

# Does the marginal tax rate affect activity in the informal sector?\*

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## Abstract:

This paper measures the effect of changing the marginal tax rate on earned income on the supply of labor to the informal sector with the purpose of evading taxation. Unlike any previous study, we do this by directly measuring the effect of a Danish 2010 tax reform that changed the marginal rate of taxation of earned income from 63 percent to 56 percent. The analysis is based on longitudinal survey data collected over the period 2009–2012. In each survey round we asked people about their activity in the informal sector. The effect of the tax reform on informal sector activity is measured by comparing the evolution of informal sector activity from 2009 to 2012 for people who in 2009 paid the middle and top rate of tax with people who did not. We find that there is no connection between the marginal tax rate and the supply of labor to the informal sector. As part of the survey we asked people about their perceived marginal net-of-tax income, and we show that the survey participants did not change their perception of their marginal net-of-tax income from before to after the reform. This suggests that the respondents in our survey were not aware of the implications of the reform. Our results indicate the changing the after-tax price of services is not an effective way of reducing undeclared work.

Keywords: informal sector, labor supply, tax reform, panel data.

JEL codes: H24, H26, H31.

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## 1. Introduction

Existing evidence shows that underreporting of taxable income and other noncompliance with tax regulations constitutes about 8–14 percent of total tax payments due in the US and Europe, with large variations across both countries and groups within countries (Slemrod, 2007). Evasion of income tax payments is thus an issue of major importance in many countries.

In this paper we investigate the informal sector labor supply effects of a 2010 tax reform that reduced the marginal taxation on labor income. We adopt the definition set out in Pedersen (2003), and used among others by Schneider (2005), and define informal economy activities as the production and exchange of goods and services that are not illegal in themselves, but where the activity is deliberately concealed from the tax authorities in order to avoid paying taxes or social security contributions. Informal sector activities may also be motivated by a wish to avoid complying with legal standards, including workplace safety requirements, or to avoid complying with required administrative procedures such as income reporting. The form of the payment derived from informal sector activities is not important in this definition; payment may be in the form of cash, a quid pro quo, or a combination of the two. What we have in mind is regular but undeclared work, for example that supplied by a carpenter who supplements his regular paycheck by working after hours without declaring his additional income, giving him the opportunity to charge a lower price and thereby benefitting both himself and the buyer. We do not have in mind illegal activities such as drug dealing or burglary. As explained in Slemrod and Weber (2011), this definition of the informal economy overlaps somewhat with the traditional concept of tax evasion, but the concepts are not identical.

According to the canonical model of tax evasion, Allingham and Sandmo (1972), tax filers evade tax if the expected benefits are high and/or the costs of evading are low. The expected pay-off from activity in the informal sector increases when the pay for such activities increases, and it decreases when the risk of detection and the size of the punishment increase. The reduction in the marginal tax rate on earnings in the formal sector could potentially reduce activity in the informal sector, because the relative return on activity in the formal sector is increased (for a given level of auditing risk and penalty). The expected returns framework also implies that lowering the penalty and/or the auditing risk will increase evasion, and experimental evidence confirms the conjecture that changing the risk of detection will affect evasion by those with more opportunity to evade (Slemrod et al., 2001 and Kleven et al., 2011). Kleven et al., 2011 shows that evasion rate for third-party

reported items is small whereas the evasion rate for self-reported items is significant. Their evidence suggests that the effect of changing the marginal amount of taxation (e.g., lowering the gain from evasion) on evasion will be largest on the evasion prone self-reported items. Interestingly, in theoretical terms, the effect on evasion of changing the marginal taxation of income is ambiguous, and it has yet to be determined empirically whether or not this channel is important (Kleven et al., 2011).

Clotfelter (1983) and Feinstein (1991) use data from the US Tax Compliance Measurement Programs and test for the importance of marginal tax rates on evasion. They both find that the marginal tax rate is positively correlated with evasion. These studies are, however, based on cross-sectional data, and estimates are therefore effectively obtained by comparing people with high and low marginal tax rates. Identifying the effect using such a design is challenging, because unobserved factors relating to ability to evade and/or to preferences may vary across individuals and thus confound such comparisons. In addition, the marginal tax rate may be endogenous, insofar as behavior in the two sectors is influenced by unobserved factors that contribute to determining the level of activity in both sectors, for example specific skills, productivity levels, and networks of costumers. Lemieux et al. (1994) use survey data where respondents were asked directly about underground economy jobs, and find a large negative elasticity of underground-sector hours with respect to the wage rate in the formal sector, although the distortion is not economically significant for regular wage earners, who are unlikely to participate in the informal sector. Perhaps the most compelling evidence is provided by Kleven et al. (2011), who conducted a randomized auditing field experiment in combination with discontinuity in marginal tax rates around the top-rate tax threshold in the Danish tax schedule to identify the effect of the marginal tax rate on evasion. Their design is arguably more powerful in detecting and quantifying the effect of changing the marginal tax rate on evasion than the designs used in most previous studies. They find that the marginal tax rate has at most a small positive substitution effect on tax evasion for individuals with substantial self-reported income. However, their design is based on tax audits, and is therefore unlikely to include income or exchange of goods and services not involving some kind of recording related to the exchange, i.e. they are not likely to capture moonlighting and cash-in-hand payments, or informal exchanges of services and goods. What is more, they do not have much to say about the reasons behind their finding only a small effect.

Measuring economic activity in the informal sector is complicated, because it typically involves some illegal activity that people have no wish to have recorded. We follow Lemieux et al. (1994) and attempt to measure activity in the informal sector by “brute force”, i.e. by asking subjects directly in a telephone survey how much activity they have carried out in the informal sector. However, instead of estimating the effect of the tax rate by means of a cross-sectional comparison, we take a more direct approach and measure the effect of changing the marginal tax rate on the level of activity in the formal sector subsequent to the Danish 2010 tax reform, using a panel data set from before and after the reform. The reform itself reduced the highest marginal tax rate,  $\tau$ , from 63 percent to 56 percent, equivalent to a change in the after-tax rate,  $1-\tau$ , of close to 20 percent.

