Tax Progressivity and Self-Employment Dynamics

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Abstract

Analysis of the relationship between taxes and self-employment should account for the interplay between responses in self-employment and wage employment. To this end, we estimate a two-state multi-spell duration model which accounts for both observed and unobserved heterogeneity using a large longitudinal administrative dataset for Norway for 1993 to 2011. Our findings confirm theoretical predictions, and are robust to various changes to definitions and sample selections. A policy experiment simulating a flatter tax schedule in the year 2000, is found to encourage both entry into and exit from self-employment, resulting in a net increase of predicted inflow into self-employment from 3.0% to 5.4%.

JEL codes: H24; H25; J24; C41.

Keywords: Tax progressivity; Income tax; Self-employment; Duration analysis.

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1 Introduction

Numerous studies show that reductions in marginal tax rates increase the labour supply of wage earners, both at the extensive and the intensive margins (see for example, Blundell and MaCurdy (1999), and Keane (2011)). However, models of the choices facing the wage earners typically neglect the fact that tax-payers may exit or enter self-employment because of differences in tax schedules. Since the interplay between the occupational choices is typically not considered in models of labour supply, these models are silent on how tax differences across occupational choice affect decisions.[1]

The above contrasts sharply with the models of choice of the self-employed, which are dominated by perspectives where decisions are based on implicit or explicit comparisons to the wage sectors. One obvious reason for this asymmetry is the relative sizes of the sectors. For example, the self-employment rate (as a percentage of total employment) in Norway is 7%, while the European Union average is approximately 15% (OECD, 2018).

The relationship to the wage sector is not the only factor that complicates the assessment of effects of taxation on self-employment. From a theoretical perspective, the tax effects are ambiguous. For example, deductibility of business losses can act as a type of risk sharing with the government, and hence, can foster self-employment (Domar and Musgrave, 1944). On the other hand, a progressive tax schedule can discourage successful risk-neutral business owners, since a tax cut reduces taxes saved from possible losses through loss offsets (Cullen and Gordon, 2007; Gentry and Hubbard, 2000). Hence, we cannot rule out that tax cuts that result in a reduction in progressivity in the tax schedule may substantially reduce risk-taking and thus self-employment.

A large majority of empirical studies on the effect of taxes on the level of self-employment activity, focus on the United States. These studies examine the extensive margin in occupational choice models (see Bruce (2000, 2002), Gentry and Hubbard (2000, 2004), Schuetze (2000), Schuetze and Bruce (2004), Cullen and Gordon (2007), and Moore (2004)).[2] Studies for other countries include, Hansson (2012) for Sweden; Fossen (2007, 2009), and Fossen and Steiner (2009), for Germany; and Wen and Gordon (2014), for Canada. Results from these studies are mixed. Results for the United States, for example, do not provide an unambiguous answer about the relationship between tax progressivity and self-employment. However, in other countries, tax progressivity is generally found to discourage self-employment.[3]

The representation of the tax schedule is important in any analysis of tax effects on self-employment. Some studies include measures of marginal and/or average taxes in a quasi-experimental or reduced-form analysis to investigate the effect of non-linearities in taxes on entrepreneurship.[4] In other studies, authors have used measures of expected net-income differences and/or tax progressivity to capture the tax effects. For example, Gentry and Hubbard (2000, 2004) use the spread in the marginal (or average) tax rates faced by a self-employed individual at various levels of 'success', where success is defined as the observed distribution of the three-year real wage growth for entrants into self-employment.

In two recent studies (Fossen, 2009; Wen and Gordon, 2014), authors derive the tax variables within a structural framework where the decision making is based on the difference in expected utilities. Yet, the two papers differ in many aspects and draw different conclusions. The use of different utility functions and assumptions regarding the distribution of pre-tax income, result in different variables that capture the effects of non linearities in the tax schedule. They also differ in terms of the statistical model they use (logit vs. probit). The conclusions drawn are also different.

