish law.[23] Taxpayers in the 0% audit group were never audited even if the characteristics of the return would normally have triggered an audit.[24]

Although SKAT intended to audit all taxpayers in the 100% audit group, the actual audit rate was in fact a bit lower than 100%. This is because some tax returns were impossible to audit due to special circumstances such as individuals dying, leaving the country, or being unreachable for some other reason. In the empirical analysis below, estimates are always based on the entire 100% audit group (including those who could not be audited), so that we are measuring intent-to-treat effects rather than treatment effects. As the actual audit rates were 98.7% for employees and 92% for self-employed individuals, our estimates are very close to actual treatment effects.[25] It is also important to emphasize that those thorough tax audits

[21] Besides the stratifications with respect to employment status (employee/self-employed) and tax return complexity (light employee/heavy employee), an additional stratification was made with respect to geographical location. The geographical stratification ensured that the same number of taxpayers was selected from each of the 30 regional tax collection centers in Denmark. Because the regional tax collection centers are of roughly similar sizes, this does not oversample any particular region by much.

[22] SKAT made considerable effort to ensure a uniform and thorough auditing procedure across all taxpayers in the full-audit group. This included organizing training workshops for the tax examiners involved in the experiment, and providing detailed auditing manuals to each examiner.

[23] As mentioned above, penalties are in practice rare.

[24] However, SKAT did maintain the option of carrying out retrospective audits *after* the completion of the experiment.

[25] We prefer to present intent-to-treat effects rather than treatment effects (which would be obtained by running a 2SLS regression on actual audit and using treatment group as an instrument), because the impossibility to audit some returns reflects actual limitations in the real-world auditing environment.

may not uncover all tax evasion and hence our results provide a lower bound on total individual income tax evasion. The same issue arises in the US TCMP studies which blow up tax evasion uncovered by audits (and without the help of third-party information returns) by a multiplier factor 3.28 to arrive at the official tax evasion estimates. Unfortunately, this blowing up factor is large and has very large measurement error so that total tax evasion rates are at best rough approximations.[26] In this study, we therefore focus solely of *detectable* tax evasion.

In the second stage, employees (but not self-employed individuals) in both the 100% audit and 0% audit groups were randomly selected for *pre-announced* tax audits of tax returns filed in 2008 (for 2007 income). The pre-announcements were made by official letters from SKAT sent to taxpayers one month prior to the filing deadline on May 1, 2008.[27] A third of the taxpayers in each group received a letter telling them that their return would certainly be audited, another third received a letter telling them that half of everyone in their group would be audited, and the final third received no letter. The second stage therefore provides exogenous variation in the probability of being audited, conditional on having been audited in the first stage or not. The audit probability is 100% for the first group, 50% for the second group, and equal to the current perceived probability in the third group.

The wording of the threat-of-audit letters was designed to make the message simple and salient. The wording of the 100% (50%, respectively) letter was the following: "As part of the effort to ensure a more effective and fair tax collection, SKAT has selected a group of taxpayers—including you—for a special investigation. For (half the) taxpayers in this group, the upcoming tax return for 2007 will be subject to a special tax audit after May 1, 2008. Hence, (there is a probability of 50% that) your return for 2007 will be closely investigated. If errors or omissions are found, you will be contacted by SKAT." Both types of letter included an additional paragraph saying that "As always, you have the possibility of changing or adding items on your return until May 1, 2008. This possibility applies even if you have already made

[26] The 3.28 factor was based on a survey of taxpayers from the TCMP survey in 1976. Obviously, such self-reported levels of undetected tax evasion are likely to be very noisy. In addition to this blowing up factor, the Internal Revenue Service has developed special surveys designed to measure specifically under-reported tip income and informal supplier income. See Internal Revenue Service, 1996, pp. 20-21 and pp. 41-43 for complete details.

[27] The pre-populated returns are administered around mid-March after which taxpayers are allowed to file their tax return. When the pre-announcement letters were delivered, some taxpayers (around 17%) had already filed a new return. However, as explained in the previous section, taxpayers are allowed to change their returns all the way up to the deadline. Only the final report is considered by tax examiners. The letters emphasized this possibility of changing the report.

adjustments to your return at this point."

After returns had been filed in 2008, SKAT audited all taxpayers in the 100%-letter group and half of all taxpayers (selected randomly) in the 50%-letter group. However, to save on resources, these audits were much less rigorous than the first round of audits in 2007. Hence, we do not show results from the actual audits in 2008, but focus instead on the variation in audit probabilities created by the threat-of-audit letters.

4.3 Data

The data is obtained from SKAT's Business Object Database, which contains all information available to SKAT concerning each taxpayer. This includes all income items from the third-party information reports and from the pre-populated, filed, and audited tax returns for each year and each taxpayer. For the 2007 filing season (2006 income), we extract item-by-item income data from the third-party information report (**I**), the pre-populated return (**P**), the filed return (**F**), and the after-audit return (**A**). For the 2008 filing season (2007 income), we extract income data from the third-party information report (**I**), the pre-populated return (**P**) and the filed return (**F**).[28] We also extract variables from the computer-generated audit flag system (presence and number of flags) on which audit decisions would normally be based. Finally, the database contains a limited number of socio-economic variables such as age, gender, residence, and marital status. For employees, we also extracted information on the industrial sector of the employer (21 categories) and the total number of employees at the firm.

5 The Anatomy of Tax Compliance

5.1 Overall Compliance

This section analyzes data from the baseline audits of tax returns filed in 2007 for incomes earned in 2006 in the 100% audit group. The results are shown in Table 3. Panel A of this table shows filed income (column (1)), the total audit adjustment (column (2)), adjustments due to under-reporting (column (3)), and adjustments due to over-reporting (column (4)). Each of these four variables are disaggregated into a number of different income categories, and for each category we show average amounts (in Danish kroner) and percent of tax filers with non-zero

[28] We are not using the **A**-event in 2008, because those audits were much less comprehensive and deep than the first round of audits in 2007.

amounts. All statistics are reported using population weights to reflect averages in the full population of tax filers in Denmark,[29] and standard errors are shown in parentheses.

In Table 3 and all the following tables, earnings include wages and salaries for employees only, while earnings for self-employed individuals is reported separately as part of self-employment income. Earnings is the single largest income component and is reported by about 65% of all tax filers. Personal income includes earnings, pensions, and transfers (see Table 1 for a detailed definition), and is reported by over 95% of tax filers. Capital income is negative on average mainly due to mortgage interest payments and is also very common. Capital income is equal to about -5% of personal income, and about 94% of tax filers report non-zero capital income. Deductions also represent about -5% of personal income, but only 60% of tax filers report deductions.[30] Stock income constitutes less than 3% of personal income and is reported by about 22% of tax filers. Self-employment income is about 5% of personal income and is reported by 7.6% of tax filers. The sum of the above income components is defined as "net income", which is very close to personal income as the other components about cancel out on average.

Note that each of the components of net income that we described above are themselves the sum of single line items (which correspond to specific boxes on the tax return). A given line item is either always positive (such as interest income received) or always negative (such as mortgage interest payments). As we shall see, for third party reported items, the distinction between positive line items and negative line items is critical. Therefore, we split net income into "positive income" and "negative income" defined as the sum totals of all the positive and negative income components, respectively. The table also shows the total tax payment, which is equal to 34% (pre-audit) of net income.

The second column of Table 3 shows the total audit adjustment for each income category. The adjustment amounts are positive for all categories showing that taxpayers do indeed evade taxes.[31] These adjustments are strongly statistically significant in all cases, except for capital income where detected tax evasion is very small. Total detectable tax evasion can be measured

[29] As noted above, SKAT over-sampled complex returns and returns with self-employment income in order to obtain more precise estimates with a smaller sample.

[30] In this and the following tables, we show deductions as negative income values.

[31] For negative items (such as mortgage interest payments included in capital income for example), a positive adjustment means that the absolute value of the mortgage interest payment was reduced. We use this convention so that upward adjustments always mean higher net income (and hence higher net tax liability).

by the adjustment of net income and is equal to 3,744 Danish kroner ($\simeq$ USD 750), corresponding to about 1.8% of net income. The tax lost through detectable tax evasion is 1,670 DKK, or 2.4% of total tax liability.[32] As discussed above, net income can be decomposed as positive income plus negative income. The adjustment rate is 1.41% for positive income and only .78% (in absolute value) for negative income.

Hence, the overall *detectable* evasion rate is very small in Denmark despite the high marginal tax rates described in the previous section. But there is substantial heterogeneity across different income components, with evasion rates (amounts in columns (2)/(1)) equal to 0.4% for earnings, 1.1% for personal income, 1.4% of capital income (in absolute value), 1.4% of deductions (in absolute value), 4.9% for stock income, and 8.1% for self-employment income. We come back to the reasons for this heterogeneity below.