By using longitudinal data rather than cross-sectional data we can control for unobserved influences that do not change over time, which is likely to be important in this context. Within-individual comparisons enable us to control for idiosyncratic productivity in the formal/informal sector and differences in the ability to evade tax, to the extent that these factors are constant across the periods on either side of the reform. In order to obtain longitudinal data about the supply of labor in the informal sector, we conducted a repeated survey about economic activity in the informal sector with a stratified random sample drawn from a population consisting of males aged 18–45 who had completed vocational training, who were either employed or self-employed, and who had reported incomes in a range likely to be affected by the 2010 tax reform that changed the marginal tax rate. We focused on this sample because it included people who were most likely to be active in the informal sector and therefore more likely to reallocate activity from the informal sector to the formal sector. Also, third party reporting to tax authorities / withholding tax at source is less frequent/possible in this area, and this increases the scope for engaging in activity in the informal sector. This is common for the US (Slemrod, 2007) and for Denmark, where Kleven et al. (2011) have shown that the self-employed form the category for which the volume of self-reporting is the greatest.

There is natural skepticism concerning the possibility of measuring activity in the informal sector using survey methods (see for example Slemrod 2007; Slemrod and Weber 2012). The criticism is that it is unlikely that respondents will tell the truth when asked delicate questions, and that this misreporting leads to a downwards bias in reports of activity in the informal sector. We show that respondents’ answers about income in the formal sector are correlated with third-party reporting of

income in the formal sector. While this does not guarantee that answers about activity in the informal sector are correct, it does provide some evidence that respondents answer truthfully. We also show that the data contain the same type of cross-sectional variation as in the data used by Lemieux et al. (1994). We then use a simple differences-in-differences design and find that changing the marginal tax rate has no detectible effect on activity in the informal sector, either by affecting the number of people participating in informal sector activities or by changing the level of activity of those already participating before the tax reform. The results are robust to various changes in the specification. We also asked respondents in our survey about whether they understood the changes in the tax system. Specifically, we asked how much additional money people thought they would receive after tax if their earnings increased by DKK 1,000. Comparing answers across the point of the tax reform revealed that respondents did not understand that the reform increased the after-tax return to activity in the formal sector. The fact that people were not able to correctly state the incentive they had to work in the formal sector gives some credibility to the null result, because no effect can be expected if respondents do not understand the incentive. Our results suggest that differences in evasion are not driven directly by the changes in the tax incentive. This is consistent with Kleven et al. (2011), who show that the auditing threat is much more important than marginal tax rates for achieving compliance. Our results suggest that this is because people do not fully understand the incentives provided by the tax system.

The next section presents details about the institutional setup in Denmark concerning taxation of labor income and details of the 2010 tax reform. Section 3 presents the data and Section 4 the results. Finally, Section 5 concludes.

## **2. Institutional background**

Denmark has an individual-based tax system, i.e. members of couples are taxed separately.<sup>1</sup> In 2009, i.e. before the reform, taxpayers were subject to a gross labor market tax (LT) of 8 percent of labor income (LI), and a municipal and regional tax of around 32.8 percent of LI minus LT, varying slightly according to place of residence. On top of this they faced a three-tiered progressive state tax

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<sup>1</sup> The system has a few elements of joint taxation for spouses. For example, in 2009 when computing the middle level tax of the three levels of income tax, it was possible to transfer unutilized allowances between spouses, meaning that some married persons with income in a certain range pay the top tax but not the middle tax.

consisting of a “bottom tax” (5.04 percent of LI minus LT), a “middle tax” (6 percent of LI minus LT) and a “top tax” (15 percent of LI minus LT). In 2009 the middle and top tax thresholds were in alignment, with both these taxes being paid on labor income exceeding DKK 377,000. With an exchange rate of DKK 6 per US Dollar, the top/middle tax threshold of DKK 377,000 corresponds to around USD 63,000. See, for example, Kleven and Schultz (2013) for more details on the Danish tax system.

From January 2010 the tax system was reformed.<sup>2</sup> The declared goal of the reform was to reduce the taxation of labor income in order to stimulate labor supply. The tax cut on labor income was financed primarily by decreasing the value of deductions (including deductions for interest payments on loans), reducing business subsidies, and increasing energy and environmental taxes, thus keeping the government revenue roughly constant. The reform mainly reduced marginal tax rates on labor income for high-wage earners. This was done by raising the top tax income cutoff point from DKK 377,000 to DKK 424,000, by removing the middle tax bracket and by reducing the bottom tax rate to 3.67 percent. This produced a reduction in the marginal tax rate for high-wage earners,  $\tau$ , from 63 to 56 percent, equivalent to a change in the after-tax rate,  $1-\tau$ , of about 20 percent for individuals affected by these changes. Due to the pre-reform alignment of the middle and top tax bracket individuals with incomes in the range DKK 377,000 to DKK 424,000 experienced an even higher reduction in the marginal tax rate from 63 percent to 42.1 percent. Individuals with incomes just below the top/middle tax threshold were subject to a marginal tax rate of 43.4 percent before the reform and 42.1 percent after the reform, and thus experienced a change in the after-tax rate of only two percent. The top/middle tax cutoff point also depends also on the size of net capital income (excluding stock income) if it is positive. However, the large majority of taxpayers in Denmark have negative net capital income.

Since the 1940s, collection of taxes from personal taxation has been based on a system where income tax is withheld at source, i.e. by the employer, and remitted to the tax authorities. Employers are required to report information about all types of income for each of their employees to the tax authorities.<sup>3</sup> Everyone in the Danish population has a unique personal identification

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<sup>2</sup> The Danish tax year follows the calendar year so the reform was in effect covering all of tax year 2010 and onwards.

