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Labor supply when tax evasion is an option

by

Øystein Jørgensen[1], Tone Ognedal[2] and Steinar Strøm[3]

Abstract

We estimate labor supply when tax evasion is an option, using a discrete choice model on pooled Norwegian survey data from 1980 and 2001. Direct labor supply elasticities, conditional on sectors, are in the range of 0.2-0.4. The elasticities are higher for work that is not registered for taxation, than for registered work. Overall wage increases have a positive impact on the supply of registered work and a negative impact on supply of unregistered work. In addition to economic factors such as wages and tax rates, also social norms and opportunities for tax evasion at the work place have an impact on the supply of unregistered labor.

The model is used to simulate the impact on labor supply of changes in the tax structure, such as the lowering of marginal tax rates. The fraction of the population who did unreported work was reduced from 1980 to 2001. Lower and less progressive tax rates after 1980 have contributed to this reduction. Although taxes matter for supply of both reported and non-reported labor, the impact is not strong. Social norms and opportunities for tax evasion at the work place are also important in explaining the change.

JEL classification: C25, D12, D81, H26, J22.
Keywords: Labor supply, tax evasion, survey data, microeconometrics.

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1. Introduction

A key issue in the public policy debate is how taxes affect behavior. Income taxes may affect the number of hours worked, but also how many of these hours that are registered for taxation. Hereafter, we use the term "unregistered work" about legal work that is not reported to the tax authorities. There have been several theoretical studies of tax evasion and labor supply, but few unambiguous results. In the numerous extensions and refinements of the pioneer model by Allingham and Sandmo (1972) there are few unambiguous predictions of how tax evasion is affected by economic variables such as the wage rates, tax rates, penalty tax and probability of detection. [4] Thus empirical evidence is needed. However, empirical evidence is difficult to obtain, since the activities we want to observe are activities that people try to hide from the authorities.

In our study we have pooled micro data from two Norwegian surveys in 1980 and 2001. Others studies of individual supply of unregistered labour based on survey data are Isachsen , Klovland and Strøm (1982) Isachsen and Strøm (1985) and Isachsen, Samuelson and Strøm (1985), as well as Lacroix and Fortin (1992) and Lemieux, Fortin and Frechette (1994). [5]

Lacroix and Fortin (1992) use a quadratic utility function together with budget constraints to generate labor supply functions for registered and unregistered labor. Agents decide under uncertainty, given probabilities for being detected and fines if detected. The model is made stochastic by assuming that one of the parameters in the utility function is random. Labor supply functions are derived by equating marginal rates of substitution to net wages (the marginal criteria approach). The model is estimated on Canadian survey data.

Lemieux, Fortin and Frechette (1994) apply the same data set to estimate a similar labor supply model. Also in this study both registered and unregistered labor supply is estimated, including the participation rate in tax evading activities. The utility function is assumed to be quasi-linear and separable in consumption and leisure. The model is made random by assuming that a parameter in the budget constraint is random. Again, labor supply functions are derived by applying the marginal criteria approach. One main result is that earnings from unregistered work are concentrated among workers with low earnings from registered work. Moreover, while the number of registered work hours is positively correlated with wage rates in the economy, the opposite is the case for hours of unregistered work.

Our basic assumptions about the individuals' behavior are the same as in these previous contributions. When faced with the risk of being detected and penalized if they evade taxes, agents are assumed to maximize expected utility. The modeling of individual utility and the budget constraints is different, however. In contrast to the two previous contributions we assume a random utility model with extreme value distributed utilities. The specification of the deterministic part of the utility function is a Box-Cox transformation of consumption and leisure. This specification allows us to check directly whether the estimated utility function is quasi-concave, which is not so easily done with flexible functional forms such as a quadratic utility function. The Box-Cox utility function is rather flexible with linear and log-linear utility functions

[4] See for example Andersen (1977), Isachsen and Strøm (1980), Cowell (1985), Srinisivan (1973)),

[5] Studies by Clotfelter (1983), Slemrod (1985) and Feinstein (1991) use microdata from the tax authorities, such as The U.S. Treasury Tax File, The Internal Revenue Service (IRS) and Tax Compliance Measurement Program (TCMP).

as special cases. Also, we model the budget constraints to take into account all details of the tax structure. In 1980 the marginal tax rates were not uniformly increasing with income, thus the budget set was non-convex. The latter implies that marginal criteria cannot be applied to represent labor supply decisions. Instead, in our model the agents are assumed to compare utilities across all alternatives when making their decisions. Since all details of the tax functions are accounted for, we are able to use the estimated model to simulate the outcome of different tax structures.

An important novel feature of our model is that we include variables that capture social norms for tax evasion and variables that reflect the individual's opportunity to evade taxes at the work place. Several studies suggest that economic considerations alone cannot explain the observed high level of tax compliance (see for example Slemrod (ed.), 1992). Norms are an important factor in explaining people's willingness to evade taxes. Erhard and Feinstein (1994) show that if we include a fraction of honest taxpayers in a theoretical model of tax compliance game the empirical predictions become more reasonable. In a study on a data set similar to the one used here, Barth, Cappelen and Ognedal (2004) find that people's choice to evade taxes or not are significantly affected by what they believe is other people's attitude towards tax evasion. In our model, an individual chooses to be honest as long as the net expected gain from being an evader is lower than a "threshold value", which differs between the individuals. This threshold value depends on the individuals' norms, which we approximate by what he believes is the social norm towards tax evasion. The threshold also depends on his opportunities to evade taxes at the workplace. The interpretation is that with no opportunity to evade at the workplace, there may be some fixed costs of finding and organizing unregistered work on the side. To represent the moral threshold in our model we specify a norm- and opportunity density, which may be interpreted as weighting the deterministic part of the utility function that appears in the choice probabilities.

In the surveys, the respondents are asked what they believe is the probability of being detected if they evade taxes. Consequently, we can study the effects of the individuals' perceived probability of detection on their supply of unregistered labor. In the model, we allow for the possibility that the agents give overweight to low probabilities of being detected as a tax evader. Thus, the traditional Neuman-Morgenstern model is a special case, and it is left to the data to determine whether the agents are giving overweight to detection probabilities.

We find that economic incentives matter, but the effect is not strong. Thus, the changes in tax structure over the last 20 years towards lower and less progressive tax rates have contributed to the reduction in tax evasion. However, the effects of norms and opportunities to do unregistered work are also important. Like Lemieux, Fortin and Frechette (1994) we find that individuals with low income from registered work are more inclined to do unregistered work, and that an overall wage increase is positively correlated with hours worked registered and negatively correlated with hours worked unregistered. As a consequence, we should expect that as the individuals gradually becomes richer over time, participation in tax evading activities decline. Most of the parameters are sharply determined and the implied utility function is quasi-concave. The estimates indicate that the agents give overweight to the low probabilities of being detected.