Instead of measuring evasion rates as the share of income being evaded, we may consider evasion rates measured by the share of taxpayers evading (percent in columns (2)/(1)).[33] The overall evasion rate measured by the share of taxpayers having their net income adjusted is equal to 10.5%. For each income component separately, we have evasion rates of 2.2% for earnings, 2.8% for personal income, 2.6% for capital income, 6.2% of deductions, 4.6% for stock income, and 37.7% for self-employment income. These evasion rates are generally larger than for amounts, but follow the same qualitative pattern of heterogeneity. Moreover, the t-statistics are always much higher for percent of taxpayers being adjusted than for the adjustment amounts, because amount variables have large standard errors due to outliers with very large incomes and possibly large audit adjustments. As we shall see later, this implies that it is much easier to detect statistically significant effects on probabilities of changing reported income than the effects on the reported amounts themselves.

The third and fourth columns split the total audit adjustments into upward adjustments (under-reporting) and downward adjustments (over-reporting).[34] We see that under-reporting takes place in all income categories, and that the detected under-reporting is always strongly

[32] Estimated under-reporting from the TCMP study for the US individual income tax for 1992 is 13.2% of total tax liability (Internal Revenue Service, 1996, Table 6, row 3, p .13). However, as discussed above, this factor includes a multiplier factor of 3.28 of detected under-reporting so that actual under-reported income in the US should be around 4%, higher than in Denmark but not overwhelmingly so.

[33] The evasion rate measured this way is conditional on having a non-zero income (in the category being considered).

[34] As mentioned above, for negative items such as mortgage payments, under-reporting means over-reporting of such deductions in absolute value.

significant (also for capital income where the net adjustment is insignificant). The heterogeneity across income categories follows the same pattern as for the total adjustment. We also see that there is some over-reporting taking place in all income categories. The over-reporting amounts are small but statistically significant in most income categories. The small amount of over-reporting most likely reflects honest mistakes resulting from a complex tax code. In particular, if there are transaction costs associated with filing a tax return correctly due to complexity and administrative hassle, one would expect to see some over-reporting of small amounts.[35] We come back to the role of such transaction costs when interpreting the results of the letter experiment below.

5.2 Self-Reported vs. Third-Party Reported Income

Each income category in Table 3 consists of some income items that are self-reported and other income items that are subject to third-party reporting. But the prevalence of information reporting varies substantially across income categories, with substantial third-party reporting for earnings and personal income at one end of the spectrum and very little third-party reporting for self-employment income at the other end of the spectrum. The results described above therefore suggest that evasion rates are higher when there is little third-party reporting, consistent with the findings of the TCMP studies in the United States as discussed in Section 2. A key advantage of our data is that they allow an exact breakdown of income into third-party reported income and self-reported income, facilitating a more rigorous analysis of the role of third-party reporting for tax compliance. This is done in Panel B of Table 3, which shows third-party reported income and self-reported income (in columns (5) and (7)) as well as detected under-reporting for those two forms of income separately (in columns (6) and (8)).

For earnings, third-party reporting constitutes almost 100% of total income as self-reported earnings are negligible. Third-party reporting constitutes even slightly more than 100% of total income for personal income as self-reported income includes some deductions (e.g. pension contributions). Capital income reported by third-parties is negative on net due to interest payments on mortgages, bank loans, etc., and is more than 100% of total negative capital income as self-reported capital income is positive (but relatively small). For the remaining income

[35] Notice that the Danish system of pre-populated tax returns described in Section 4 implies that tax return filing is not in itself associated with transaction costs (because the taxpayer can always choose to do nothing, in which case the pre-populated return is automatically filed). Transaction costs are incurred only by investing the time and/or money to ensure a correct filing.

components, the share of third-party reporting is 62.3% for deductions, 67.1% for stock income, and only 11.2% for self-employment income. By adding the subcomponents of income, we see that third-party reporting is equal to 95.1% of total net income, 91.8% of total positive income, and 73.6% of total negative income. Hence, third-party reporting is extremely widespread in the Danish tax system, creating high probabilities of detection for a very large part of income.

It is interesting to notice that third-party reporting is not strictly zero even for self-employed individuals. An example of third-party reporting for self-employed individuals would be an independent contractor working for a firm (but not as a formal employee), which reports the contractor wages directly to the government.[36] The fact that self-employment income consists of both self-reported income and third-party reported income is very useful, because it will allow us to distinguish between the effect of third-party information and the effect of other aspects of being self-employed that may matter for compliance. In the example of an independent contractor working for a firm, even though the firm submits an information report, they are not required to withhold and remit tax liability. If income tax withholding is important for compliance above and beyond the effect of third-party reporting, we would expect to see substantial noncompliance for self-employment income subject to information reporting.[37]

We split total tax evasion into under-reporting of self-reported income and under-reporting of third-party reported income. As mentioned above, we observe line-by-line income amounts in the information report ($\mathbf{I}$), the filed tax return ($\mathbf{F}$), and the audit-adjusted report ($\mathbf{A}$). Each report consists of line items that are either always positive (as in the case of earnings) or always negative (as in the case of deductions and losses). Consider first the always-positive line items (such as regular wage earnings for example). We can say that under-reporting of third-party income took place is the individual reported less on her return than what is obtained from third-party reports and there was a subsequent upward audit adjustment. Formally, if we have $\mathbf{F} < \mathbf{A} < \mathbf{I}$, then third-party cheating is equal to $\mathbf{A} - \mathbf{F}$. If we have $\mathbf{F} < \mathbf{I} \leq \mathbf{A}$, then third-party cheating is equal to $\mathbf{I} - \mathbf{F}$. In all other cases (i.e., if either $\mathbf{A} \leq \mathbf{F} < \mathbf{I}$ or $\mathbf{F} \geq \mathbf{I}$), third-party cheating is zero. Given this procedure, we measure under-reporting of self-reported income as the residual difference between total under-reporting and third-party under-reporting.

[36] Such income information reporting for some forms of self-employment income also takes place in the United States through 1099-MISC forms.

[37] As discussed in Section 2, the empirical literature on tax evasion from the TCMP studies notes that withholding and third party information reporting help enforcement but does not try to evaluate the enforcement benefit of each component separately.

Consider next the always-negative line items such as losses and deductions. If the taxpayer reports losses and deductions (in absolute value) than what is obtained from third party reports and then receives an upward audit adjustment (i.e., is denied part or all of those extra losses), this may reflect self-reported under-reporting (that is later denied in the audit) or trying to misreport third party reported losses or deductions. Our data does not allow us to separate between the two. It is possible to estimate an upper bound for third-party cheating by saying that, if $\mathbf{F} < \mathbf{I} = \mathbf{A}$, then we can call $\mathbf{I} - \mathbf{F}$ third-party cheating. However, this upper bound is likely to capture mostly self-reported cheating and is therefore not very useful. Therefore, we will define third-party under-reporting only for positive income items.[38]

We find a very strong variation in tax evasion depending on the information environment. Consider the tax evasion rates for third-party reported income (columns (6)/(5)) and for self-reported income (columns (8)/(7)). For third-party reported income, the evasion rate for total positive income is only 0.24%, and the evasion rates vary from 0.2% to 0.9% across the different income components. For example, the evasion rate for self-employment income conditional on third-party reporting is 0.9%, suggesting that tax evasion among self-employed individuals is large because of the information environment and not because of other aspects of being self-employed (such as the absence of withholding). By contrast, tax evasion for self-reported income is substantial: the evasion rate for positive self-reported income is 15.8%. The evasion rates are equal 8.7% for capital income, 14.9% for stock income, and 11.6% for self-employment income.[39] Notice that the evasion rate for self-employment income is not particularly high compared to the other forms of income once we condition on self-reporting. For total self-reported net income, the tax evasion rate is equal to 36.9%. Because self-reported net income consists of positive amounts and negative amounts that just about cancel on average (self-reported net income is quite small), measuring tax evasion as a share of self-reported net income may give an exaggerated representation of the evasion rate.

To summarize these results, tax evasion is very low overall and equal to about 1.8% of total income. The low evasion rate overall reflects that almost all of taxable income (95%) is subject to third-party information reporting where the probability of detection is very high and tax

[38] For negative items, we can say with confidence that a reporting error in the third party category took place only if reported deductions/losses are smaller (in absolute value) than third-party reported deductions/losses and there is a subsequent audit adjustment. However, such mis-reporting is by definition unfavorable to the taxpayer and leads to a downward audit adjustment. Such events are extremely rare.

[39] When self-reported income is negative, the evasion rate calculations are based on incomes in absolute value.

evasion is essentially zero. Once we zoom in on purely self-reported income, tax evasion rates are substantial. Although self-reported income constitutes only about 5% of total income, it is responsible for 87% of detected tax evasion. These results suggest that overall tax evasion is low, not because taxpayers are *unwilling* to cheat, but because they are *unable* to cheat successfully due to the widespread use of third-party reporting.