<sup>3</sup> For taxpayers who only have third-party-reported income this system means that it is practically impossible to evade tax payments. To be able to evade tax, employers and employees need to agree to omit the third-party reporting. Kleven et al. (2011) show that evasion is more likely to take place when collaboration involves only a few agents, i.e. in small firms. The income of business owners is primarily self-reported, and the scope for underreporting is thus great for small business owners.

number, to which all this information is linked and which enables employers and the tax authorities to clearly identify individual taxpayers. Since 1988 this information has been used to set up pre-populated tax returns, and since 2006 these pre-populated tax returns have been accessible via the internet in March, i.e. about 2-3 months after the end of the tax year. The purpose of this automated process is to lower taxpayer compliance costs by relieving them of the burden of having to fill in most of the return. The taxpayer has the option of making adjustments before submitting the final return in May. We refer to OECD (2006) and Kleven et al. (2011) for more details on the Danish system and to Kreiner et al. (2013) for more information on the Danish 2010 tax reform.

### 3. Data

The measurement of activity in the informal sector is based on survey data where we ask respondents directly about participation and level of activity in the informal sector. After collection, the survey data were linked at the individual level with third-party-reported administrative register data from Statistics Denmark containing information about income from tax returns as well as a host of items of demographic information.

The survey was administered to a stratified random sample. Previous studies of the informal economy have shown a few characteristics to be strongly associated with participation. High participation rates have been found among younger rather than older individuals, males rather than females, and individuals with vocational training rather than tertiary education (Lemieux et al. 1994; Feld and Larsen 2012; Hvidtfeldt et al. 2010). We therefore sampled males with a vocational training who were aged 18–45 in 2009 and who were either wage earners or self-employed.<sup>4</sup> Within this group, we focus on individuals with a stated income according to the income tax register of 2007 in the range DKK 250,000 – DKK 450,000. We selected people in this range in order to focus on a sample of the people who were most likely to be affected by the tax reform.

Figure 1 plots the density of observations along the 2009 income axis together with the marginal tax rates applying to the different income levels. The figure shows how the marginal tax rate applied to earned income above DKK 377,000 changes because the top tax threshold moves and because the

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<sup>4</sup> The sampling was stratified on wage earners and the self-employed, with oversampling of the self-employed. We performed all analyses with population weights and also separately for the two groups, and found that results were similar to those reported for the pooled sample.

marginal tax rate applied to the top tax bracket is reduced.

The sampling was performed by Statistics Denmark, who knows the identities of the entire Danish population. After collecting the data, Statistics Denmark is allowed to merge the survey data with various administrative data and make the results available to authorized researchers via Statistics Denmark's Research Scheme.<sup>5</sup> Any information that can identify respondents is removed before the data are made available to us. By law, Statistics Denmark is under no circumstances allowed to reveal the identity of respondents to anyone, including government institutions such as the tax authorities. Authorized researchers have had access to sensitive data under this scheme for almost 30 years without any breaches of confidentiality, and the credibility of the system is therefore widely accepted in the population. In fact, as part of an OCED initiative, Statistics Denmark has conducted a study monitoring trust in official statistics that shows that only three percent of the respondents asked in a 2010 survey about Statistics Denmark indicated that they disagreed with the statement that Statistics Denmark keeps information confidential. Internationally, the Danish level of trust in the national statistical agency is at the top of the scale, along with that in Australia, New Zealand and Sweden.<sup>6</sup>

The survey questionnaire data were collected through telephone interviews carried out by Statistics Denmark. The interviews were conducted during the last two weeks of November and the first two weeks of December in each of the years 2009, 2010, 2011 and 2012. A week prior to the interviews in 2009 all selected respondents received a letter informing them that they had been selected to participate in a survey with questions on labor market participation, earnings etc. The letter explained that all respondents were selected at random and that it was important for the validity of our results that everyone participated. Furthermore, respondents were informed about the length of the interview (approx. 6 minutes). Finally, the letter included phone numbers and email addresses for Statistics Denmark and for the researchers, in case respondents wanted further information or had any questions of clarification. In addition, the letter also included a short leaflet with background information about the research project, including specific examples of survey questions and information about why, when, and how the respondent would be contacted. The leaflet informed respondents that participation was voluntary and that all interviews were anonymous, even to the researchers, and indicated when and how the results would be published. Finally, the

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<sup>5</sup> <http://www.dst.dk/ext/645846915/0/forskning/Access-to-micro-data-at-Statistics-Denmark--pdf>

<sup>6</sup> <http://unstats.un.org/unsd/dnss/docViewer.aspx?docID=2759>



leaflet explained that all participating respondents would automatically be included in a lottery draw in which six randomly selected respondents would win money prizes of between DKK 1,500 and DKK 5,000.

The survey itself consisted of two parts. Part one primarily included questions on the formal labor market, and these were all adopted directly from the Danish Labor Force Survey. They included questions on labor market status (employed, unemployed, student, etc.) and on the length of a typical working week. At the end of part one, we asked each respondent about how much of an additional DKK 1,000 in labor income he would retain net of taxes. This question provided a simple measure of the respondents' self-perceived rate of earnings net of tax. Part two included questions on the informal economy. As the interviewer progressed from part one to part two, he was instructed to remind the respondent about the interview anonymity.<sup>7</sup> The questions on the informal economy labor supply consisted of four short question batteries of 4-6 similarly worded questions separated according to the type of informal payment received (cash payment, pre-arranged exchange of favors, and payment in kind) and a final group of questions related to home production and sales (against payment of any type).

The first question in each battery was on participation, which, for respondents answering affirmatively, was followed up by questions on the length of the average informal working week, the average hourly wage, and a one-line job description. All the questions on the informal economy were framed to relate to the most recent six-month period prior to the interview. Appendix A presents selected questions from the survey, the questions were asked in Danish, and have been translated into English solely for the purpose of including them in Appendix A.

The level of survey participation is reported in Table 1. Statistics Denmark attempted to contact 5,725 people in December 2009. It was not possible to contact 1,966 of the selected respondents, or they said they did not wish to take part in the interview, giving a response rate of 66 percent. Further, 19 respondents had item non-responses in one of the sections we include in the analysis.

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<sup>7</sup> Every year prior to the survey interviews, we held an instruction meeting with all the interviewers. The meeting was led by Statistics Denmark (SD); their employee in charge of collecting the Danish Labor Force survey (DLF) went over our DLF questions (part 1) with the interviewers (many of whom also interviewed for the SD DLF data collection procedure). In collaboration with this SD employee we (the researchers) went over the questions on the informal economy. The point of these meetings was to discuss our survey questions and possible answers, so that the interviewers felt comfortable in the actual interview situation. The interviewers, like the respondents, were informed that we were interested in a descriptive analysis of the total Danish labor supply, but our research questions on the effect of the marginal taxes were not disclosed specifically.