The paper is organized as follows: In Section 2 we describe the data and in Section 3 the model is specified. Estimates and labor supply elasticities are given in Section 4, and policy simulation in Section 5. Section 6 concludes.

2. Data

We use data from two similar Norwegian surveys, from 1980 and 2001. The private survey bureau, MMI, conducted the surveys. With few exceptions, the questions asked were the same in the two years, which gives us the opportunity to use the pooled data in the econometric analysis. The questions asked in the survey are given in Appendix 2.

The participants in the surveys were recruited in MMI's regular omnibus survey in October in the two years. The recruitment of participants was drawn randomly from the Norwegian population. People were asked if they were willing to participate in a survey on issues related to taxation and tax evasion. Those who said yes received the questionnaire by mail, and were asked to fill it out and mail it back to MMI anonymously. The procedure guaranteed the participants full anonymity.

The surveys give information about relevant personal characteristics and economic variables of the respondents, such as gender, age, education, employment, hours of work and wage rates, income and taxes paid. The participants were asked several questions about their engagement in unregistered work. For example, they were asked if they had done unregistered work during the last 12 months, and if yes, how many hours and at what wage. In addition, they were asked about their attitude towards doing unregistered work, and their beliefs about other people's attitudes.

A common problem with surveys is that those who agree to participate may be a selected group. For example, those who participate may be less inclined to do unregistered work than those who would not participate, or the opposite. The participants may also have their own "agenda" when answering, such that we get biased answers. The selection problems and the possibility of biased answers may bias the results of the econometric analysis. However, the two-stage process in recruiting and filling out the questionnaires allows for some control of the selection problem. In addition, in both years the response rates have been high for surveys of this type. Table 1 gives the response rates for the two years. Finally, the controls of the selection problems indicate that the samples do not deviate to any significant degree from population characteristics (see Isachsen, Klovland and Strøm (1982) and Goldstein, Hansen, Ognedal and Strøm (2002)).

Table 1. Response rates

	1980	2001
Asked to participate	1198	1690
Agreed to participate	80%	81%
Answer percentage	73%	58%
Response rate, percent of asked	58%	47%

In the econometric analysis we have pooled the data from the two years. There are two reasons for this. First, the sample becomes larger. Second, the economic environment was very different in these two years, in particular the tax structure. In 1980 the tax structure was more progressive than in 2001, as shown in Appendix 1. In 1980 there were 18 tax brackets, with marginal tax rates ranging from 0 to 75.4%. In 2001 there were only 5 tax brackets, with a maximal marginal tax rate of 55%. An interesting aspect of the tax structure in 1980 was that marginal tax rates were not

uniformly increasing with income. Thus the budget was not convex, which implies that we cannot use standard marginal calculus to represent behavior. By pooling the datasets for 1980 and 2001 we get more variation in the economic constraints.

As seen from Table 2 below, the fraction of tax evaders has declined in the period 1980 to 2003.[6] There are several factors that may have contributed to this decline:

- Average taxes are lower and the tax function less progressive in 2001 than in 1980.
- The opportunity to take part in tax evading activities is less in 2001 compared to 1980. One reason is that the fraction of individuals working in the public sector has increased drastically. Also, private firms have become larger and more professional, with cash registers and other technological obstacles to tax evasion.
- Real income has increased, which gives rise to higher negative income effects for both reported and unreported work.
- The participation rate for women in the regular labor market has increased. Participation in the regular labor market makes it less attractive to do unregistered work in the informal labor market.
- The tax morale seems to have improved over the last 23 years, but this may be explained by the lower tax rates that make it cheaper to be law obedient.
- In the data, the fraction that believes in a high probability of being detected has increased from 1980 to 2001. One reason may be due to the fact that the Norwegian tax authorities have increased their efforts to detect tax evaders over time, and their audits have received more publicity. This policy may have increased the subjective probability of being caught for tax evasion.

Table 2: During the last 12 months, have you had labor income that was not reported to the tax authorities? (Percent)

	1980	1989	2001	2003
Yes	20	22	13	10
No	76	75	87	90
No answer	4	3	0	0
Sum	100	100	100	100

In Tables 3-5 we report the summary statistics for the sample used to estimate our labor supply model. All economic variables are in NOK 2001 values (8.2 NOK~1 EURO). The sample is smaller than the sum of the two initial samples. The most important reason is that individuals below 20 and above 60 years of age are excluded from the sample. Also, individuals receiving different types of welfare benefits and retired people have been excluded from the sample.

An interesting observation is that the tax evaders tend to work more registered hours than the non-evaders, on average, and their annual income from registered work is higher. As a consequence, the tax evaders pay more taxes on average than the non-evaders. As expected, the evaders are more likely to believe that tax evasion is

[6] Unfortunately the data-files for 1989 have been lost and data for 2003 is under processing.

socially accepted. However, the percentage of non-evaders that believes tax evasion is socially accepted is also high (almost 50 percent in 2001).

Table 3: Summary statistics; the whole sample. All values are in 2001 NOK.

	Mean	St.D.	Minimum	Maximum
Age	37.6	11.05	20	60
Hourly wage rate, NOK	144.0	41.1	85	242,5
Gross annual wage income, NOK	237 687	114 288	48490	596700
Weekly hours worked in the regular economy	31.0	11.7	10	50
Annual tax, NOK	76 747	49 151	6457	259 073
Perceived fine if detected, per cent	17.9 %	14.3	0.6 %	36.7 %
Subjective probability of detection	0.09	0.06	0.0025	0.25

Number of observations	1049
Number of non-evaders	843
Number of evaders	206
Number of observations in 1980	509
Number of observations in 2001	540
Percentage females in the sample	48.8 %
Percentage who thinks that tax evasion is socially accepted	67.3 %

Table 4: Summary statistics; non-evaders. All values are in 2001 NOK

	1980	2001
Age	36,9	40.1
Percentage females	51.4 %	60.2 %
Weekly hours.	28,9	32.2
Annual gross wage income,	234 887	229 600
Annual tax	82 284	69 137
Perceived fine if detected, percent	17,4 %	17.5 %
Subjective probability of detection	0,09	0.10
Percentage who thinks that tax evasion is socially accepted	78.4 %	49.5 %

Table 5: Summary statistics; evaders. All values are in 2001 NOK.

	1980	2001
Age	32.2	35.3
Percentage females	16.7 %	21.1%
Weekly hours in the regular economy	32.2	32.9
Annual hours in tax evading activities	98.4	72.3
Annual gross wage income in the regular economy	263 467	244 444
Annual tax	98 548	76 094
Annual gross income evaded	7341	4042
Perceived fine if detected, percent	20.3%	18.4 %
Subjective probability of detection	0.06	0.05
Percentage who thinks that tax evasion is socially accepted	93.9 %	73.3%

3. The model

We assume that an individual chooses the hours of registered and unregistered work that maximizes utility; given the wage rates, tax rates, penalty tax and his subjective probability of being detected. In addition, norms and the opportunity to do unregistered work may affect his choices. The opportunity to do unregistered work may depend on which sector he works in and his occupation. For example, evading income is much easier for a worker in the construction sector than for a bureaucrat in the government sector.