5.3 Socio-Economic vs. Tax Information Factors

To explore the determinants of noncompliance, Tables 4A and 4B report the results of OLS regressions of an audit adjustment dummy and the audit adjustment amount on a number of dummy covariates. The regressions are run for the full-audit group using population weights, and consider adjustments in total net income as the dependent variable.

Table 4A investigates the relationship between income class and the probability of audit adjustment (Panel A) and the audit adjustment amount (Panel B). In columns (1) and (3), the only regressor is a constant and the estimated coefficients show the fraction of tax returns being adjusted and the average adjustment amount (repeating the estimates for net income in Table 3). Columns (2) and (4) add dummies for *post-audit* income levels: a dummy for negative income and dummies for different quantiles of the distribution of positive income. The excluded group is the bottom quartile of positive incomes, so that effects are estimated relative to this group. We find that the presence of negative income increases the likelihood of misreporting by 30.6 percentage points and the amount of under-reporting by DKK 10,700. Conditional on having a positive income, the probability of audit adjustment is increasing in the level of income, with incomes above the 95th percentile being 13.4-16.9 percentage points more likely to be adjusted. However, the amount of under-reporting is lower at the top than at the bottom, implying that tax evasion as a share of income is strongly declining in income.[40]

Table 4B explores the role of social versus economic and informational factors for noncompliance. Panel A (columns (1)-(4)) shows results for a basic set of explanatory variables, while Panel B considers a richer set of explanatory variables (columns (5)-(8)). Column (1) considers four social variables: gender, marital status, geographical location (dummy for living in the capital Copenhagen), and age (dummy for being older than 45 years of age). The table shows

[40] The finding that evasion rates are declining in income is consistent with U.S. evidence (e.g., Christian, 1994). Slemrod (2007) notes that this pattern is consistent with the saying among tax professionals that "the poor evade and the rich avoid."

that being female is negatively associated with noncompliance, being married is positively associated with noncompliance, while the effects of location and age are small and insignificant. Column (2) adds firm size (a dummy for working in a firm with less than 10 employees) and industrial sector (a dummy for working in the "informal" sector defined as agriculture, forestry, fishing, construction, and real estate sector).[41] We see that working in a small firm and working in the informal sector are positively associated with noncompliance.[42] Column (3) considers tax return variables capturing the presence and size of self-reported income: a dummy for having non-zero self-reported income, a dummy for having self-reported income above DKK 20,000, and a dummy for having self-reported income below DKK -10,000. The results show very strong effects of having non-zero self-reported income and of having large self-reported income (in absolute value). Column (4) brings all the variables together in order to study their relative importance. The results show that by far the strongest predictors of evasion are the variables capturing self-reported income. The effect of firm size is also fairly strong and significant, while the effect of "informal" industrial sector becomes insignificant. The effects of gender, marital status, and geographical location are much smaller although they remain significant, while age is insignificant. Interestingly, the effect of marital status changes sign and being married is associated with less noncompliance when including the income information variables. The female dummy effect on noncompliance remains negative. It is illuminating to consider the R-squares and adjusted R-squares across the different specifications. The specification including only self-reported income variables explains about 14.3% of the variation, while the specification with only socio-economic factors explains only about 1.3%. Adding socio-economic variables to the specification with tax return variables only increases the R-square from 14.3% to 14.6%. This suggests that information, and specifically the presence and size of income that is difficult to trace, is the most central aspect of the compliance decision.

In columns (5)-(8), we investigate whether these findings are robust to including a much richer set of explanatory variables. We include 6 location dummies (corresponding to the 6 main geographical areas of Denmark), 3 age group dummies, 5 firm size dummies, 22 industry sector dummies, along with dummies for having non-zero self-employment income, capital in-

[41] The informal sector classification is meant to capture industries that are generally prone to informal activities.

[42] The link between small firm size and noncompliance is consistent with the theory of Kleven, Kreiner, and Saez (2009), which centers on firm size as the key determinant of third-party information and tax evasion. However, that model focuses on collusion between workers (taxpayers) and firms (third-parties), which is not specifically what is being tested here.

come, stock income, and deductions. We also include a dummy for having been flagged by the computer-based audit selection system at SKAT (described in Section 4). The overall conclusions are the same as above. Although several of the socio-economic variables are significant, the largest effects by far are driven by variables capturing self-reported income and self-employment income. The presence of stock income also has a fairly strong and significant effect, while the other income variables are small and insignificant. The effect of the audit flag is also insignificant, conditional on the other variables. As before, the R-squares show that social variables explain a very small part of the variation, while tax return variables explain a much larger part of the variation. This confirms the conclusion from above that information and traceability are central to the compliance decision.

In sum, those basic descriptive findings confirm the general conclusion from Table 3 that self-reported vs. third-party reported income is the critical distinction for tax evasion. It should be noted however that social factor such as gender and marital status still have a significant impact on evasion, although small in magnitude, even after controlling for tax related income information variables.

6 The Effects of Tax Enforcement on Compliance

6.1 Randomization Test

In this section, we consider the effects of audits and threat-of-audit letters on subsequent reporting. We start by running a randomization test to ensure that the treatment and control groups are ex ante identical in both experiments. Table 5 shows the results of the audit randomization in Panel A (columns (1)-(4)) and the letter randomization in Panel B (columns (5)-(8)). The table shows average incomes in different categories, percent of taxpayers with non-zero incomes in different categories, the share of females, and average age. Notice that we do not show self-employment income for the letter experiment, because this experiment was implemented only for employees (defined as those with no self-employment income). Unlike the baseline compliance study above, statistics are no longer estimated using population weights to match the full Danish population, but reflects instead the composition in the stratified random sample on which the experiments are based. We use experimental weights so as to increase slightly the power of our results. This is the reason why the statistics for the 100% audit group in column (1) are not the same as the statistics in Table 3.

For the audit randomization, income statistics are based on the tax returns filed in 2007 for the 2006 tax year (incomes earned in 2006), i.e. right before the baseline audits were implemented. We see that the differences between the 0% and 100% audit groups are always very small and are far from statistically significant at the 5% level, showing that the randomization was indeed successful. For the letter randomization, statistics are based on the pre-populated tax returns in 2008 with respect to the 2007 tax year, i.e. right before the letter experiment was implemented. Again, we find that none of the differences are statistically significant at the 5% level. Hence, we can conclude that the letter randomization was also successful. In the next section, we report and discuss our findings for the effect of audits on reporting in the following year.

6.2 The Effect of Audits on Future Reporting

It is useful to start by considering the effect of audits on future reporting in the context of the economic model of tax evasion developed in Section 3. In that model, reported income depends on the perceived probability of detection when engaging in tax evasion. Because tax audits are rare events for a taxpayer, experiencing an audit is likely to provide new information and therefore lead to a change in the perceived probability of detection. We may think of the detection probability as a product of two probabilities: the probability of audit and the probability of detection conditional on audit. Audits may affect the perceived detection probability through both channels. One would expect the effect on the perceived audit probability to be positive. The effect on the perceived probability of detection conditional on audit is ambiguous, because the taxpayer may learn that the tax authorities are either more or less effective at uncovering evasion than expected. However, because of the way the audit procedure works (in the experiment and outside the experiment), it is most likely that the audits have a positive effect on the perceived probability of detection conditional on being audited. This is because audited taxpayers are contacted only if tax inspectors upon examining the return believes that hidden income or unjustified deductions can potentially be uncovered. Hence, taxpayers are typically only aware of being audited in cases where tax inspectors are successful. Hence, the probability of detection conditional on audit (as well as the audit probability) is likely to increase as a result of experiencing an audit, in which case the standard economic model predicts an increase in reported income. In particular, we would expect to see increases in self-reported reported income,

but not necessarily in third-reported income where the probability of detection is already close to one.

As the experimental audits were implemented on tax returns filed in 2007, we estimate the effects of audits on subsequent reporting by comparing changes in filed income from 2007 to 2008 (income earned in 2006 and 2007 respectively) in the 0% and 100% audit groups. Table 6 shows estimates for the probabilities of increasing filed income (Panel A) and for the actual income changes (Panel B) for different income components. For panel B, income changes have been trimmed at -200,000 and +200,000 Danish Kroner in order to get rid of extreme observations that would make estimates very imprecise.[43] Column (1) reports the audit adjustment in the 100% audit group in the baseline year. This column provides a useful benchmark to compare the effects of prior audits to actual detectable evasion.

Actual detectable evasion can be seen as the amount of income that can be *mechanically* uncovered by a thorough audit while the effect on subsequent reported income the following year can be seen as the extra amount of income that can be recovered by the tax administration through *behavioral* responses to the perceived change in audit probability.