Fossen (2009) models the transitions between wage and self-employment using data from the German Socio-Economic Panel (GSOEP) over the period 2002 to 2006, and a logit model in which agents are assumed to trade-off risks and returns. He uses a constant relative risk-aversion utility, and assumes normally distributed pre-tax income. The two relevant model-generated variables are: (i) the difference in net incomes in the two occupations, and (ii) the variances of the post-tax income distributions in the transition equation.

By contrast, Wen and Gordon (2014), use a pooled cross-sectional sample from the Canadian Survey of Labour and Income Dynamics over the years 1999 to 2005 to estimate the probability of self-employment in a probit model.[5] They assume risk neutrality and a log-normal distribution for the pre-tax income. The relevant 'tax-variables' are: (i) the difference in log net incomes in the occupations (*netincdiff*), and (ii) a variable that they call *convexity*. The variable *convexity* has an intuitive interpretation as the 'increase in tax-liability taken on by self-employed due to the volatility of their business income, expressed as a proportion of their disposable income'.[6]

Both studies use selectivity corrected income equations to predict individual pre-tax incomes, and then use a tax-transfer micro-simulation model to generate the relevant expected net incomes and the variances of the distributions. The estimated models are subsequently used to simulate the effects of hypothetical tax policy scenarios that reduced progressivity. Fossen finds the 'flatter-tax' reforms considered, discourages individuals from choosing self-employment;[7] Wen and Gordon find a 'small' positive effect on the probability of finding someone in self-employment.[8]

In the following, we use the two variables *netincdiff* and *convexity* suggested by Wen and Gordon (2014). Although some of the tax effects in both studies are captured via net-income differences, the additional variable *convexity* in Wen and Gordon (2014) is an individual-specific measure that intuitively captures the interaction between the progressivity of the tax schedule and the volatility of self-employment income relative to wage income.

Our work complements the existing empirical literature in a number of ways. First, our definitions of wage employment and self-employment are based on reported incomes from tax records, and not on survey responses. We use data drawn from various Norwegian population registers over the period 1993 to 2011. The data include rich socio-demographic information together with highly accurate income measures from the annual tax returns. Second, we model the evolution of employment spells using a two-state multi-spell duration model that controls for observed as well as correlated unobserved heterogeneity, and account for observed censoring in the spells. This contrasts with several previous contributions, which mainly focus on self-employment entries or exits using survey data with self-reported employment status and short panels of individuals.

We generally find significant effects of both *netincdiff* and *convexity* on the probability of exit from both types of employment spells, conforming to theoretical predictions. The increase in *convexity* is found to increase the probability of exiting self-employment, and to decrease the probability of entry into self-employment, i.e., *convexity* has a discouraging effect on self-employment. On the other hand, an opposite effect is found for *netincdiff*. Additionally, in our base model, we find a larger effect of *convexity* relative to that of *netincdiff*, implying that small increases in *convexity* will require large increases in *netincdiff* to discourage the self-employed from quitting, and to encourage wage earners to enter self-employment.

Given the way the tax variables are constructed, a change in the progressivity of the tax schedule will have an impact on the *convexity* and on the *netincdiff* by changing the expected net income difference in self-employment and wage employment. From this, the total effect on the rate of self-employment of a decrease in the progressivity of the tax schedule is hard to predict. Hence, to better understand the net effect, we simulate a tax experiment that replaces the personal income tax structure in the year 2000 with a less-progressive, revenue-neutral tax schedule, as explained in Section 5.2. The overall estimated effect of this policy change is positive on the share of self-employment. The average exit rate from self-employment is estimated to go down by 0.149 (s.e 0.004) percentage points, while the estimated exit rate from wage-employment is estimated to increase by 0.104 (s.e 0.0001) percentage points. This change results in a net increase of predicted inflow into self-employment changing from about 3.0% to 5.4%.