We model the individual's decisions as if he made them in two stages. At stage 1 he chooses which type he wants to be, honest (H) or an evader (E). At stage 2, when his type is determined, he chooses the optimal labor supply for his type. As honest, he will only supply registered work, i.e. all work hours are registered. As an evader, he chooses the number of registered and unregistered work hours that maximizes his utility. Consequently, he may supply both registered and unregistered work. When the individual chooses his type at stage 1, he calculates and compares the expected maximized expected utility of the two types at stage 2. His probability of being an evader exceeds the probability of being honest if the expected consumer surplus of being an evader minus the expected surplus of being honest exceeds a certain threshold. This threshold is higher the higher the individuals tax morale is and the fewer his opportunities for tax evasion are at the workplace. Hence, norms and opportunities for unregistered work affect the individual's choice of being an evader or not. Norms and opportunities play no role, however, when he decides how many hours he will supply as honest or as an evader.

The reason to model the labor supply decision in two stages is that we believe that norms and opportunities are important for the decision of whether to be honest or not, but are not important for how many hours he wants to work, registered and unregistered. For example, norms for illegal activities like tax evasion often occur as a

threshold, or a fixed cost of violating the law: The individual will violate the law if and only if the expected difference in maximized utility between violating the law and not violating the law exceeds a certain threshold. The threshold is higher the higher the individual's morale is.

To an outside observer, there is a random component in the individual preferences. At best we are therefore able to derive the probability that an individual will pursue a tax evading strategy or an honest strategy. To derive these probabilities we assume that the random components in the utilities are extreme value distributed. As demonstrated by Ben-Akiva and Lerman (1979) we are able to find a closed form solution for the expected value of the maximum of the random utility for the two different strategies. The probabilities of choosing an honest or an evading strategy depend on these expected values of maximum expected utility. In addition the probability of choosing an honest or an evading strategy also depends on the individual's perception of how socially acceptable tax evading is and on the opportunities for the individual to evade taxes.

Tax evasion is a risky activity. There is a probability that a tax evader will be detected and penalized for tax evasion. We follow Allingham and Sandmo (1972) and let the individuals maximize expected utility when they decide under uncertainty whether to evade or not. However, we extend their approach by allowing the individuals to give overweight to small probabilities that are related to undesirable events, see Kahneman and Tversky (1979).

To explain the econometric model, we start with stage 2: The choice of optimal labor supply for each of the two types, honest individuals (H) and evaders (E).

Stage 2: Labor supply of an honest individual (H)

An individual that has chosen to be honest (H) will choose the number of hours of registered work that maximizes his expected utility. Let C_{iH} be his after tax wage income and let h_{iH} be annual hours; i=1,2…n, where n is the number of categories of hours. When i=1, the individual does not work. W_H is the hourly wage rate for registered work and R_{iH} is gross annual wage income, Hence, $R_{iH} = W_H h_{iH}$. Non-wage income is denoted I. The taxes paid, T, is a step-wise linear function of wage income and non-wage income, i.e. $T = T(R_{iH}, I)$.

Thus

$$(1) \quad C_{iH} = R_{iH} + I - T(R_{iH}, I) \;; i = 1, 2, , , n$$

Let U_{iH} be the utility for an honest individual that works h_{iH} hours, and let X be a vector of socio-demographic characteristics. Moreover, ε_{iH} is a random variable (random to the analyst), assumed to be extreme value IID with zero mean and a constant variance.

Thus

$$(2) \quad U_{iH} = u(C_{iH}, h_{iH}, X) + \varepsilon_{iH}; i = 1, 2, ...n$$

u(.) is the deterministic part of the utility function and ε_{iH} is the random part. The random part may be known to the individual but not to the outside observer.

Let S_H denote the expected value of the maximum of the utility function. As demonstrated in Ben-Akiva and Lerman (1979), S_H is given by

$$(3) \quad S_H = E[\max_{i=1,2,,,n} U_{iH}] = \mu_2 \ln \sum_{k=1}^{n} \exp(u_{kH} / \mu_2)$$

S_H can also be interpreted as the expected consumer surplus associated with the n alternatives (reported for taxation). μ_2 is a constant which reflects unobserved heterogeneity in preferences. The larger μ_2 is, the more uncertain are preferences.

The conditional probability of choosing h_{iH} hours, conditional on choosing to be honest (H), is given by

$$(3) \quad P(h_{iH} \mid H) = P(U_{iH} = \max_{k=1,2,,,n} U_{kH}) .$$

With ε_{iH} being extreme value IID, it is well known that this optimal choice probability $P(h_{iH}|H)$ is a multinomial logit. This multinomial logit can be derived by taking the derivatives of the consumer surplus S_H with respect to the deterministic part of the utility function:

$$(4) \quad P(h_{iH} \mid H) = \frac{\partial S_H}{\partial u_{iH}} = \frac{\exp(u_{iH} / \mu_2)}{\sum_{k=1}^{n} \exp(u_{kH} / \mu_2)}; i = 1, 2, , , n$$

Since μ_2 is absorbed in the scaling of the deterministic part of the utility function, it is named the scaling coefficient. Of course, μ_2 is not identified from data.

Stage 2: Labor supply of a tax evader (E)

An individual who has chosen to be an evader (E) chooses the number of both registered and unregistered work that maximizes his expected utility. Let h_{iH} be the number of hours registered for taxation and h_{jE} the hours that are not registered (evaded). His total number of work hours is denoted h_{ij}, i.e. $h_{ij} = h_{iH}+h_{jE}$. The i's and j's, the categories for registered and unregistered work hours, both run from 1 to n. W_E is the hourly wage rate for unregistered work, and W_H is the wage rate for registered work. His gross income from registered work is therefore $R_{jH}=h_{iH}W_H$,and his gross income from unregistered work is $R_{jE}= W_E h_{jE}$.

In contrast to an individual who has chosen to be honest, an evader has to take into account the risk of being detected and penalized. Let subscript T indicate that the individual's tax evasion is detected and penalized. $C_{ijE,T}$ is his net income, i.e. net of taxes and penalties, when he works h_{ij} hours annually. $C_{ijE,NT}$ is the after tax wage income of an evader, when his tax evasion is not detected. Let τ be the fine that the evader has to pay if detected. His net income if he is detected can then be written as

$$(5) \quad C_{ij,E,T} = R_{iH} + R_{jE} + I - T(R_{iH} + R_{jE}, I) - \tau(R_{jE})$$

The net income if he is not detected can be written as

$$(6)\quad C_{ij,E,NT} = R_{iH} + R_{jE} + I - T(R_{iH}, I)$$

where i,j = 1,2,…..n.