We start by considering the effect of audits on total reported income (columns (2)-(4)), and then break down the total effect into the effect on self-reported income (columns (5)-(7)) and the effect on third-party reported income (columns (8)-(10)). In each case, the three columns are organized as follows: column (1) reports the income change (probability of increase in Panel A and nominal amount of change in Panel B) in the 100%

For total net income, we see that prior audits have a positive impact on both the probabilities of increasing income and the actual income amounts. The probability of increasing total net income is 62.54% in the 100% audit group compared to 61.48% in the 0% audit group, corresponding to an effect of 1.06 percentage points on the probability of increasing income. This estimate is statistically significant at the 5% level. The estimated effect on the amount of total net income is equal to DKK 2826, which is equal to 54% of the audit adjustment in the 100% group in base year. Similarly, prior audits have a positive impact of 1.09 percentage points on probability of tax increase, and increase taxes by an amount of 1368 DKK which is 58% of taxes underpaid according to baseline audits. This shows that audits, in addition to mechanically increased tax collections due to adjustments, also generate substantial future income and taxes

[43] Less than 2% of observations are trimmed on average.

through behavioral responses of taxpayers following an audit.

Considering the effects on the each subcomponents of income, we see that the effects of audits are generally positive with the only exception being a small negative (and statistically insignificant) effect on the probability of increasing capital income. However, the estimates for most of the subcomponents are quite small and several of them are statistically insignificant; only for self-employment income is the effect large and statistically significant. Because self-employment income is almost fully self-reported, this suggests again that the informational context is central to tax enforcement effects on compliance.

To explore the role of information, we split the effect on total income into the effect on third-party reported income and the effect on self-reported income. For third-party reported income, estimated effects of audits are always small and statistically insignificant at the 5% level. This is also the case for the (small) part of self-employment income that is subject to third-party reporting. For self-reported income, a very different picture emerges. The effect on net income is equal to DKK 2409. The effect on self-employment income is equal to DKK 1815. These effects are strongly statistically significant. Consistent with these findings for income amounts, we also find strong and statistically significant effects on the probabilities of increasing self-reported net income and self-employment income. For the remaining income items, we cannot detect any significant effects on amounts, but we do find effects on the probabilities of increasing income for some items. In contrast, we do not find any significant effects of prior audits on third party reported incomes.

We conclude that audits have significant and substantial effects on subsequent reporting of self-reported income, but negligible effects on the reporting of third-party income. This is consistent with the simple economic model presented in Section 3 if experiencing an audit raises the perceived probability of detection for self-reported items (where the probability is low initially) but not for third-party reported items (where the probability is close to one initially).

6.3 The Effect of Threat-of-Audit Letters

We now turn to the effect of the threat-of-audit letters, which provide exogenous variation in the probability of audit. As described above, the letters announce audit probabilities of either 50% or 100% to randomly selected taxpayers in the full-audit and no-audit groups. In interpreting the results, it is important to keep in mind that the probability of audit is not the same as

the probability of detection, which is the parameter that ultimately determines tax compliance according to economic theory. The variation in the audit probability creates variation in the detection probability, with the size of the variation depending on the probability of detection conditional on being audited. The conditional probability of detection is unobservable, but is likely to be quite low for self-reported income where tax inspectors have very little hard information to guide them in uncovering hidden income. Hence, while the audit probabilities being imposed in the experiment are extremely high, the detection probabilities are much more modest and the magnitude of the estimates should be interpreted in this light.

In order to study the effects of the threat-of-audit letters, we consider the sample of employees (as the letter randomization did not include self-employed individuals), who filed tax returns in both 2007 and 2008, and who have an address on record so that they could be reached by mail. Because taxpayers received the threat-of-audit letters shortly after receiving the pre-populated return (**P**-event) and about one month prior to the filing deadline (**F**-event) in 2008, we focus on the effect of letters on difference between the **P**- and **F**-events in 2008 (for incomes earned in 2007). These are self-reported adjustments to the pre-population return. The pre-population return includes all third-party information available to the government, and the estimates should therefore be interpreted as effects on self-reported income. In order to obtain sufficient statistical power, we focus on the probability of changing incomes on the pre-population return instead of effects on incomes per se. As noted above, standard errors are much higher for income changes than for the fraction of taxpayers changing income, which makes it easier to detect effects on probabilities than on amounts.

The estimates are shown in Table 7. We start by discussing the results displayed in columns (1)-(5), which show letter effects for the entire sample of employees (including both the 0% and 100% audit groups) and concerns the effect of receiving any letter (50% and 100% letters together). Columns (1) and (2) show the probabilities of self-reported adjustments in the control group (who did not receive a letter) and the treatment group (who did receive a letter). Column (3) reports the difference in adjustment probabilities between the control and treatment groups (column (2)-(1)), while columns (4) and (5) split the total effect on adjustments into the effects on upward and downward adjustments. As an adjustment is either upward or downward, column (3) is the sum of columns (4) and (5). As in earlier tables, standard errors are reported below the estimate in parenthesis. The following three findings emerge.

First, there is a clear significant effect of threat-of-audit letters on the probability of making an adjustment for most income components. For total net income, the probability increases by 2.17 percentage points from a base of 27.55%, corresponding to an increase of 7.9%. The effect is also strongly significant for total tax paid. Interestingly, the effects of letters on adjustment probabilities are relatively larger for income items that are rarely adjusted such as earnings, personal income, and stock income. The percentage increase in adjustment probabilities (columns (3)/(1)) is equal to 17.9% for earnings (marginally significant), 14.6% for personal income, 12.2% for capital income, 2.9% for deductions, and 29.5% for stock income. The small effect on deduction is statistically insignificant. Second, the effect of letters on adjustments reflect primarily *upward* adjustments of taxable income, except for the (statistically insignificant) effects on deductions. This is obviously consistent with the standard economic model: letters increase the perceived probability of detection and therefore deter taxpayers from underreporting. Third, letters also increase the probability of *downward* adjustment of all income items shown in the table, although none of the differences are statistically significant at the 5% level (only 2 of the 7 estimates have a t-statistic above 1.5). The presence of downward adjustments is incompatible with the simple AS-type model presented in Section 2, but can be understood by accounting for transaction costs associated with filing correctly. Filing correct tax returns is costly given the complexity of the tax code. If a return is not correct, the taxpayer faces potential transaction costs of subsequently having to deal with an audit.[44] Therefore, tax filers who receive threats-of-audits might rationally spend more time to file correct returns, reducing filing errors and hence leading to a higher rate of downward adjustments as well.

We now turn to the results in columns (6)-(11), which split the sample by 100% audit and 0% audit in the baseline year. The main conclusion from these estimates is that letter effects are stronger in the 0% audit group than in the 100% audit group. For the 100% audit group, the effects of letters on adjustments (any, downward, and upward) are almost always statistically insignificant. For the 0% audit group, effects tend to be larger and more statistically significant, especially for income components that are very common and rarely adjusted such as earnings, personal income, and capital income. The percentage increase in the probability of

[44] Consistent with this idea, the letters did generate complaints from tax filers who resented being chosen for this special audit study. Presumably, the complainers were honest tax filers who did not plan to deliberately evade taxes, because cheating tax filers would not have complained to SKAT for fear of the signal that this would send to tax inspectors.

any adjustment in the 0% audit group (columns (6)/(1)) is equal to 24.5% for earnings, 30.1% for personal income, and 19.3% for capital income. Moreover, the effects on *upward* adjustments are higher and more significant on average for the 0% audit group, and there is now a significant effect on upward income adjustments from deductions. Effects on *downward* adjustments also tend to be larger for the 0% audit group, although all except one (personal income) are still statistically insignificant.

The fact that letter effects are stronger in the 0% audit group than in the 100% audit group is consistent with our findings from the audit experiment discussed in the previous section. There we concluded that audits raise the perceived probability of detection for self-reported items in the following year. This implies that, when the letter treatment is implemented in the year following the audits, the perceived probability of detection is already high among individuals in the 100% audit group. This effectively weakens the letter treatment and provides an explanation why effects are mostly insignificant in the 100% audit group.

Finally, Table 7 explores the differential effects of the 50% letters and 100% letters. Column (12) shows the difference in adjustment probabilities between the 50%-letter and the no-letter groups, while column (13) shows the difference in adjustments between the 100%-letter and 50%-letter groups. The table shows that there is no evidence that the 100% letters generate more adjustments than the 50% letters. The differences between the 100%-letter and 50%-letter groups are sometime negative and sometimes positive, but they are always statistically insignificant. This result can be explained in the context of the standard economic model if an audit probability of 50% is large enough to push taxpayers to a corner solution with zero *detectable* evasion. Notice that, as the probability of audit becomes sufficiently high, it is optimal to file a report ensuring a zero probability of detection conditional on being audited. This does not imply that taxpayers report truthfully, only that they report income that can potentially be uncovered by the tax inspectors. Because an audit probability of 50% is indeed very high, it is likely to push taxpayers to a corner solution of this type.