The rest of the paper is organised as follows: Section 2 describes the taxation of self-employment income and wages during our sample period. Section 3 sets out our econometric model. In Section 4 we provide details of the data and the sample selected for our analyses. This Section also presents the procedure used for estimating the tax variables. The estimation results are discussed in Section 5, along with the results from our policy simulation, and some sensitivity checks. The paper concludes with the final Section 6.

2 Taxation in Norway

Tax reforms undertaken in 1992 introduced a dual-income tax system in Norway. Under this regime, all types of capital income are taxed at a flat rate, but a progressive schedule applies to labour and pension income. Individuals pay income tax on two different tax bases: (i) *ordinary* income, and (ii) *personal* income.

Ordinary income comprises all sources of income (wages, transfers and pension income, self-employment income, and capital income), less the applicable deductions.[9] A flat-rate tax, 28% during most of the period, is paid on *ordinary* income. The social security contributions and a surtax (two surtaxes since 2000) are paid on *personal* income, which includes gross wages, imputed personal income for self-employed individuals, and transfers and pension income. No further deductions are considered in the calculation of *personal* income.

As an example, consider a wage earner whose only source of income is from wages in the year 2005. The solid line in Figure 1 represents the marginal tax rates that apply to the wage income. After reaching the tax-free threshold, the social security contributions are paid at a levelling rate of 25% until it becomes equivalent to a rate of 7.8% on *ordinary* income. The flat tax on ordinary income (28% in 2005), is paid on the part of income exceeding the sum of the personal allowance and the basic allowance. The drop in Figure 1 results from the taxpayer having income in the interval of increasing basic allowance before reaching the maximum. The last two steps represent the surtaxes that raise the marginal tax rates by 12 percentage points and 15.5 percentage points, respectively. The maximum marginal tax rate of 51.3% is reached after the two surtaxes become effective.

[Figure 1 here]

Taxation is more complicated for the self-employed because income represents reward to the labour of the individual, as well as returns to the invested capital in the firm. Given the lower tax rate on capital income, the decision about how to declare the income was not left to the discretion of the self-employed; rules were established to split the net profits into labour and capital income.[10] The dashed line in Figure 1 represents the marginal tax rates that apply to self-employment income in the case where no capital is invested in the firm. The main difference compared to the wage income case is the higher social security contribution paid (10.7% in 2005).

[Figures 2 and 3 here]

Tax progressivity is ensured through the tax-free allowances applied to the ordinary income, and through the surtaxes on personal income. However, during the years under consideration, the progressivity changed several times as a result of changes to the tax rates and to the number of and thresholds for surtaxes. Overall, tax progressivity decreased during the period. As an illustration, Figures 2 and 3 show the marginal tax rates and average tax rates in different years for an individual whose only source of income was wage income.[11] Marginal tax rates in the year 2010 were lower than in the year 1995, and, for most part, they were also lower than in the year 2005. Similarly, the average tax rates in 1995 were in general higher than the rates in 2005 and 2010 (Figure 3).

3 Econometric model

Employment transitions are modelled using a two-state multi-spell discrete duration model accounting for observed as well as correlated unobserved individual heterogeneity. The two employment states are self-employment and wage employment. The duration variable is measured in terms of the Norwegian financial year which is also the calendar year (January-December). Approximately 70% of individuals in our sample have a first spell that is left censored. We have no information on how long they have already spent in that spell prior to entering our sample. We include these individuals and specify a different model of exit rates.[12] We check for sensitivity of our results when these left censored spells are excluded from the estimation sample.