Let q denote the probability of detection (1≥q≥0), and let f(q) be a probability weighting function. We use a specification of this probability weighting function f(q) that allows for the possibility that individuals give overweight to small probabilities related to undesirable events, as discussed in Kahneman and Tversky (1979). The specification implies a rank-dependent expected utility model, with the expected utility model as a special case; see Quiggin (1982, 1993).

Thus

$$(7)\quad \begin{cases} f(q) = 1 - \frac{1}{2}[1 + (1-q)^a - q^a]; 1 \geq a \geq 0 \\ f(q) = \frac{1}{2} \text{ for } a = 0 \\ f(q) = q \text{ for } a = 1 \end{cases}$$

For a>0, we have

$$(8)\quad \begin{cases} f(1) = 1 \\ f(0) = 0 \\ f(\frac{1}{2}) = \frac{1}{2} \end{cases}$$

Moreover, when a>0

$$(9)\quad \begin{cases} \frac{\partial f(q)}{\partial q} > 0 \text{ for all } q \\ \frac{\partial^2 f(q)}{(\partial q)^2} = 0 \text{ for } q = \frac{1}{2} \\ \frac{\partial^2 f(q)}{(\partial q)^2} < 0 \text{ for } q < \frac{1}{2}, 0 < a < 1 \\ \frac{\partial^2 f(q)}{(\partial q)^2} > 0 \text{ for } q < \frac{1}{2}, 1 < a < 2 \\ \frac{\partial^2 f(q)}{(\partial q)^2} < 0 \text{ for } q < \frac{1}{2}, a \geq 2 \end{cases}$$

For an individual that has chosen to be an evader (E), the random utility function denoted U_{ijE}, has two parts. The first part, which is deterministic, is the expected or rank dependent expected utility of doing both registered and unregistered

work, which is a risky activity. The second part is random to the analyst, and has the same distribution as the random term in (2). Thus,

$$(10)\quad U_{ijE} = f(q)u(C_{ij,E,T}, h_{iH} + h_{jE}, X) + (1-f(q))u(C_{ij,E,NT}, h_{iH} + h_{jE}, X) + \varepsilon_{ijE}; i, j = 1, 2, , , n$$

As above, let S_E be the expected value of the maximum of the expected random utility, that is

$$(11)\quad S_E = E[\max_{i=1,2,,n;j=1,2,,n} U_{ijE}] = \mu_2 \ln \sum_{k=1}^{n}\sum_{r=1}^{n} \exp(u_{ijE}/\mu_2)$$

where

$$(12)\quad u_{ijE} = f(q)u(C_{ijE,T}, h_{iH} + h_{jE}, X) + (1-f(q))u(C_{ijE,NT}, h_{iH} + h_{jE}, X)$$

The conditional probability of working h_{iH} registered and h_{iE} unregistered, conditional on being a tax evader, is then given by:

$$(13)\quad P(h_{iH,}h_{jE} \mid E) = \frac{\partial S_E}{\partial u_{ijE}} = \frac{\exp(u_{ijE}/\mu_2)}{\sum_{k=1}^{n}\sum_{r=1}^{n}\exp(u_{rkE}/\mu_2)}; i, j = 1, 2, , , n$$

Stage 1: The choice between being honest (H) and being a tax evader (E)

When an individual chooses between being honest (H) and being an evader (E) he compares the expected values of the maximized expected (random) utilities for the two choices. Let P(H) denote the probability that the individual choose to be honest (H). The probability that he chooses to be an evader, P(E), is then equal to 1-P(H). As shown in Ben-Akiva (1973), the probability of choosing an optimal strategy can be evaluated by the expected consumer surpluses.
Thus

$$(14)\quad P(H) = \frac{\exp(S_H/\mu_1)}{\exp(S_H/\mu_1) + \exp(S_E/\mu_1)}$$

where μ_1 is a positive constant.

This two stage modelling of labor supply, when tax evasion is an option, is a nested multinomial logit model. McFadden (1978) has shown that the nested multinomial logit model is consistent with the maximization of a random utility function if $\mu_1 \geq \mu_2$. μ_1 reflects the unobserved heterogeneity in preferences in stage 1 of the decision structure, while μ_2 does the same in stage 2.

When $\mu_1 \to \infty$, P(H) and P(E) approaches ½. When $\mu_2 \to \infty$, both $P(h_{iH}|H)$ and $P(h_{iH},h_{jE}|E)$ approaches 1/n. Thus, at these extreme values of the μ's, the model degenerates to a model where the individuals' choices are random. The ambition of the structural microeconomic model outlined above is to explain observed behavior better than a pure random model does. The pure random model will be used as a benchmark when we later report the goodness of fit of our model.

The likelihood expression

Let N_H be the group of individuals in the sample who are observed to be honest (H). In our dataset, N_H is the group that answered no to the question of whether they have evaded taxes the last twelve months. Let N_E be the group of tax evaders in the sample, i.e. those who answered yes to the question. Let subscript s indicate individual. The joint a priori probability of what we observe is then given by the likelihood L:

$$(15) \quad L = \prod_{s \in N_H} P_s(h_{iH}, H) \prod_{s \in N_E} P_s(h_{iH}, h_{jE}, E)$$

The unconditional probabilities $P(h_{iH},H)$ and $P(h_{iH},h_{jE},E)$ in (15) are given by

$$(16) \quad P(h_{iH}, H) = P(h_{iH} \mid H)P(H)$$

and

$$(17) \quad P(h_{iH}, h_{jE}, E) = P(h_{iH}, h_{jE} \mid E)P(E)$$

The unknown parameters of the utility function (to be specified below), μ_2/μ_1 and a, are then estimated by maximizing L with respect to these parameters.

Social norms and tax evasion opportunities

Tax evasion is an illegal act and we therefore believe that the inclination of an individual to evade taxes is strengthened the more widespread tax evasion is in the population. Elster (1989) suggests that the social norm related to tax evasion might be of the type: Do E if everyone else did E. Hence, for such norms to be viable, they must be shared by other people and sustained by their approval and disapproval. We assume that the probability of choosing a tax evasion strategy depends on the individual's own perception of how socially acceptable tax evasion is. This perception is measured by the observed variable Z_1, which is based on the answer to the following question in the survey: *"What do you think is the attitude among people towards doing work where the income is not reported to the tax authorities? Do you think it is accepted/accepted to some extent/not accepted/don't know."* The answer to this question may reveal the individual's perception of the social norm better than more direct questions about his own attitude towards tax evasion. Consequently, we use the answer as a proxy for the individual's own internalized norm for tax evasion.