7 Conclusion

The economics literature on tax evasion follows on the seminal work of Allingham and Sandmo (1972), who considers a situation where a taxpayer decides how much income to self-report facing a probability of audit and a penalty for cheating. In effect, this type of model considers tax

evasion as another risky asset in a household's portfolio. Micro-simulations as well as laboratory experiments show that, at realistic levels of audit probabilities and penalties, an AS-type setting predicts much less compliance than we observe in practice, at least in developed countries. This suggests that the AS-model misses important aspects of the real-world reporting environment, and a number of different generalizations have been proposed and analyzed in the literature. In particular, several authors have argued that observed compliance levels can only be explained by accounting for psychological or cultural aspects of the reporting decision such as guilt, shame, and a moral obligation to pay taxes.

While we do not deny the importance of psychological and cultural aspects in the decision to evade on taxes and indeed our results show that social factors do play a role, overall the evidence presented in this paper points to a more classic information story. In particular, we show that the key distinction in the taxpayer's reporting decision is whether the income item in question is subject to information reporting from third parties or if the information is collected solely by self-reporting (combined with audit threats and penalties). Unlike previous empirical studies, our data enable us to distinguish precisely between income items subject to each type of reporting. Only the part of income subject to pure self-reporting is adequately described by an AS-type setting, and for such income items we do indeed find that evasion is quite substantial. On the other hand, for the part of income that is subject to third-party reporting, the government has perfect information unless the taxpayer and the third party collude and jointly underreport income. Our study suggests that, absent such collusion, third-party reporting is an extremely effective enforcement device.[45] Our results also suggest that third-party information reporting rather than withholding at source is the most important factor for successful enforcement, a point we plan to investigate more deeply. Given the very costly nature of tax audits and their limited effectiveness is detecting hidden income, we conclude that enforcement resources are better spent protecting third-party tax bases and extending third-party reporting rather than using traditional audits of self-reported items.

[45] Kleven, Kreiner, and Saez (2009) set out a theory of tax evasion providing a mechanism design story that can explain why collusion for tax evasion between individuals and third-party is difficult to sustain in large modern business organization and explaining why third-party reporting is so successful.

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Figure 1: Probability of Detection under Third-Party Reporting