After deselecting these observations we end up with a final sample for 2009 consisting of 3,740 observations. In the subsequent survey rounds we contacted all those individuals who had participated in the previous round. As shown in Table 1, the conditional response rates were 75 and 76 percent in 2010 and 2011 respectively, and in 2012 it was as high as 90 percent, amounting to 1,884 interviews. As the sample was drawn from the population register we were able to merge the records of both participants and non-participants in the survey with a host of other administrative registers, and to determine whether there were any systematic differences between the two groups in terms of the information available in the administrative registers. In Table 2 we compare average age, income, marital status, municipality, sector of employment and propensity to engage in part-time or full-time employment of participants and non-participants. On average, participants are slightly older, have higher earnings, and are less likely to live in Copenhagen, but average differences are small in relative terms. In particular, it is interesting that we do not find any important differences in terms of sector of employment, since work sector is likely to be correlated with opportunities for participating in the informal sector.

A valid concern is whether it is at all possible to collect credible answers by asking directly about activity in the informal sector. The criticism is that it is unlikely that respondents will tell the truth when asked delicate questions, leading to a downward bias in reports of activity in the informal sector. There is obviously no direct way of verifying whether data about activity in the informal sector are credible. The ability to match data to administrative registers, however, allows us to verify whether answers from the survey about activities in the formal sector line up with actual activity. For this purpose we asked respondents to state their annual earnings in the formal sector, and we then matched the stated income at the individual level with the information based on third-party reports about earned income from the individual's income-tax return. The results are displayed in Figure 2. The graph shows that the majority of respondents appear to have a good sense of their actual earnings, but also that some respondents gave answers that are quite far away from what is recorded in the income-tax return. It also shows the diagonal line on which all data points should be located if the two measures were exactly identical, a local polynomial regression line and a parametric linear regression line. The last can be interpreted as a summary measure of the overall alignment between the survey and the register measure. This is estimated to be 0.53. In a previous study in which the present authors were involved (Kreiner et al. 2014) we found a similar level of correlation between register and survey measures when trying to assess the accuracy of survey information about income collected using questions similar to those included in the Panel

Study of Income Dynamics (PSID). Of course, this does not prove that the answers supplied about activity in the informal sector are credible, but we would be reluctant to have faith in answers concerning informal sector activity if survey answers about formal sector activity had no relation to actual formal sector activity.

We have also investigated whether our data contain basic patterns that align with other data sets used for analyzing informal sector participation. Lemieux et al. (1994) analyze survey data where respondents were asked directly about underground economy jobs. They find that informal hours are positively correlated with formal sector wages and negatively correlated with informal sector wages. They also find that formal sector hours are correlated with formal sector income. In our survey we asked about hours supplied to both the formal and the informal sectors, and about the informal wage rate. From income tax returns we know total formal sector earnings. We can therefore calculate moments that are comparable to some of the moments listed by Lemieux et al. (1994). These are presented in Table 3. Reassuringly, we find correlations that are similar: formal sector hours are positively correlated with formal sector earnings, formal sector hours are positively correlated with the informal wage rate, and informal hours are negatively correlated with the informal sector wage rate, albeit not significantly. Furthermore, we find that hours supplied to the informal sector are negatively correlated with hours supplied to the formal sector, and that the informal hourly wage is positively correlated with formal sector earnings. To make sure that these correlations are not driven by differences in sample composition across cells we have repeated the calculations for a balanced sample where we have information about formal/informal sector earnings and hours for all respondents. Results are displayed in panel B of Table 3, and are essentially similar.

#### **4. Results**

##### *The 2010 tax reform*

To estimate the effect of changing the marginal taxation on activity in the informal sector, we employ a simple differences-in-differences estimator. The treatment group consists of individuals who were recorded in the income-tax register as paying middle and top taxes in 2009. The control

group consists of people who only paid bottom taxes.<sup>8</sup> Specifically, we estimate the following equation:

$$Y_{it}^{Informal} = \beta_0 + \beta_1 D_i^{Treat} + \beta_2 D_{it}^{Post} + \beta_3 D_i^{Treat} \times D_{it}^{Post} + \beta_3 X_{i2009} + u_i \quad (1)$$

where  $Y_{it}^{Informal}$  is the outcome variable that we measure in the survey. The outcome that we focus on is a dummy variable indicating whether the respondent has indicated that he participates in the informal sector, where we have included all types of informal sector activity. In some versions we will consider informal sector activity in terms of the total number of hours supplied and in other versions in terms of total earnings from informal sector activities.  $i$  is a person identifier, and  $t$  is an indicator for the year of observation. We have collected data for the years 2009, 2010, 2011 and 2012.  $D_i^{Treat}$  is a dummy variable taking the value one if the respondent was a middle and top taxpayer in 2009.  $D_{it}^{Post}$  is a dummy variable taking the value one if the observation pertains to 2010, 2011, or 2012. Finally,  $X_{i2009}$  is a vector of characteristics that were measured in 2009, i.e. before the change in the marginal tax rate. The characteristics include age, marital status, region of residence, labor market participation, sector of employment, income in 2009 and the survey-elicited subjectively-perceived risk of being discovered doing work in the informal sector by the tax authorities and consequently receiving a fine.

Table 4 presents the results from estimating the parameters of equation (1) for the propensity to participate in the informal economy, and for the supply of hours and earnings conditional on participation in the informal economy both before and after the tax reform. These estimates thus attempt to capture both the external and the internal marginal effects of the tax reform, which might differ if, for example, there are fixed costs associated with entering the informal economy. For each of the outcomes the table presents estimates where the data set includes observations for 2009–2010, 2009–2011 and 2009–2012 respectively. Among the covariates, only the estimated effect of the subjectively perceived probability of being caught doing informal sector activity is shown.