One might think that the variable Z_1 is too strongly related to the likelihood of being a tax evader. However, as revealed by the summary statistics, a majority of the non-evaders also think that tax evasion is socially accepted. It is worth noticing that the social acceptance of tax evasion measured this way seems to be in line with what the Norwegians think about making homemade liquor (Isachsen and Strøm, (1981)). Both making homemade liquor and tax evasion are law violations.

The opportunity to evade taxes differs across jobs. To take the extreme cases, it is a lot easier for a worker in the construction sector to do unreported work than for a bureaucrat in the government sector. To reflect these possible differences in tax evasion opportunities, we have introduced two dummy variables; one for those

working in the construction sector (Z_2) and one for those working in the government sector (Z_3).

To bring norms and opportunities into the econometric model we weight the expected utility value of choosing a tax evasion strategy by a social norm and opportunity density $g(Z_1, Z_2, Z_3)$, or the shorter $g(Z)$. Instead of (14) we then get

$$(14a) \quad P(H) = \frac{\exp(S_H / \mu_1)}{\exp(S_H / \mu_1) + g(Z)\exp(S_E / \mu_1)},$$

which can be shown to yield

$$(14b)\ P(H) = \frac{\left[\sum_{k=1}^{n} \exp(u_{kH} / \mu_2)\right]^{(\mu_2/\mu_1)}}{\left[\sum_{k=1}^{n} \exp(u_{kH} / \mu_2)\right]^{(\mu_2/\mu_1)} + g(Z)\left[\sum_{k=1}^{n}\sum_{r=1}^{n} \exp(u_{krE} / \mu_2)\right]^{(\mu_2/\mu_1)}}$$

The norm and opportunity density $g(Z)$ can be interpreted as a threshold level. Since our model is stochastic, we are only able to relate the threshold level to choice probabilities. From (14) we get that $P(E) > P(H)$ if $\frac{\exp\left(\frac{S_E}{\mu_1}\right)}{\exp\left(\frac{S_H}{\mu_1}\right)} > \frac{1}{g(z)}$, i.e. if $[S_E - S_H] > -\mu_1 \ln g(z)$. Thus, the probability of being a tax evader will exceed the probability of being honest if the difference in expected consumer surplus exceeds the threshold $-\mu_1 \ln g(z)$.

When $\mu_2 / \mu_1 = 1$, the nested multinomial logit model degenerates to a multinomial logit model, or

$$(18) \quad P(h_{iH}, H) = \frac{\exp(u_{iH} / \mu_2)}{\sum_{k=1}^{n} \exp(u_{kH} / \mu_2) + g(Z)\sum_{k=1}^{n}\sum_{r=1}^{n} \exp(u_{krE} / \mu_2)}$$

and

$$(19) \quad P(h_{iH}, h_{jE}, E) = \frac{g(Z)\exp(u_{ijE} / \mu_2)}{\sum_{k=1}^{n} \exp(u_{kH} / \mu_2) + g(Z)\sum_{k=1}^{n}\sum_{r=1}^{n} \exp(u_{krE} / \mu_2)}$$

Empirical specifications

Let $v(C,h,X)=u(C,h,X)/\mu_2$. This deterministic part of the utility function is assumed to be a Box-Cox transformation of disposable income and leisure. A justification for this functional form is given in Dagsvik and Strøm (2005).

$$(20)\quad v(C,h,X)=(\alpha_0)\frac{(C/100000)^{\lambda}-1}{\lambda}+(\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3)\frac{(8760-h)^{\gamma}-1}{\gamma},$$

where C is disposable income.

In measuring C, all details of the step-wise tax-functions given in Appendix 1 are taken into account. The fine, if tax evasion is detected, is based on the perceived fines as reported by the respondents. The probability of detection is also based on the individuals' perception of detection probabilities as reported by the respondents. As shown in Section 2 above, these probabilities are small. To account for the possibility that the individuals' overweight the probabilities related to undesirable events, we have included the weighting function f(q).

We use the hourly wage rates for registered work to calculate gross earnings for both evaders and non-evaders. The survey gives us a good estimate of these wage rates, since most respondents report their wage rates for registered work. Only a few of the respondents report their wage rate for unregistered work, however. It is likely that the wage rate for unregistered work is lower than the wage rate for registered work, but we only observe by how much for a few of the participants in the sample. We have therefore not tried to estimate the potential unregistered wage rate. Instead, we use the wage rate for registered work as a proxy for the wage rate for unregistered work.

Hours of registered work per week are observed in broad intervals, with 50 hours a week as a maximum. We have used the midpoints of the intervals. Hours of unregistered work are reported as annual hours, and again in broad intervals with midpoints 10, 25, 37, 75, 150, 250 and with 600 as a maximum. Due to the exclusions of some respondents (retired, disability etc), we have no observations of zero hours registered work. Hence, we do not take into account the decision whether to participate in the regular labor market or not. Of course, zero hours of unregistered work is an option in the model. Annual leisure is (8760-h).

The set of feasible hours in the questionnaire differs somewhat from that in the model. The main difference is that the feasible hours differ between registered and unregistered work. This way of treating feasible hours reflects that doing unregistered work has the character of being a side job.

X_1 is a dummy, which equals 1 if the year of observation is 2001 and zero if the year of observation is 1980. Thus, we have pooled the two observation sets and we allow the scaling parameter in front of leisure to vary between the two years of observation. X_2 is age (in years) and X_3 is a dummy, which equals 1 if the individual is a woman and zero if a man.

A sufficient condition for the deterministic part of the utility function, v(.) to be quasi-concave function, is that both λ and γ are less than 1. When λ and γ are both equal to 1, the utility function is linear. When they approach zero, the utility function approaches a log-linear function of consumption and leisure.

The opportunity and norm density is

(21) $g(Z)=\exp(g_0+g_1Z_1+g_2Z_2+g_3Z_3)$

With $\mu_1 \ln g(z) = -g_0^* - g_1^* z_1 - g_2^* z_2 - g_3^* z_3$, where $g_k^* = \mu_1 g_k$, it follows from the interpretation of the threshold above that we should expect g_1 and g_2 to be positive and g_3 to be negative. A positive g_1 means that if the individual thinks that evasion is socially acceptable, the threshold is low.

The variables appearing in the Z-vector are:

Z_1 equals 1 if the respondent answers that he or she thinks that people in general accept tax evasion, and it equals zero otherwise,

Z_2 equals 1 if the respondent works in the construction sector, otherwise equals zero,

Z_3 equals 1 if the respondent works in the government sector, otherwise zero.