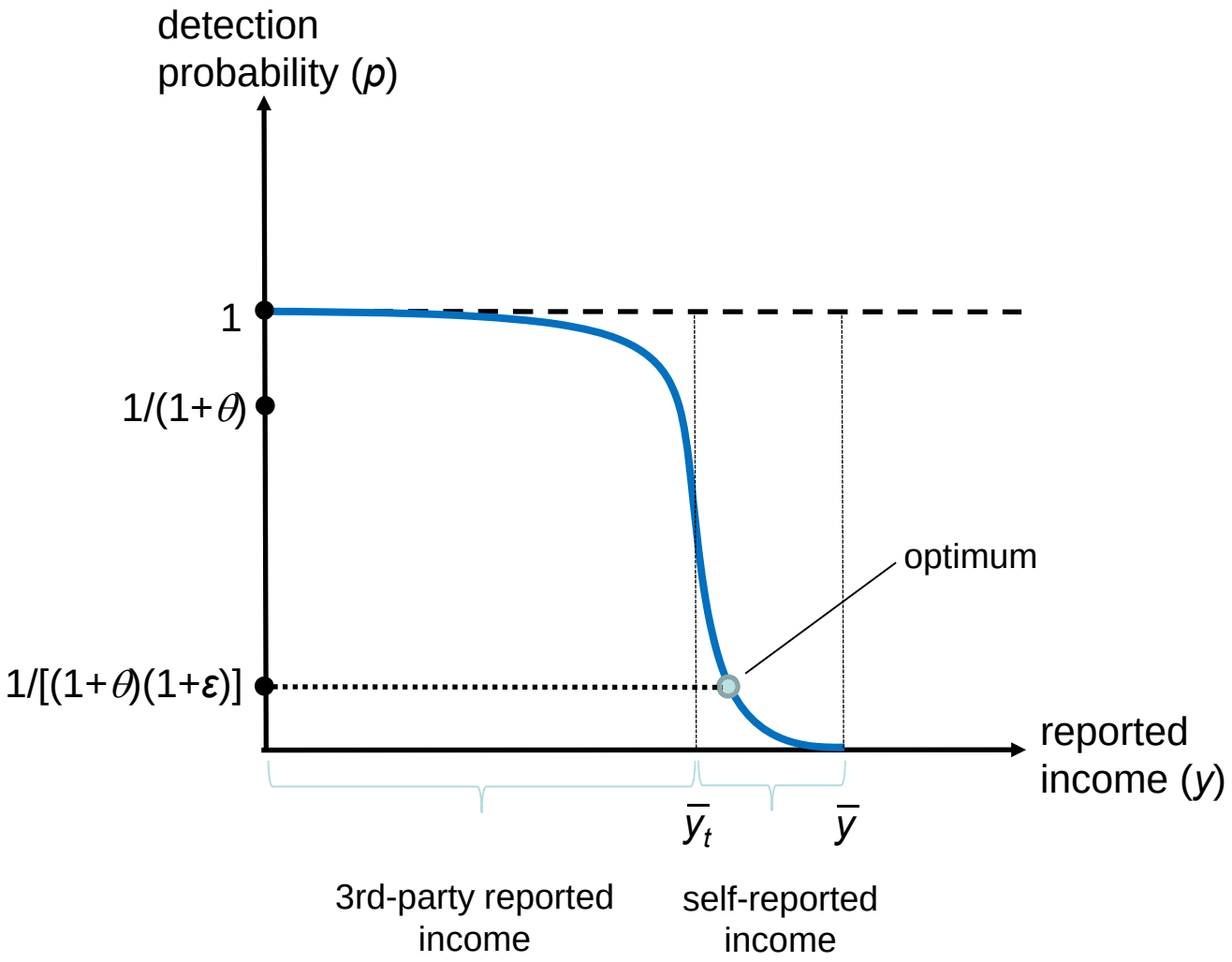

Figure 2. Experimental Design for Employees

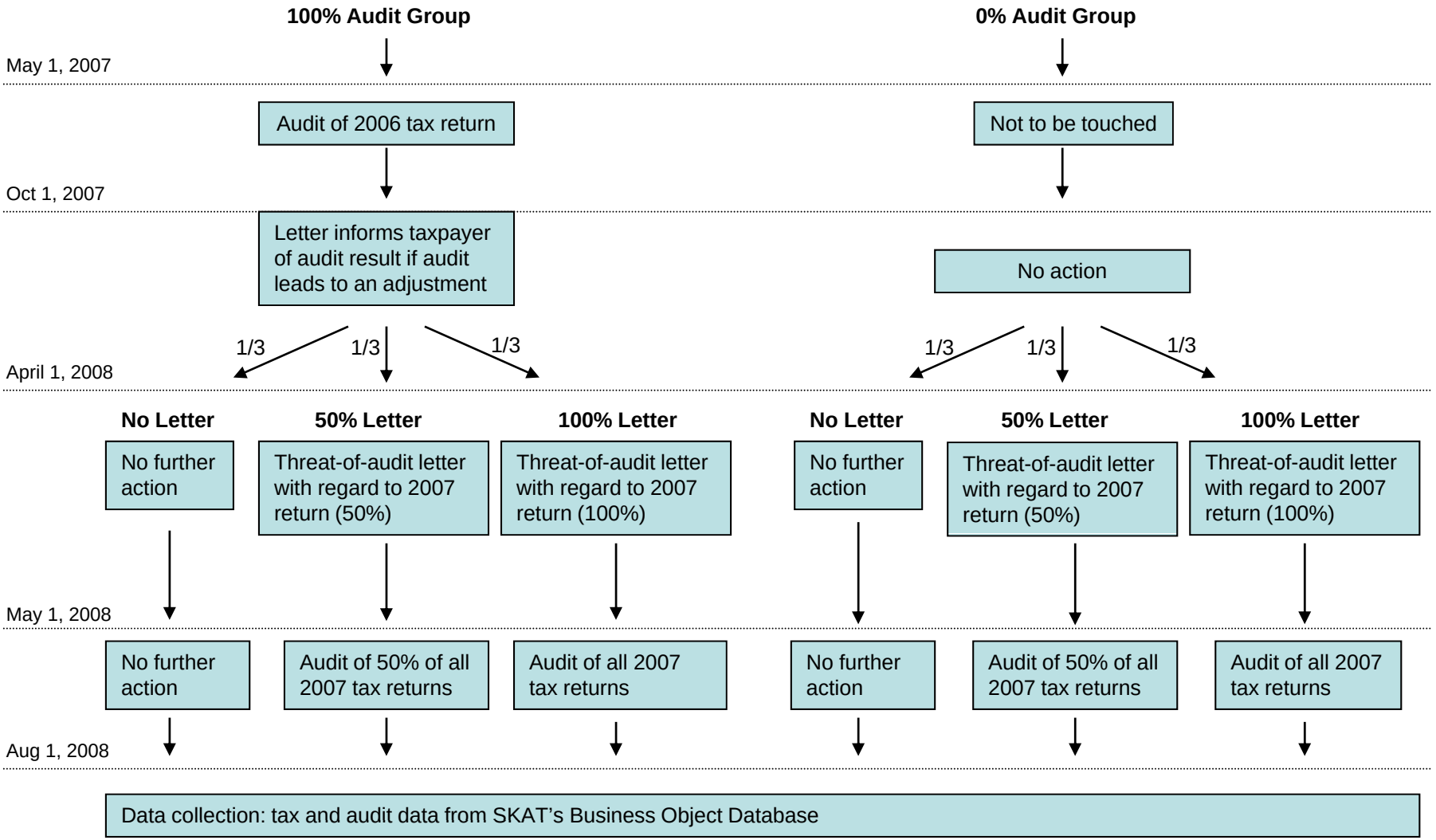

Table 1. Income concepts in the Danish individual income tax in 2006

Income concept	Main items included
1. Labor income	Salary, wages, honoraria, fees, bonuses, fringe benefits, business earnings
2. Personal income	Labor income (1) + transfers, grants, awards, gifts, received alimony – labor market tax, certain pension contributions
3. Capital income	Interest income, rental income, business capital income – interest on debt (mortgage, bank loans, credit cards, student loans)
4. Deductions	Commuting, union fees, UI contributions, other work expenditures, charity, paid alimony
5. Taxable income	Personal income (2) + capital income (3) - deductions (4)
6. Share income	Dividends and realized capital gains from shares

Table 2. Tax rates and tax bases in the Danish individual income tax in 2006

Tax type	Tax base	Bracket (DKK)[1]	Rate (%)
Labor market tax	Labor income	All income	8.0
EITC	Labor income	up to 300.000	2.5
Bottom Tax	Personal income + capital income if > 0	38,500-	5.5
Middle Tax	Personal income + capital income if > 0	265,500-	6.0
Top Tax	Personal income + capital income if > 0	318,700-	15.0[2]
Regional tax	Taxable income	38,500-	32.6[3]
Tax on shares	Share income	0-44,400; 44,400-	28.0; 43.0

1. All amounts in Danish Kroner (DKK). DKK 5 $\simeq$ USD 1.
2. This rate may be affected by a tax ceiling on the total marginal tax rate (see below).
3. The regional tax includes municipal + county taxes in 2006. The rate shown is the average across all municipalities, and includes an optional church tax equal to 0.7%.

Table 3. Audit Adjustments Decomposition

		A. Under-reporting vs. Over-reporting				B. Third party vs. self-reported			
		Pre-audit Income	Total Audit adjustment	Under-reporting	Over-reporting	Third party income	Third party under-reporting	Self-reported income	Self-reported under-reporting
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Net Income and Total Tax									
Net Income	Amount	206,038	3,744	4,255	-511	195,969	536	10,070	3,719
		(2,159)	(439)	(424)	(132)	(1,798)	(80)	(1,380)	(416)
	Percent	98.38	10.33	8.39	2.86	98.57	1.72	38.18	7.28
		(0.09)	(0.22)	(0.20)	(0.12)	(0.08)	(0.09)	(0.35)	(0.19)
Total Tax	Amount	69,940	1,670	1,782	-112				
		(1,142)	(223)	(222)	(21)				
	Percent	90.76	10.08	7.85	2.23				
		(0.21)	(0.21)	(0.19)	(0.11)				
Positive and Negative Income									
Positive Income	Amount	243,984	3,449	3,719	-271	223,882	536	20,102	3,183
		(2,511)	(437)	(419)	(122)	(1,860)	(80)	(1,693)	(411)
	Percent	98.24	6.98	5.54	1.44	98.15	1.72	19.53	4.11
		(0.09)	(0.18)	(0.16)	(0.08)	(0.10)	(0.09)	(0.28)	(0.14)
Negative Income	Amount	-37,946	296	536	-240	-27,913		-10,032	536
		(1,014)	(73)	(53)	(50)	(406)		(862)	(53)
	Percent	79.09	5.25	3.70	1.55	78.21		29.49	3.70
		(0.29)	(0.16)	(0.13)	(0.09)	(0.29)		(0.33)	(0.13)
Income Components									
Earnings	Amount	161,745	619	661	-42	161,726	427	19	234
		(1,599)	(94)	(92)	(16)	(1,530)	(77)	(484)	(49)
	Percent	65.39	1.47	1.35	0.12	65.29	1.00	5.51	0.40
		(0.34)	(0.09)	(0.08)	(0.02)	(0.34)	(0.07)	(0.16)	(0.04)
Personal Income	Amount	209,681	2,343	2,472	-128	211,244	475	-1,563	1,997
		(1,473)	(402)	(401)	(34)	(1,385)	(78)	(540)	(393)
	Percent	95.18	2.71	2.10	0.65	95.20	1.31	11.61	0.85
		(0.15)	(0.12)	(0.10)	(0.06)	(0.15)	(0.08)	(0.23)	(0.07)
Capital Income	Amount	-11,075	156	335	-178	-14,556	33	3,481	302
		(340)	(160)	(56)	(150)	(602)	(7)	(542)	(55)
	Percent	93.93	2.42	1.79	0.89	94.91	0.31	12.29	1.55
		(0.17)	(0.11)	(0.09)	(0.07)	(0.16)	(0.04)	(0.23)	(0.09)
Deductions	Amount	-9,098	129	206	-77	-5,666		-3,432	206
		(104)	(18)	(16)	(10)	(48)		(85)	(16)
	Percent	60.07	3.73	2.61	1.12	57.61		22.60	2.61
		(0.35)	(0.14)	(0.11)	(0.08)	(0.35)		(0.30)	(0.11)
Stock Income	Amount	5,635	274	308	-33	3,783	31	1,852	276
		(1,405)	(48)	(46)	(12)	(976)	(12)	(943)	(45)
	Percent	22.47	1.03	0.84	0.19	22.44	0.07	2.45	0.79
		(0.30)	(0.07)	(0.07)	(0.03)	(0.30)	(0.02)	(0.11)	(0.06)
Self-Employment	Amount	10,398	838	1,086	-248	1,164	10	9,234	1,075
		(812)	(124)	(130)	(60)	(177)	(4)	(816)	(130)
	Percent	7.63	2.88	2.59	0.63	1.40	0.09	7.66	2.54
		(0.19)	(0.12)	(0.11)	(0.06)	(0.08)	(0.02)	(0.19)	(0.11)

Notes: Column (1) displays income or tax reported before audits, column (2) displays the net audit adjustment, column (3) displays under-reporting in the audit adjustment (upward audit adjustments unfavorable to the tax filer), column (4) displays over-reporting in the audit adjustment (downward audit adjustments favorable to the tax filer). Note that (2)=(3)+(4).

Column (5) displays third party income, column (6) displays third-party income under-reporting (defined as upward audit adjustments in case where third party income is higher than final reported income for positive income items), column (7) displays self reported income (defined as total reported income minus third party reported income), column (8) displays self-reported income under-reporting (defined all upward audit adjustments net of third-party income under-reporting). Note that (5)+(7)=(1) and (6)+(8)=(3).

Panel 1 reports net income (sum of all positive income components minus all negative income components and other deductions) and total tax. Panel 2 reports positive income (sum of all positive income components) and negative income (sum of all negative income components and deductions). Panel 3 displays various earnings components. Earnings is defined as employment earnings. Personal income is earnings, pensions, alimony, minus some retirement contributions. Capital income is interest income, returns on bonds, net rents, minus all interest payments. Deductions include work related expenses, union fees, charitable contributions, alimony paid, and various smaller items. Stock income includes dividends and realized capital gains on stocks. Self-employment income is net profits from unincorporated businesses. Net income is personal income, capital income, stock income, self-employment income, foreign income (not reported specifically), minus deductions.

For each income component, the first row reports the amounts in Danish Kroner (US $1 = DKK 5) and the second row reports the percent of filers with non-zero amounts. Negative amounts are reported in negative. All estimates are population weighted and based solely on the 100% audit group (19,680 observations). Standard errors reported in parenthesis.