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<sup>8</sup>A few individuals paid top bracket taxes but not middle bracket taxes in 2009. They were classed as being in the control group because their change in NTR was equal to that of the control group. We also tried splitting the sample according to tax bracket in 2007 and 2008, and also delimiting the treatment group to only include people who were top rate taxpayers in 2007, 2008, and 2009. These actions did not change the results and results are therefore not reported.

Strikingly, the estimated effect of the reform is insignificant in all cases, i.e. according to the estimates the reduction in the marginal tax rate influenced neither the decision to participate in the informal economy nor the supply of hours or earnings for those who already participated in the informal economy before the reform.<sup>9</sup> It is noticeable, however, that the subjectively-experienced risk of getting caught engaging in informal sector activities, as it was elicited in 2009, does predict the propensity to participate. While this estimate does not reveal the causal effect of varying the risk of getting caught, these results are consistent with those found by Kleven et al. (2011) showing that the effect of increasing the auditing risk has a larger impact on evasion than does a change in the marginal rate of tax on income.

The lack of any significant estimated effect on informal sector activity of exogenously varying the marginal tax rate could potentially reflect the fact that the perceived risk of getting caught engaging in informal sector activities changed together with the reform in such a way as to counterbalance the financial effects of the tax reform. To investigate this we estimated the effect of the reform on the subjectively-perceived risk of getting caught doing informal sector activity by estimating equation (1) using the subjective risk as the dependent variable (and not including the 2009 value among the regressors). Results are displayed in Table 5 for three different before–after horizons, namely 2009–2010, 2009–2011, and 2009–2012. In all cases the estimated effect of the reform is non-significant, showing that there has been no systematic change in the subjectively perceived risk across the reform.

A necessary condition for a change in the marginal tax rate to influence activity in the informal sector is that people should understand the incentive generated by the tax reform. Tax issues tend to be perceived as relatively complicated and incentives are therefore arguably not very salient. Chetty et al. (2009) find that even in situations with simple shopping decisions it matters for consumer decisions whether prices are displayed with or without VAT, holding the final price fixed. Furthermore, in another study (Kreiner et al. 2013) of the Danish 2010 tax reform, we investigate the extent of income shifting from 2009 to 2010 among wage earners and find that few top taxpayers were aware that they would gain in terms of paying less in tax by shifting income from 2009 to 2010. To investigate whether people understand the tax reform, we asked the respondents in

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<sup>9</sup> Persons with incomes in the interval DKK 377,000 to DKK 424,000 experienced a drop in the marginal tax rate from 63 percent to 42.1 percent, i.e. a drop in the marginal tax rate of almost 21 percentage points. We tried to re-estimate table 4 allowing for people with 2009 incomes in this interval to have different responses, but the results did not deviate from those reported in table 4 and are therefore not reported.

the survey about how much additional money they would be left with, if they increased their earnings by DKK 1,000. The question was asked in all the rounds of the survey. To assess whether respondents understand the incentive provided by the tax reform, we estimate equation (1) using the answers from this question as the dependent variable. If respondents understand the consequences of the reform we would expect the estimated effect to be positive and of the order of about DKK 70.<sup>10</sup> The actual results are presented in Table 6. On average, the treatment group indicated that they would take home an additional DKK 5 after the reform from an additional DKK 1,000 in gross income. The control group stated that they thought they would take home an additional DKK 2 after the reform, so that the estimated effect is DKK 3. This is much smaller than expected, and the estimate is not significantly different from zero.

If respondents really do not understand the consequences of the tax reform, we would not expect to see any effect of changing the marginal tax rate on activity in the formal sector either. To investigate this we also estimated the effect of the reform on formal sector activity, and the results are shown in Table 6. Consistent with the analysis of the perceived marginal tax rate, we find that the exogenous change in the marginal tax rate has no effect on the number of hours supplied in the formal sector. We take this set of results as evidence that the respondents do not fully understand the incentive provided by the reform, and we conclude that a necessary condition for the marginal tax rate to have any effect on activity in the informal sector is not fulfilled.

## 5. Conclusion

Undeclared work appears to be significant in most economies. Standard theories of tax evasion suggest that the marginal rate of taxation of income could impact the amount of labor supplied in the informal sector. In this paper we investigate this hypothesis directly by measuring how a selected group of people, those most likely to engage in activity in the informal economy, responded to a Danish 2010 tax reform that lowered the highest marginal rate of taxation from 63% to 56%.

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<sup>10</sup> The 2010 tax reform was passed in the Danish parliament on May 28th 2009 and signed into law taking effect from January 1st 2010. Respondents were interviewed for the first time in November/December 2009. The question on net-of-tax-rate was put in present form but if respondents mistakenly thought about their new marginal tax rates (as of 2010) it would invalidate their answers.

We investigate whether the tax reform had an effect on the supply of labor to the informal sector by asking a selected group of people consisting of males with vocational training aged 18–45 in 2009 and who were either wage earners or self-employed whether they had supplied labor that they did not declare. The same people were asked both before and after the reform, and we examined whether those affected by the tax reform changed their informal sector labor supply in a different way from those not affected by the tax reform. We find no effect of changing the marginal tax rate on the supply of labor to the informal sector. To obtain further insight into the reasons for the lack of response to the reform, we also asked the survey participants about their understanding of the consequences of the tax reform for their marginal earnings. We find that respondents did not understand how the tax reform could change their after-tax income, suggesting that the lack of response is related to the salience of tax reforms.

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## Appendix A: Examples from the survey of questions on activity in the informal economy

### *Informal economy*

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**Q100.** Now I have some questions about different types of undeclared work. Before you answer, you should know that this interview is 100% anonymous.

**First:** Have you performed any undeclared work, and been paid for it, in the past 6 months?

Yes .....

No .....

**Q102.** State an average number of hours per week (where you have performed undeclared work in return for a cash payment).

No. of hours \_\_\_\_\_

**Q103.** What was your hourly undeclared wage?

DKK per hour \_\_\_\_\_

**Q104.** What sort of work did you do?

\_\_\_\_\_

(Instruction to the interviewer: The type of work which has taken up the most time, overall, during the past 6 months.)

**Q106. Now on to a different type of undeclared work. Have you, at any point in the past 6 months, done favors or worked for anyone without getting paid for it, but instead got, or expected to get, a favor in return?**

Yes .....