4. Estimation results

Estimates

The estimation results are set out in Table 6. First, we tried to estimate the nested logit model, with μ_2/μ_1 as a free parameter. Since we were not able to obtain a sharp estimate of μ_2/μ_1, significantly different from 1 (the point estimate was slightly above 1), however, we have estimated the model with $\mu_2/\mu_1=1$. In Table 6 we observe that most of the parameters are rather precisely determined.
First we observe that the estimates of λ and γ are significantly below 1, which means that the estimated deterministic part of the utility function is quasi-concave. This is in line with estimates obtained on more traditional labor supply where the opportunity for tax evasion is ignored (Dagsvik and Strøm (2005))

Next we observe that the marginal utility of income is slightly lower in 2001 than in 1980. Age has no significant impact on leisure, while the gender effect implies that females have a higher marginal utility of leisure than males.

The point estimate indicates that the respondents overweight low probabilities of being detected. However, the parameter of the probability weighting function is not precisely estimated, and the estimate is not significantly different from 0.We remember that if a=0, the individuals toss a coin with respect to whether they will be detected when evading taxes. Thus it seems that the individuals may give a rather high overweight to low probabilities of detection.

The g-function is rather precisely estimated and it plays an important role in explaining whether the respondent chooses to be honest or to be an evader. The perceived social norm has a significant impact on the inclination to be a tax evader. The probability of choosing to be an evader (E) increases if the respondent believes that people in general accept tax evasion. Not surprisingly, having a job in the construction sector seems to make it easier to become a tax evader, while the opposite is the case for those working in the government sector.

Economic incentives seem to play a less important, but still significant, role in explaining the choice between being honest and being an evader. The policy simulations below, confirm the limited role for economic incentives for this choice.

Table 6: Estimation results

Variables	**Parameter**	**Estimates**	**t-values**
Consumption, scale	α_0	1.9036	6.8
Consumption, exponent	λ	0.4340	3.8
Constant, leisure	β_0	1.2599	1.6
Leisure, X_1=1 if 2001	β_1	-0.3935	-2.0
Leisure, age	β_2	-0.0046	-0.8
Leisure, X_3=1 if woman	β_3	1.0712	2.1
Leisure, exponent	γ	-8.2426	-4.4
Prob. weighting function	a	0.5469	1.2
Opportunity density, constant	g_0	-4.4013	-21.5
Opportunity density, Norm	g_1	1.1451	5.4
Opportunity density, construction	g_2	1.8993	6.2
Opportunity density govt	g_3	-1.058	-2.2
No of observations	1049		
Goodness of fit	0.424		

Goodness of fit is defined as 1 minus the ratio of the log-likelihood related to the estimates to the log-likelihood when all alternatives have an equal chance of being chosen ("McFaddens rho squared"). Our estimate of this goodness of fit is 0.424. Thus compared to a model where all choices are made at pure random our model explains data 42.4 percent better.

Labor supply elasticities

In tables 7-9 we report the elasticity of labor supply with respect to the wage rate for both registered and unregistered work (an overall wage increase). We report the following labor supply responses:

1) Probabilities of being honest, P_H, and tax evader, P_E
2) Expected supply of registered, conditional on being honest, denoted $(L_H|H)$
3) Expected supply of registered labor, conditional on being an evader, denoted $(L_H|E)$
4) Expected supply of unregistered labor, conditional on being an evader, denoted $(L_E|E)$
5) Expected supply of registered labor, unconditional, denoted L_H
6) Expected supply of unregistered labor, denoted L_E

Formally,

$$
(22)\begin{cases}
(L_H \mid H) = 52\sum_{i=2}^{5} P(h_{iH} \mid H)h_{iH} \\
(L_H \mid E) = 52\sum_{i=1}^{5}\sum_{j=1}^{8} P(h_{iH}, h_{jE} \mid E)h_{iH} \\
(L_E \mid E) = \sum_{i=1}^{5}\sum_{j=1}^{8} P(h_{iH}, h_{jE} \mid E)h_{jE} \\
L_H = P(H)(L_H \mid H) + P(E)(L_H \mid E) \\
L_E = P(E)(L_E \mid E)
\end{cases}
$$

We observe that overall wage elasticities are numerically low. An overall wage increase tends to increase the supply of registered work, but the impact on unregistered work is the opposite. This result is in line with the finding in Lemieux et al (1994). An increase in only the wage rate for registered work increases the supply of registered labor, while the impact on the supply of unregistered labor is negative. The opposite occurs if the wage rate for unregistered work is increased. The positive impact on supply of unregistered labor is stronger than the positive impact on supply of registered labor from an increase in the wage rate for the different type of work.

Table 7: Mean value of elasticity of labor supply with respect to a wage increase in both sectors, for registered and unregistered work (Standard deviation in parenthesis).

Labor supply variables	1980	2001
P_H	0.01 (0.03)	0.01 (0.02)
P_E	-0.04 (0.09)	-0.06 ((0.07)
$L_{H\|H}$	0.03 (0.05)	0.06 (0.07)
$L_{H\|E}$	-0.08 (0.04)	-0.01 (0.05)
L_H	0.09 (0.04)	0.05 (0.06)
$L_{E\|E}$	-0.07 (0.12)	-0.08 (0.10)
L_E	-0.11 (0.20)	-0.14 (0.16)

Table 8: Mean value of elasticity of labor supply with respect to a wage increase in the regular sector only (Standard deviation in parenthesis).

Labor supply variables	1980	2001
P_H	0.09 (0.05)	0.07 (0.04)
P_E	-0.31 (0.10)	-0.33 (0.09)
$L_{H\|H}$	0.03 (0.05)	0.06 (0.07)
$L_{H\|E}$	0.05 (0.03)	0.10 (0.05)
L_H	0.04 (0.04)	0.08 (0.04)
$L_{E\|E}$	-0.39 (0.05)	-0.42 (0.06)
L_E	-0.69 (0.14)	-0.73 ((0.14)

Table 9: Mean value of elasticity of labor supply with respect to a wage increase in the irregular sector only (Standard deviation in parenthesis).

Labor supply variables	1980	2001
P_H	-0.09 (0.05)	-0.06 (0.04)
P_E	0.30 (0.07)	0.30 (0.06)
$L_{H\|H}$	0.00	0.00
$L_{H\|E}$	-0.14 (0.03)	-0.11 (0.03)
L_H	-0.03 (0.02)	-0.02 (0.01)
$L_{E\|E}$	0.33 (0.10)	0.35 (0.07)
L_E	0.63 (0.14)	0.65 (0.12)

5. Predictions and policy simulations

As shown above, the fraction that chooses to be evaders has gone down from 20 percent to 13 percent from 1980 to 2001. During this period the tax rates have gone down and tax functions have become less progressive. Also, there has been an increase in real wages. Both these changes in economic incentives make it more profitable to be honest, relative to being an evader. Over the same period norms and opportunities for tax evasion at the work place have also changed. Tax evasion seems to be less socially acceptable in 2001 than in 1980. Growth in public sector employment and decline in informal employment relationships both reduce the opportunities for unregistered work.The estimated model is used to simulate the changes in tax rules and wages, and to compare the impact of changes in taxes and wages with the impact of changes in norms and opportunities for tax evasion.