Table 4A. Audit Adjustments by Income Groups

	A. Probability of Audit		B. Audit Adjustment Amount	
	(1)	(2)	(4)	(5)
Constant	10.33	6.33	3,744	9,158
(percentile 0 to 25 omitted)	(0.22)	(0.43)	(439)	(874)
Income Percentile 25 to 50		0.81		-8,180
		(0.61)		(1,244)
Income Percentile 50 to 75		5.78		-7,736
		(0.61)		(1,243)
Income Percentile 75 to 95		6.17		-7,297
		(0.65)		(1,320)
Income Percentile 95 to 99		16.89		-5,189
		(1.18)		(2,404)
Income Percentile 99 to 100		13.37		-1,112
		(2.32)		(4,742)
Negative Income		30.57		10,700
		(1.91)		(3,916)

Notes: This table reports coefficients of the regression of an audit adjustment dummy (Panel A columns (1) to (2)) and the audit adjustment amount (Panel B columns (3) to (4)) on various regressors. In columns (1) and (3), the only regressor is a constant. In columns (2) and (4), dummies by size of total income are added. We use income after audits to define income percentiles. Negative income is a dummy for having negative total income. Percentile X to Y denotes a dummy for having positive income falling into percentile X to Y. The omitted income group is percentile 0 to 25. Audit adjustments are 30.57 points more likely when total income is negative (relative to having positive income in percentile 0 to 25). All the amounts are in Danish Kroner (US $1 = DKK 5). All estimates are population weighted and based solely on the 100% audit group (19,680 observations). Standard errors reported in parenthesis.

Table 4B. Probability of Audit Adjustments: Socio-economics vs. Tax Return factors

		A. Basic Variables					B. Detailed Variables			
		Social factors	Socio-economic factors	Tax return factors	All factors		Social factors	Socio-economic factors	Tax return factors	All factors
		(1)	(2)	(3)	(4)		(5)	(6)	(7)	(8)
Constant		12.81	11.74	2.49	3.71		8.04	4.68	2.02	4.47
		(0.42)	(0.44)	(0.26)	(0.44)		(0.78)	(0.89)	(0.81)	(1.08)
Female Dummy		-5.83	-5.29		-2.40		-5.50	-4.25		-2.07
		(0.43)	(0.44)		(0.42)		(0.43)	(0.45)		(0.43)
Married Dummy		1.56	1.52		-1.65		-0.68	-1.26		-2.34
		(0.46)	(0.46)		(0.43)		(0.49)	(0.48)		(0.46)
Geographical Location	Copenhagen dummy	0.08	0.50		2.00	6 location	p-value	p-value		p-value
		(0.66)	(0.66)		(0.61)	dummies	0.01	0.02		0.00
Age	Age>45 dummy	-0.46	-0.19		0.56	4 age group	p-value	p-value		p-value
		(0.45)	(0.45)		(0.43)	dummies	0.00	0.00		9.31
Firm Size	Firm size<10 dummy		4.34		3.49	5 firm size		p-value		p-value
			(0.82)		(0.77)	dummies		0.00		0.00
Industrial Sector	Informal sector dummy		3.80		-0.91	22 industry		p-value		p-value
			(0.86)		(0.81)	dummies		0.00		0.00
Self-Reported Income Dummy				11.26	11.40				9.53	9.72
				(0.53)	(0.54)				(0.57)	(0.57)
(Self-Reported Income>20,000DKK)				20.68	20.02				11.37	10.22
				(0.92)	(0.93)				(1.08)	(1.09)
(Self-Reported Income<-10,000DKK)				17.08	17.00				16.86	16.59
				(0.73)	(0.73)				(0.72)	(0.73)
Self-Employed Dummy									14.30	11.96
									(1.03)	(1.31)
Capital Income Dummy									-0.19	0.00
									(0.85)	(0.86)
Stock Income Dummy									3.00	3.59
									(0.49)	(0.51)
Deduction Dummy									0.05	0.18
									(0.46)	(0.59)
Auditing Flag Dummy									-0.02	0.54
									(1.44)	(1.44)
R-square		1.01%	1.31%	14.26%	14.61%		2.19%	6.09%	15.48%	16.43%
Adjusted R-square		0.99%	1.28%	14.25%	14.57%		2.14%	5.92%	15.44%	16.25%

Notes: This table reports coefficients of the regression of an audit adjustment dummy on various dummy regressors. Bottom rows report the R-square and adjusted R-squares from the OLS regressions. All estimates are population weighted and based solely on the 100% audit group (19,680 observations). Standard errors reported in parenthesis. In Panel A (columns (1) to (4)), we include a basic set of dummy variables, while a richer set of variables is included in Panel B (columns (5) to (8)). In Panel B, we do not report the full set of coefficients for geographical, age, firm size, and industrial sector. We instead only report the p-value from an F-test that the coefficients of those dummies are all equal to zero (for each category). The 6 location dummies are defined as Copenhagen, North Sealand, Middle and South Sealand, South Denmark, Middle Jutland, and North Jutland. The 4 age dummies are for age groups 0-25, 26-45, 46-65, 65+. The 5 firm size dummies are for firms' size: 1, 2-10, 11-100, 101-1000, 1001+. For income categories, self-employed dummy means non zero self-employment income, etc.

Table 5. Randomization Checks: Audit and Letter experiments

	A. Audit randomization				B. Letter Randomization			
	0% audit group	100% audit group	Difference 100%-0%	Difference standard error	No Letter group	Letter group	Difference L-NL	Difference standard error
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Net Income	266,690	267,059	369	(6,133)	243,393	249,386	5,994	(3,427)
Total Tax	101,465	102,031	566	(3,059)	83,360	85,620	2,260	(1,608)
Earnings	185,383	187,547	2,164	(2,401)	206,426	208,586	2,159	(3,373)
Personal Income	219,501	220,639	1,138	(2,422)	261,226	263,949	2,723	(2,949)
Capital Income	-12,987	-12,948	38	(1,057)	-16,853	-15,906	947	(529)
Deductions	-11,999	-12,153	-155	(163)	-8,400	-8,265	136	(152)
Stock Income	18,421	16,570	-1,851	(5,075)	6,259	8,334	2,075	(1,689)
Self-Employment	53,740	54,684	944	(2,727)				
Female (%)	40.25	39.92	-0.33	(0.49)	50.01	50.34	0.33	(0.69)
Age	49.18	49.32	0.14	(0.16)	48.73	48.53	-0.19	(0.25)
% with Net Income	99.79	99.76	-0.03	(0.05)	99.85	99.83	-0.02	(0.05)
% with Total Tax	97.04	96.93	-0.10	(0.17)	96.93	96.64	-0.30	(0.24)
% with Earnings	64.88	64.70	-0.17	(0.47)	69.22	69.78	0.56	(0.63)
% with Personal Income	95.54	95.45	-0.09	(0.21)	98.58	98.47	-0.11	(0.17)
% with Capital Income	96.19	95.90	-0.29	(0.19)	98.48	98.40	-0.07	(0.17)
% with Deductions	72.90	73.02	0.12	(0.44)	65.47	65.75	0.28	(0.65)
% with Stock Income	40.88	40.98	0.10	(0.49)	44.94	44.37	-0.57	(0.68)
% with Self-Employment	39.96	40.03	0.07	(0.49)				
Number of observations	22,048	18,554	40,602		9,116	14,824	23,940	

Notes: This table presents randomization checks for the audit experiment (panel A, cols. (1) to (4)) and the letter experiment (panel B, cols. (5) to (8)). Panel A compares baseline reported incomes in 2006 (before the audit or letter experiments took place). Columns (1) and (2) present the baseline averagesfor the treatment group and control group respectively. Column (3) presents the difference between the treatment group and the control group. The standard error of the difference is presented in column (4). Panel B compares pre-populated tax returns for 2007 incomes before the letters are sent. The columns are constructed similarly to Panel A.

In panel B, the sample is restricted to tax filers with no self-employment in base year as the letter experiment was limited to tax filers with no self-employment income. Estimates are weighted according to the experiment stratification design. Weights do not reflect population weights. All the amounts are in Danish Kroner (US $1 = DKK 5).