No .....

**Table 1:**  
Gross survey sample size and completed interviews

	Survey round			
	2009	2010	2011	2012
People contacted	5,725	3,689	2,771	2,104
Survey non-response	1,966	907	661	220
Interviews (respondents)	3,759	2,782	2,110	1,884
Response rate (interviews as share of available sample)	0.66	0.75	0.76	0.90
Item non-response: shadow market participation	19	11	4	1
Sample available for estimation	3,740	2,771	2,106	1,883

Notes: The table outlines the number of respondents and the response rates from a telephone survey panel on formal and informal labor market participation. Respondents in the sample were drawn at random from a selected population based on gender, age, income, labor market status and educational criteria from the registers at Statistics Denmark. The sample includes males aged 18–45 (2009) with income (2007) in the range DKK250,000 – 450,000 and vocational training as their highest completed educational level (2008). The sample consists of both wage earners and self-employed. The category “Survey non-response” includes respondents unavailable to come to the phone (primarily) or unwilling to take part in a survey at all. Item non-response shows the number of interviewed respondents who specifically refused to answer questions on their informal market participation.

Data source: Rockwool Foundation Research Unit survey data collected by Statistics Denmark

**Table 2:**  
Split sample t-test for survey participation

	Non-	Respondents	Mean test	Non-	Respondents
	respondents			respondents	
	mean	mean	T-statistic	#	#
<b>Age</b>	31.94	32.78	-6.15	1,956	3,755
<b>Labor earnings (DKK)</b>	247,772	265,688	-3.90	1,958	3,758
<b>Municipality</b>					
Copenhagen	0.23	0.16	7.00	1,956	3,755
Zealand	0.20	0.19	0.29	1,956	3,755
Southern	0.19	0.22	-2.52	1,956	3,755
Central	0.23	0.27	-3.51	1,956	3,755
North	0.15	0.16	-0.72	1,956	3,755
<b>Marital status</b>					
Single	0.62	0.48	10.18	1,958	3,758
Married	0.34	0.48	-10.18	1,958	3,758
Divorced	0.04	0.04	-0.24	1,958	3,758
Widowed	0.00	0.00	0.47	1,958	3,758
<b>Sector</b>					
Agriculture, forestry and fishing	0.05	0.04	1.64	1,864	3,612
Manufacturing, mining etc.	0.22	0.27	-3.95	1,864	3,612
Construction	0.36	0.36	0.36	1,864	3,612
Trade, transport etc.	0.21	0.19	1.62	1,864	3,612
Information and communication	0.02	0.01	2.55	1,864	3,612
Financial and insurance	0.00	0.00	0.34	1,864	3,612
Real estate	0.01	0.01	0.03	1,864	3,612
Other business services	0.05	0.05	0.46	1,864	3,612
Public administration	0.04	0.04	-0.51	1,864	3,612
Arts, entertainment and other services	0.02	0.02	1.25	1,864	3,612
Activity not stated	0.00	0.00	0.56	1,864	3,612
<b>Employment type</b>					
Self-employment	0.24	0.20	3.33	1,954	3,758
<b>Labor hours</b>					
Part-time	0.14	0.13	1.04	1,309	2,720
Full-time	0.86	0.87	-1.04	1,309	2,720

Notes: The table shows split sample t-tests between survey respondents and survey non-respondents. For information on the survey sample see Table 1.

Data source: Rockwool Foundation Research Unit survey data collected by Statistics Denmark

**Table 3:**

Correlations between formal and informal sector characteristics: OLS regression estimates

<b>Panel A</b>	Formal hrs	Formal hrs	Formal hrs	Informal hrs	Informal hrs	Informal hrly
Formal labor income (DKK100.000)	0.87 ***			-0.48 ***		0.01 ***
	(0.13)			(0.15)		(0.00)
Informal hours			-0.03			
			(0.03)			
Informal wage (DKK 1.000)		2.82 ***			-0.90	
		(0.79)			(0.69)	
Constant	36.65 ***	39.97 ***	40.73 ***	5.52 ***	4.18 ***	0.16 ***
	(0.45)	(0.25)	(0.21)	(0.50)	(0.20)	(0.02)
Observations	2,801	1,904	1,992	1,780	1,984	1,707
<b>Panel B</b>	Formal hrs	Formal hrs	Formal hrs	Informal hrs	Informal hrs	Informal hrly
Formal labor income (DKK100.000)	0.72 ***			-0.46 ***		0.01 **
	(0.18)			(0.17)		(0.01)
Informal hours			-0.03			
			(0.03)			
Informal wage (DKK 1.000)		2.62 ***			-0.64	
		(0.92)			(0.86)	
Constant	37.12 ***	38.96 ***	39.64 ***	5.59 ***	4.21 ***	0.17 ***
	(0.63)	(0.26)	(0.21)	(0.59)	0.24	0.02
Observations	1,518	1,518	1,518	1,518	1,518	1,518

Notes: The regressions include cross sectional observations from the 2009 survey. Standard errors in parentheses. \* p&lt;.10, \*\* p&lt;.05, \*\*\* p&lt;.01

Data sources: Rockwool Foundation Research Unit survey data collected by Statistics Denmark and the Statistics Denmark administrative register.