We have simulated two types of changes in the tax structure:

- In the first simulation, the individuals of 1980 are given the tax system of 2001, and vice versa. We thus investigate how labor supply and tax revenues in 1980 would have changed if the tax system of 1980 were replaced by the tax system of 2001, which had lower tax rates and a less progressive tax function. Similar, we find how the high tax rates and progressive tax function of 1980 would affect the labor supply and tax revenues in 2001. These simulations allow us to isolate the effect of the tax changes from 1980 to 2001 from the effects of changes in wages, norms and opportunities for tax evasion.
- In the second simulation, we study the effect of a tax reform. More specifically, we study the tax reform that took place in 1991-1992 (decided in

1991, made effective in 1992) in Norway. One of the most profound effects of the reform was that the marginal tax rates for high incomes were lowered.

Both policy simulations are compared with the predicted outcomes for 1980 and 2001. For each year, we use the estimated model and the tax system and other variables for that year to predict labor supply, tax revenues and tax evasion. The results of the predictions and policy simulations are given in Table 10 below, together with the observations for 1980 and 2001.

Responses are calculated for each individual and then these responses are aggregated to give the means for the whole population. We report both the labor supply responses given in (22) above and the tax revenues in the different cases. T_H is the expected mean amount of taxes paid by the non-evaders, while $T_{H|E}$ is the expected mean amount of taxes paid by the evaders. T is the expected mean amount of taxes paid in the total population, which, of course, lies between the two others.

T_E-$T_{H|E}$ is a hypothetical amount and is equal to the difference between the taxes the evaders would have paid if all income were reported and the taxes reported on income by the tax evaders. This difference can be associated with the amount of taxes evaded. But of course, if the tax evaders were to pay taxes on income from unregistered work, this work might not have been undertaken at all. However, this hypothetical construct gives some indication about the magnitude of tax evasion in the society.

Table 10: Simulation results: Participation rates and annual hours, mean taxes in NOK 2001.

Variables	Observed		Predicted		2001 tax rules	1980 tax rules
	1980	2001	1980	2001	1980	2001
P(H)	0.773	0.833	0.781	0.826	0.787	0.822
P(E)	0.227	0.167	0.219	0.174	0.213	0.177
$(L_H\|H)$	1386	1663	1560	1703	1627	1644
$(L_H\|E)$	1532	1668	1397	1546	1462	1488
$(L_E\|E)$	131	72	218	206	210	213
L_H	1763	1945	1523	1676	1591	1616
L_E	30	12	47	36	45	38
T_H	81660	68528	85066	70265	77527	80500
$T_{H\|E}$	89634	71260	77365	64149	70863	70604
T	83414	68992	83380	69201	76108	75851
T_E-$T_{H\|E}$	7216	3998	16086	10137	12056	13401

Predictions

When we use the estimated model to predict labor supply and tax payment we get the following main results:

- The model predicts quite well the observed fractions that choose to be honest (H) and evaders (E), respectively.

- Hours worked, conditional on being honest or an evader, are less precisely predicted. For honest individuals (H) the predicted number of hours worked (registered) is higher in 1980 than the observed number. For evaders, the total number of hours worked is fairly well predicted in both years, but the predicted number of unregistered hours is higher than observed, while the predicted number of registered hours is lower than observed. It is also interesting to note that in 1980 the observed mean hours of registered work among the tax evaders exceed the hours worked among the honest individuals.
- The model predicts taxes rater precisely.
- The bottom row in the table gives an estimate of the mean taxes evaded, "observed" (calculated) and predicted. The "observed" amounts are around 7000 NOK in 1980 and 4000 NOK in 2001. The predicted values are considerably higher: around 16 000 NOK in 1980 and 10 000 NOK in 2001.

Our model predicts that the evaders will work more hours unregistered than they actually do. The discrepancy may of course be a coincidence only. However, there are two features of our model that may lead to a too high prediction of unregistered labor supply. First, the probability of detection for an individual does not change with his amount of unregistered work in the model. In reality, however, the probability of detection may depend on the amount of both registered and unregistered work. The control authorities often use low registered income as a criterion for control. Hence, to work more unregistered hours without increasing the probability of detection too much, the individual also has to work more hours registered. In our data, we only have information about the individuals' perception of the probability of detection for approximately the amount of unregistered work they have chosen. Of course, we could have used the cross-section variation in perceived probability of detection and evaded income to estimate the relationship between detection probabilities and evaded incomes. However, this would have made the estimation trickier than it already is. The model therefore does not allow for the possibility that the probability of detection may be higher if the individuals choose more hour of unregistered work. As a consequence, we may exaggerate the expected gain from a marginal increase in supply of unregistered labor.

Another possible source of too high predictions of unregistered labor supply is that the observed hours of unregistered work may not be the hours supplied, since not all individuals are free to work unregistered as many hours as they want. For example, many of the respondents are employees who need the cooperation of their employers to do unregistered work. Barth and Ognedal (2005) argue that unregistered work in firms is actually rationed by the firms' demand for such work. If this is true, the discrepancy between predicted and observed unregistered hours may be due to the difference between supply and demand.

A swap of the tax regimes in 1980 and 2001

A swap of tax regimes has the expected effect. Implementing the more progressive tax rules of 1980 in 2001 instead of the actual tax rules reduces labor supply in the regular economy among both honest individuals and tax evaders. Hours worked unregistered are slightly increased. The opposite happens in 1980 when the less progressive tax regime of 2001 replaces the more progressive tax system of 1980.

Compared to predicted values the swap of tax regimes reduces tax evasion in 1980, when the progressive tax system of 1980 is replaced by the less progressive tax system of 2001. Tax revenues are reduced, however. The opposite is the case for 2001, when the tax system is replaced by the more progressive system from 1980: Tax evasion goes, but tax revenues also goes up. Thus, the reduction in tax rates and progression of the tax function from 1980 to 2001 has reduced tax evasion significantly, but it has also reduced the tax revenues.

As shown in Appendix 1, the tax structure in 2001 was very different from the tax structure of 1980. During the period 1980-2001, the tax structure was changed almost every year and most of the time towards a less progressive tax structure (The tax functions for 1980 and 2001 are shown in Appendix 1). One of the major revisions took place in 1991-1992, when there was a large reduction in marginal tax rates. The top marginal tax rate went up again between 1992 and 2001, but it did not reach the level prior to 1992.

The 1992-reform

The model is used to simulate the labor supply responses to the reform that took place in 1992. We have used the whole sample and the separate samples from 1980 and 2001 to predict labor supply for 1990 and 1992. The results are given in Table 11 below.