Table 6. Effects of Prior Audits on Year to Year Income Changes

	Baseline	Total Income Change			Self-Reported Income Change			Third-Party Reported Income Change		
	Audit adjustment in 100% audit group	Increase in 0% audit group	Increase in 100% audit group	Difference 100% audit vs. 0% audit	Increase in 0% audit group	Increase in 100% audit group	Difference 100% audit vs. 0% audit	Increase in 0% audit group	Increase in 100% audit group	Difference 100% audit vs. 0% audit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A. Probability of Income Increase from 2006 to 2007 (percent)										
Net Income	21.97	61.48	62.54	1.06	37.85	40.00	2.15	59.78	60.09	0.31
	(0.30)	(0.33)	(0.36)	(0.48)	(0.33)	(0.36)	(0.48)	(0.33)	(0.36)	(0.49)
Total Tax	21.50	56.72	57.81	1.09						
	(0.30)	(0.33)	(0.36)	(0.49)						
Earnings	1.50	43.22	43.20	-0.02	4.65	4.75	0.10	43.04	42.93	-0.11
	(0.09)	(0.33)	(0.36)	(0.49)	(0.14)	(0.16)	(0.21)	(0.33)	(0.36)	(0.49)
Personal Income	2.81	64.45	64.95	0.49	11.24	11.65	0.41	64.21	64.72	0.52
	(0.12)	(0.32)	(0.35)	(0.47)	(0.21)	(0.24)	(0.32)	(0.32)	(0.35)	(0.48)
Capital Income	4.26	44.74	44.60	-0.14	22.33	22.71	0.39	43.16	43.33	0.17
	(0.15)	(0.33)	(0.36)	(0.49)	(0.28)	(0.31)	(0.41)	(0.33)	(0.36)	(0.49)
Deductions	4.49	27.97	28.65	0.68	17.50	18.41	0.92	20.24	20.30	0.07
	(0.15)	(0.30)	(0.33)	(0.45)	(0.26)	(0.28)	(0.38)	(0.27)	(0.30)	(0.40)
Stock Income	1.69	23.98	24.45	0.47	5.45	5.66	0.21	23.34	23.63	0.30
	(0.09)	(0.29)	(0.32)	(0.43)	(0.15)	(0.17)	(0.23)	(0.28)	(0.31)	(0.42)
Self-Employment	14.42	20.59	22.27	1.68	20.61	22.18	1.58	3.52	3.64	0.12
B. Amount of Income Change from 2006 to 2007										
Net Income	5261	5830	8657	2826	2488	4897	2409	3343	3760	417
	(503)	(534)	(578)	(784)	(450)	(490)	(663)	(469)	(516)	(694)
Total Tax	2367	2433	3802	1368						
	(158)	(322)	(344)	(470)						
Earnings	447	6725	6888	163	20	183	162	6705	6706	1
	(91)	(424)	(466)	(627)	(103)	(106)	(147)	(421)	(463)	(623)
Personal Income	463	8433	8899	467	37	-19	-56	8396	8918	522
	(114)	(429)	(463)	(629)	(184)	(196)	(268)	(410)	(447)	(604)
Capital Income	74	-3648	-3555	92	2701	2662	-40	-6349	-6217	132
	(480)	(188)	(208)	(279)	(210)	(231)	(311)	(205)	(226)	(304)
Deductions	102	243	374	130	-101	-30	70	344	404	60
	(23)	(67)	(72)	(98)	(67)	(72)	(98)	(23)	(24)	(33)
Stock Income	521	856	1339	482	-57	588	645	914	751	-163
	(74)	(205)	(215)	(296)	(167)	(173)	(241)	(135)	(146)	(198)
Self-Employment	4062	226	1960	1733	752	2567	1815	-525	-607	-82
	(285)	(394)	(431)	(582)	(398)	(439)	(590)	(138)	(159)	(209)

Notes: This table reports the effects of prior-audits on income changes from 2006 to 2007. Panel A focuses on the probability of a (nominal) income increase while Panel B focuses on the amounts of income changes. Column (1) reports the fraction with an audit adjustment in 100% audit group in base year (Panel A) and the average amount of the audit adjustment in base year (Panel B). Columns (2) and (3) report the fraction with an income increase from 2006 to 2007 (Panel A) or the average income increase from 2006 to 2007 (Panel B) for the 0% audit group and the 100% audit group respectively. Each row corresponds to a given income items. The complete definition of each income item is given in Table 3. Column (4) reports the difference between column (3) and column (2). Columns (5) to (7) repeat the analysis of cols. (2)-(4) limited to self-reported incomes instead of total reported income. Columns (8) to (10) repeat the analysis limited to third-party reported incomes instead of total reported income.

All income items are estimated for the full sample (40,602 observations). Estimates are weighted according to the experiment stratification design. Weights do not reflect population weights. Standard errors are reported in parenthesis.

For panel B, all the amounts are in Danish Kroner (US $1 = DKK 5). Income changes are trimmed at -200,000 DKK and 200,000 DKK. That is, income changes are defined as min(200000,max(income in 2007-income in 2006,-200000). This is done to avoid extreme outcomes which make estimates very imprecise. Less than 2% of observations are trimmed on average.

Table 7. Threat-of-Audit Letter Effects on Probability of Adjusting Reported Income (in percent)

	No Letter Group	Letter Group	Differences Letter Group vs. No Letter Group									50% Letter - No letter	100% Letter - 50% letter
	Both 0% and 100% audit groups		Both 0% and 100% audit groups			0% audit group only			100% audit group only			Both 0% and 100% audit groups	
	Baseline	Baseline	Any Adjustment	Upward Adjustment	Downward Adjustment	Any Adjustment	Upward Adjustment	Downward Adjustment	Any Adjustment	Upward Adjustment	Downward Adjustment	Any Adjustment	Any Adjustment
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Net Income	27.55	29.71	2.17	1.28	0.88	2.28	1.24	1.03	2.06	1.32	0.74	2.20	-0.06
	(0.47)	(0.38)	(0.62)	(0.35)	(0.57)	(0.82)	(0.46)	(0.75)	(0.95)	(0.55)	(0.86)	(0.72)	(0.72)
Total Tax	28.05	30.02	1.98	1.27	0.70	1.84	1.37	0.47	2.11	1.17	0.94	2.10	-0.25
	(0.47)	(0.38)	(0.62)	(0.35)	(0.57)	(0.83)	(0.46)	(0.76)	(0.95)	(0.55)	(0.87)	(0.72)	(0.72)
Earnings	1.96	2.31	0.35	0.31	0.04	0.48	0.29	0.19	0.22	0.33	-0.12	0.45	-0.21
	(0.15)	(0.12)	(0.20)	(0.18)	(0.10)	(0.26)	(0.22)	(0.13)	(0.32)	(0.28)	(0.14)	(0.23)	(0.23)
Personal Income	4.25	4.87	0.62	0.31	0.31	1.28	0.55	0.73	-0.04	0.07	-0.11	0.77	-0.31
	(0.21)	(0.18)	(0.29)	(0.21)	(0.20)	(0.38)	(0.27)	(0.27)	(0.44)	(0.33)	(0.31)	(0.33)	(0.33)
Capital Income	7.48	8.39	0.91	0.76	0.15	1.44	1.01	0.43	0.38	0.50	-0.12	0.64	0.53
	(0.28)	(0.23)	(0.37)	(0.31)	(0.22)	(0.49)	(0.41)	(0.29)	(0.58)	(0.49)	(0.33)	(0.43)	(0.43)
Deductions	20.27	21.00	0.73	0.11	0.62	0.21	0.29	-0.07	1.25	-0.06	1.31	1.13	-0.80
	(0.42)	(0.33)	(0.56)	(0.08)	(0.55)	(0.74)	(0.10)	(0.73)	(0.85)	(0.13)	(0.84)	(0.64)	(0.64)
Stock Income	2.17	2.81	0.64	0.61	0.03	0.60	0.40	0.20	0.68	0.83	-0.15	0.50	0.28
	(0.15)	(0.14)	(0.22)	(0.20)	(0.10)	(0.28)	(0.25)	(0.13)	(0.35)	(0.31)	(0.15)	(0.25)	(0.25)
Number of Obs.	9,116	14,824	23,940	23,940	23,940	13,706	13,706	13,706	10,234	10,234	10,234	23,940	23,940

Notes: Columns (1) and (2) report the fraction (in percent) of taxfilers which adjust a given income item (listed on the left hand side) in the group who did not receive the letter and the group who received the letter. For each income component listed on the left column (see footnote of Table 3 for complete definitions), the table reports the effects of letters on the probability that the taxfiler adjusts the reported income when filing his income tax return. Column (3) reports the difference in fraction adjusting (col. (2)-col. (1)) between the letter and no letter groups. Column (4) reports the difference in fraction adjusting upward while column (5) reports the difference in fraction adjusting downward (col. (4)+col. (5)=col. (3)). Cols. (6), (7), (8) repeat cols. (3), (4), (5) but limiting the sample to those not audited in base year (0% audit group). Cols. (9), (10), (11) repeat cols. (3), (4), (5) but limiting the sample to those audited in base year (100% audit group). Column (12) reports the difference in adjustments between the letter group with 50% audit chance and the no letter group. Column (13) reports the difference in adjustments between the letter group with 100% audit chance and the letter group with 50% audit chance.

The sample includes only taxfilers who did not have any self-employment income in base year (as taxfilers with self-employment income were not part of the letter experiment). Estimates are weighted according to the experiment stratification design. Weights do not reflect population weights. Standard errors are reported in parenthesis.