**Table 4:**

Effects of the DK 2010 tax reform on the intensive and extensive margins of the informal economy: OLS regression estimates

	Participation			Weekly hours supply			Weekly earnings		
	2010	2011	2012	2010	2011	2012	2010	2011	2012
Tgroup	-0.01 (0.03)	-0.03 (0.03)	0.00 (0.03)	-0.28 (0.47)	-0.32 (0.46)	-0.81 * (0.45)	-3.71 (137.75)	24.25 (134.52)	-123.29 (104.55)
Post 2010	0.02 (0.01)	0.02 ** (0.01)	0.02 ** (0.01)	-0.68 *** (0.21)	-0.29 (0.22)	0.10 (0.23)	-88.86 * (53.26)	-15.28 (57.61)	66.71 (61.78)
<b>Tgroup x post 2010</b>	<b>0.03</b> <b>(0.03)</b>	<b>0.03</b> <b>(0.03)</b>	<b>0.02</b> <b>(0.03)</b>	<b>0.05</b> <b>(0.47)</b>	<b>-0.33</b> <b>(0.49)</b>	<b>0.16</b> <b>(0.50)</b>	<b>-66.47</b> <b>(138.58)</b>	<b>-169.42</b> <b>(143.06)</b>	<b>-36.89</b> <b>(136.99)</b>
Self perceived risk (2009)	-0.001 *** (0.00)	-0.001 *** (0.00)	-0.001 *** (0.00)	0.00 (0.01)	0.00 (0.01)	0.00 (0.01)	-2.39 * (1.27)	-2.05 (1.47)	-1.71 (1.42)
Observations	5,386	6,135	7,320	2,496	2,295	2,424	2,264	2,100	2,208
Respondents	2,693	2,045	1,830	1,248	765	606	1,132	700	552

Notes: The table presents the results from estimating the parameters of equation (1) for the propensity to participate in the informal economy and for the supply of hours and earnings conditional on participation in the informal economy both before and after the tax reform. For each of the outcomes, the table presents estimates where the data set includes observations for 2009–2010, 2009–2011 and 2009–2012 respectively. All regressions include controls for age, marital status, region of residence, labor market participation, sector of employment, income. All control variables are measured in 2009. The reform effect estimate is highlighted in red. Robust standard errors are

Data sources: Rockwool Foundation Research Unit survey data collected by Statistics Denmark and the Statistics Denmark administrative register.

**Table 5:**

Effect of the 2010 tax reform on the self-perceived risk of detection: OLS regression estimates

	Self-perceived risk of detection		
	2010	2011	2012
Tgroup	-0.32 (1.39)	-0.56 (1.40)	-0.33 (1.45)
Post 2010	1.06 (0.55)	* 0.50 (0.50)	-0.28 (0.50)
<b>Tgroup x post 2010</b>	<b>-0.96</b> <b>(1.27)</b>	<b>-0.07</b> <b>(1.25)</b>	<b>-0.31</b> <b>(1.28)</b>
Observations	5,324	5,988	7,156
Respondents	2,662	1,996	1,789

Notes: Table 4 shows the results from estimating the parameters of equation (1) where the dependent variable is the subjectively-perceived risk of getting caught carrying out informal sector activity. All regressions include controls for age, marital status, region of residence, labor market participation, sector of employment, income. All control variables are measured in 2009. The reform effect estimate is highlighted in red. Robust standard errors are shown in parentheses.

Data sources: Rockwool Foundation Research Unit survey data collected by Statistics Denmark and the Statistics



**Table 6:**

Effect of the 2010 tax reform on perceived NTR and formal weekly labor supply: OLS regression estimates

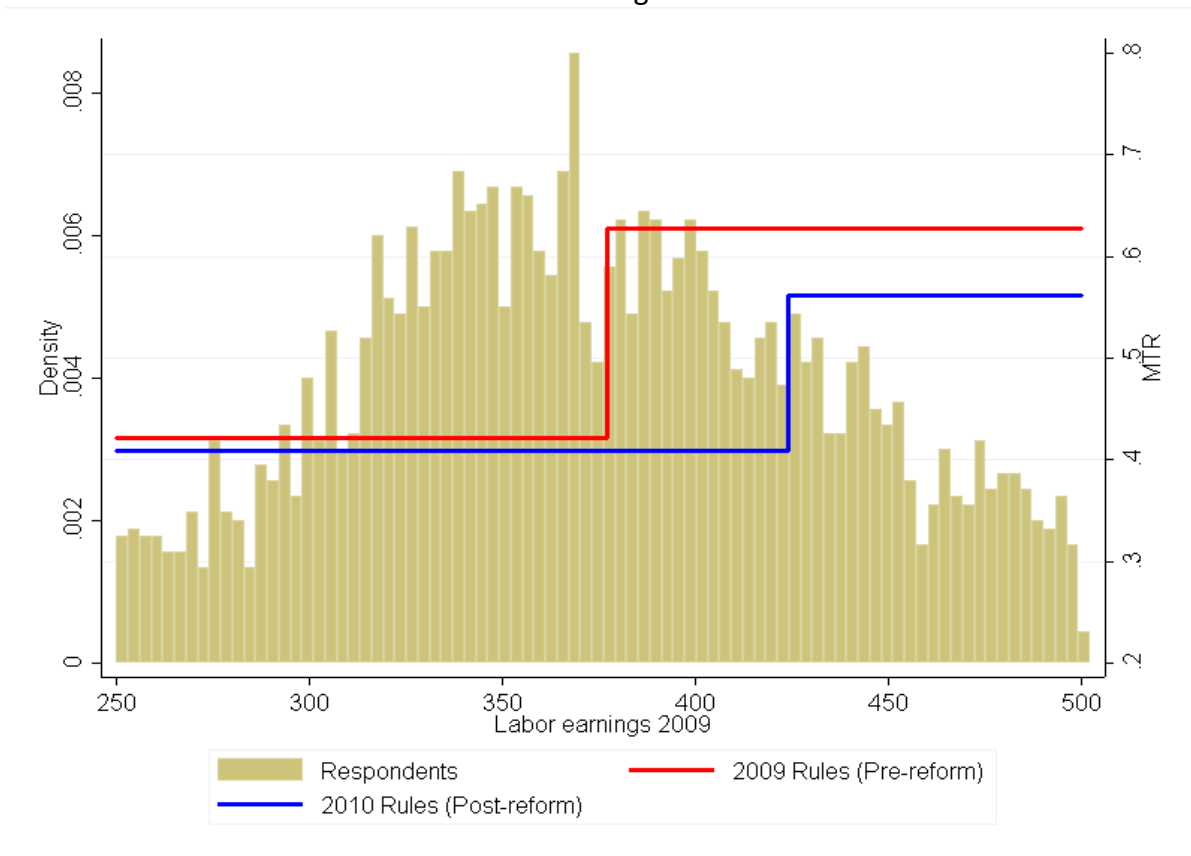
	Perceived NTR						Formal sector weekly hours supply					
	2010		2011		2012		2010		2011		2012	
Tgroup	-38.99	***	-40.95	***	-41.76	***	2.57	***	2.72	***	2.65	***
	(6.41)		(6.37)		(6.76)		(0.51)		(0.54)		(0.57)	
Post 2010	5.69	**	6.17	**	-2.49		0.46	***	0.24		0.18	
	(2.86)		(2.84)		(2.75)		(0.16)		(0.15)		(0.14)	
<b>Tgroup x post 2010</b>	<b>3.10</b>		<b>2.66</b>		<b>0.04</b>		<b>-0.05</b>		<b>0.17</b>		<b>0.40</b>	
	<b>(6.06)</b>		<b>(6.06)</b>		<b>(5.87)</b>		<b>(0.39)</b>		<b>(0.39)</b>		<b>(0.43)</b>	
Self perceived risk 2009	-0.04		-0.03		-0.05		0.02	***	0.02	**	0.02	**
	(0.08)		(0.08)		(0.09)		(0.01)		(0.01)		(0.01)	
Observations	4,458		4,614		5,908		4,788		5,316		6,156	
Respondents	2,229		1,538		1,477		2,394		1,772		1,539	