The main results are:

- The tax reform in this particular year had no impact on the likelihood of becoming a tax evader.
- The tax reform had a small and positive impact on the supply of registered hours.
- The tax reform had no impact on hours supplied among the tax evaders, neither on registered nor unregistered labor supply.
- Tax revenue increases from 1990 to 1992 despite the fact that the top marginal tax rates are lowered and labor supply responses are weak. However, from Appendix 1 we observe that the tax reform implied higher marginal tax rates on low incomes. This contributes to raising the tax revenues.
- Apparently, individual characteristics have a stronger impact on the outcomes than the economic incentives. Given the tax structures of 1990 and 1992, individual characteristics such as age, gender, education and hence wage rates, in the 2001 sample imply higher participation rates in unregistered work and higher total labor supply than the 1980 sample does.

Table 11: Effects of the 1991-1992 tax-reform (NOK 2001-values).

Variables	Based on 1980 sample		Based on 2001 sample		Based on both samples	
	1990	1992	1990	1992	1990	1992
P(H)	0,78	0,78	0,82	0,82	0,80	0,80
P(E)	0,22	0,22	0,18	0,18	0,20	0,20
$(L_H\|H)$	1507	1524	1599	1606	1551	1566
$(L_H\|E)$	1419	1422	1507	1506	1463	1464

$(L_E\|E)$	225	223	222	221	224	222
L_H	1486	1500	1581	1587	1532	1544
L_E	50	49	40	40	45	44
T_H	64678	69322	62930	62820	60991	66016
$T_{H\|E}$	60416	63426	58304	57912	57043	60623
T	63609	67926	62034	61905	60102	64865
T_E-$T_{H\|E}$	3285	2945	2394	2001	2762	2465

The comparison between the last two simulations underlines an important implication of tax reforms. A reform in one particular year may have much weaker impact on behavior than gradual and accumulating changes over many years.

6. Conclusions

A discrete choice model has been applied to estimate a labor supply model in which tax evasion is an option. The model has been estimated on pooled Norwegian survey data from 1980 and 2001. The estimates of the parameters of a Box-Cox utility function are in line with estimates based on more traditional Norwegian labor supply data. We find that economic incentives like wages and tax rates along with variables capturing social norms towards tax evasion and opportunities to evade taxes at the work place play a role in the explanation of behavior.

Labor supply elasticities are numerically low. Moreover, the elasticities are lower for supply of registered work than for unregistered. Overall wage increases have a positive impact on supply of registered work hours and a negative impact on supply of unregistered work hours. Thus, the increase in real wages in the period 1980-2001 may partly explain the observed decline in tax evasion activities reported above. However, we have also shown that lower social acceptance of tax evasion and reduced opportunities to do unregistered work have contributed.

The model has been used to simulate the impact on labor of changes in the tax structure. We find that although taxes matter for the labor supply of both registered and unregistered labor, the impact is not strong. The tax structure has changed considerably from 1980 to 2001. Gradually, tax rates have declined and the tax structure has become less progressive. Our tax policy simulations indicate that this change has reduced tax evasion to some extent. However, the tax reform in a particular year (1992) had little impact on labor supply and tax evading activities.

Appendix 1: Tax functions

Table A.1. Tax function for wage earners in1980. NOK 2001 values.

Income brackets (gross income=Y)	Tax T
Y≤33300	0
33300≤Y≤37000	0.524Y-17316
37000≤Y≤41625	0.513Y-17279
41625≤Y≤59200	0.313Y-8720
59200≤Y≤64750	0.285Y-7096
64750≤Y≤114700	0.296Y-7807
114700≤Y≤132460	0.324Y-10948
132460≤Y≤165760	0.384Y-18895
165760≤Y≤224960	0.434Y-27184
224960≤Y≤261960	0.484Y-38431
261960≤Y≤298960	0.544Y-54149
298960≤Y≤335960	0.604Y-72087
335960≤Y≤398860	0.654Y-88885
398860≤Y≤509860	0.704Y-117375
509860≤Y≤674880	0.744Y-137769
674880≤Y≤694860	0.694Y-171513
694860≤Y≤1064860	0.734Y-199307
1064860≤Y	0.754Y-220531

Table A.2. Tax function for wage earners in 2001. NOK 2001 values.

Income brackets	Tax T
Y≤47491	0
47491≤Y≤186956	0.3Y-20468
186956≤Y≤320000	0.36Y-17358
320000≤Y≤830000	0.49Y-58958
Y>830000	0.55Y-108758

Table A.3. Tax function for wage earners in1990. Nominal values.

Income brackets (gross income=Y)	Tax T
Y≤23846	0
23846≤Y≤57692	0.26Y-22100
57692≤Y≤122000	0.2158Y-19000
122000≤Y≤158000	0.36Y-53028
158000≤Y≤205000	0.53Y-86698
205000≤Y	0.615Y-103049

Table A.4. Tax function for wage earners in 1992. Nominal values.

Income brackets	Tax T
Y≤50000	0
50000≤Y≤135000	0.302Y-20120
135000≤Y≤200000	0.358Y-38090
200000≤Y≤225000	0.453Y-72044
Y>225000	0.488Y-83014

Appendix 2: Questions asked in the questionnaire

The respondents were asked to cross out answer-alternatives that vary across the questions. These alternatives are not shown here, but are available upon request.

Q.1. Gender
Q.2. Age
Q.3. Number of children living in the house
Q.4. Marital status
Q.5. Does your spouse have income generating work, and if so, how many hours?
Q.6. Education in years
Q.7. Occupational status (wage worker, self-employed, unemployed, retired, etc)
Q.8. Hours of work last week in the regular economy
Q.9. Hourly wage rate in main occupation
Q.10. Annual, net income (after tax) in main occupation
Q.11. Annual gross income in main occupation
Q.12 Occupation by industry
Q.13. Do you receive other income than wage income such as social security benefits/unemployment benefits/capital income?
Q.14.What is your tax rate for overtime work, the marginal tax rate in percent?
Q.15 How much tax do you pay in percent of your total annual gross income?
Q.16.What do you think is the attitude among people with respect to receive payment for work that is not reported to the tax authorities? Do you think it is accepted/accepted to some extent/not accepted/don't know
Q.17. Have you ever been engaged in non-reported income activities?
Q.18. If so, what kind of activities was it?
Q.19. If you had the opportunity to receive income without having to report it to the tax authorities, would you then accepted such income?
Q.20. If you don't report income to the tax authorities, how large do you think the chance (percent) is that you would be caught?
Q.21. If you do not report income to the tax authorities, say NOK 20 000, and you are caught; you have to pay a penalty tax in addition to the regular tax on the non-reported income. How large do you think this penalty tax rate is (percent)?
Q.22. During the last 12 months, have you received compensation for work that has not been reported or will not be reported to the tax authorities?
Q.23. Approximately how many hours of non-reported work have you done during the last 12 months?
Q.24. At the last tax declaration; what was the total annual income from work and capital income that you did not report?

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