Notes: The table presents the results from estimating the parameters of equation (1) using the answers from survey questions on perceived rates of earning retention net of tax and formal weekly labor supply as the dependent variables. For each of the outcomes, the table presents estimates where the data set includes observations for 2009–2010, 2009–2011 and 2009–2012 respectively. All regressions include controls for age, marital status, region of residence, labor market participation, sector of employment, income. All control variables are measured in 2009. The reform effect estimate is highlighted in red. Robust standard errors are shown in parentheses.

Data sources: Rockwool Foundation Research Unit survey data collected by Statistics Denmark and the Statistics Denmark administrative register.

**Figure 1:**

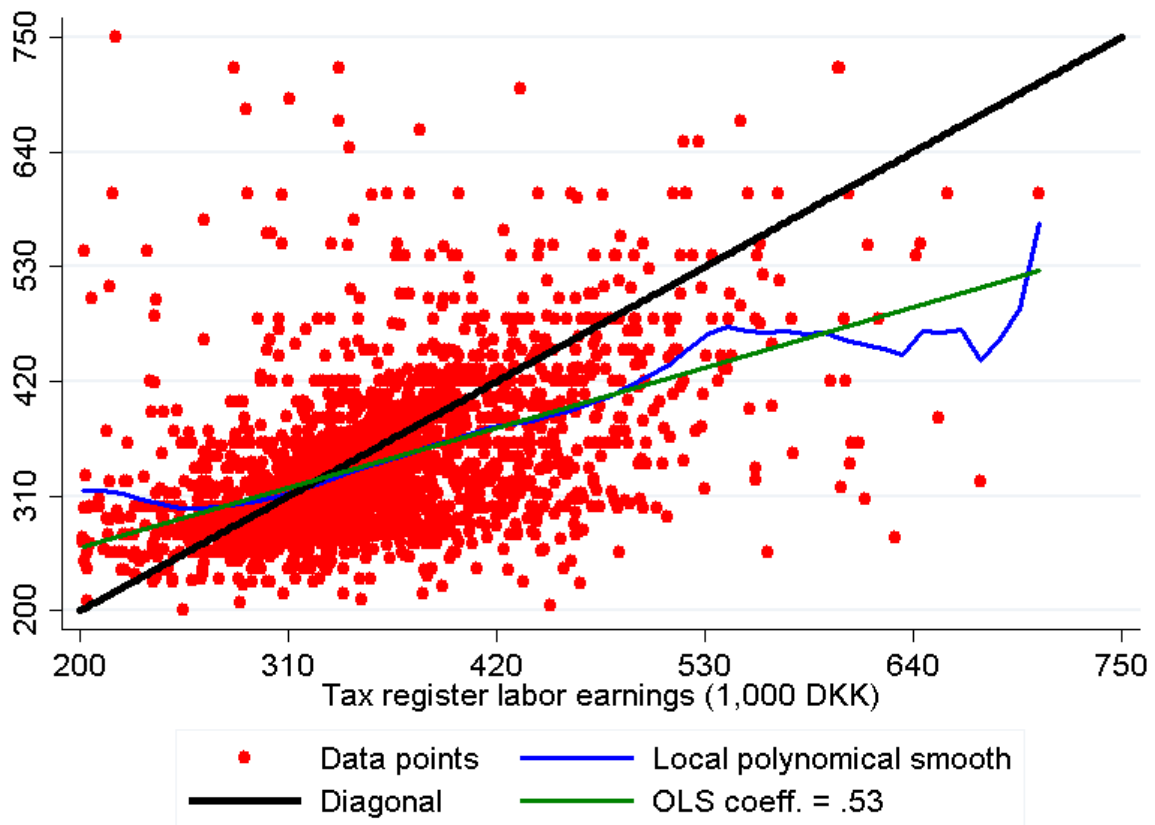
Danish marginal tax rates on labor income superimposed on a histogram of survey sample earnings



Notes: This figure shows the marginal tax rates on labor income in Denmark before and after the 2010 tax reform. The marginal tax rates are superimposed on a histogram of the 2009 labor market earnings of 2,999 survey respondents, with labor earnings retrieved from the income registers at Statistics Denmark. For information on the survey sample see Table 1.

Data source: Rockwool Foundation Research Unit survey data collected by Statistics Denmark. The marginal tax rates can be found at the Danish Ministry of Taxation website, [www.skm.dk](http://www.skm.dk)

**Figure 2:**  
Labor income as stated in the survey and on the tax return



Notes: The figure shows respondent-specific stated annual formal sector labor earnings as a function of tax return information on labor earnings. It also includes a diagonal line on which all data points should be located if the two measures were exactly identical, a local polynomial regression line and a parametric linear regression line. The last can be interpreted as a summary measure of the overall alignment between the survey and the register measures. This is estimated to be 0.53. The figure includes 2,344 survey respondents.

Data sources: Rockwool Foundation Research Unit survey data collected by Statistics Denmark and Statistics Denmark income register data.