Following the literature, we assume unobserved heterogeneity to be distributed independently across individuals as well as of the covariates included in the model, but fixed over spells. However, we allow these to be correlated across the two employment states and the type of spell (fresh vs left-censored). Following the semi-parametric approach pioneered by Heckman and Singer (1984*a*) and McCall (1996), we assume the vector characterising the unobserved heterogeneity follows a discrete multinomial distribution with two points of support.[13]

We provide the form of the hazard function used, but refer the readers to Ham, Li and Shore-Sheppard (2016) who have a similar setup of the likelihood function. For notational simplicity, in the specification below we do not distinguish between duration time and calendar time, although the estimated model does. The duration time random variable is denoted as Υ. Let $j = \{sf, wf, sc, wc\}$ where the first letter denotes the self-employment (s)/wage-employment (w) spell, and the second letter denotes the fresh (f)/left censored spell (c). The probability that individual i would leave the spell in employment-spell type j at the *end* of time t, conditional on not having left in $t-1$, is a discrete time hazard $\lambda(t)$ given by:

$$\begin{aligned} \lambda_{i,j}(t|x_{ij}, \omega_{i,j}) &= \Pr(\Upsilon_{i,j} = t|\Upsilon_{i,j} > t-1, \mathit{taxation}_{ij}(t), x_{i,j}(t), \omega_{i,j}) \\ &= F\left(h_j(t) + x_{i,j}(t)'\beta_j + \alpha_j' \; \mathit{taxation}_{ij}(t) + \omega_{i,j}\right) \end{aligned} \tag{1}$$

where h_j is the duration dependence function, $x_{i,j}(t)$ contain time-fixed and time-varying observed individual characteristics, *taxation* contain the tax variable(s), $\omega_{i,j}$ is the unobserved heterogeneity, and F is the distribution function. We allow for two types of individuals $(m = 1, 2)$ with four different support points with the associated probabilities p,and $(1-p)$. We set $\omega_{sf} = \omega_{ef} = \omega_{sc} = \omega_{ec} = 0$, for identification since all support points cannot be identified when an intercept is present in each of the hazards (see equation (1)). F is assumed to be a complementary log-log distribution function.[14] We also check for sensitivity of our conclusions when these left censored observations are excluded from the estimation sample.

4 Data, sample, and variable definitions

4.1 Data and sample selection

The present study benefits from rich longitudinal Norwegian administrative data for the period 1993 to 2011. The main data source is the *Income and Wealth Statistics for Persons and Families* (Statistics Norway, 2005). The data are drawn from the annual tax returns, and the education registers (years of education and fields of studies). This data also contain individual and family socio-demographic characteristics. Since our focus is on wage earners and the self-employed who have strong labout market attachment, we restrict our analysis to Norwegian citizens aged 25 to 61, and exclude those who have reported any income from agricultural, forestry or fishing activities.[15]

We use an income-based definition to identify periods or spells of self-employment and wage employment. In our main analysis, we classify an individual observation as 'self-employed' if the major source of income is self-employment income, i.e., if the reported net self-employment income (net of expenses) is larger in absolute value than the wage income, and is also larger than government transfers (which include disability insurance, unemployment benefits and other types of pensions).[16] Additionally, we restrict our sample to those who have been classified as either being in wage employment or self-employment during the observation period 1993 to 2011.[17]

[Figure 4 here]

The majority of individuals never experience any self-employment spells. For example, the average rate of self-employment over the sample period is around 5%, (see Figure 4).

To reduce the computational burden of working with over 2 miliion individuals, we use a 50% random sample to generate our tax variables. From this sample, we next randomly select 2% of individuals who have never been categorised as self-employed, and 20% from the other group, which includes individuals with periods of self-employment spells only, and individuals with a mix of types of employment. This gives us a sample of $476,275$ individual-year unweighted observations. All analyses presented use sample weights to account for this endogenous sample selection, following Solon, Haider and Wooldridge (2015).

4.2 Defining and estimating the tax variables

Our analysis is based on the theoretical exposition of an expected utility maximisation approach discussed in Wen and Gordon (2014), who in turn base their model on the one developed by Rees and Shah (1986). Assuming risk neutrality, a convex tax schedule, and log-normally distributed pre-tax income, they show how the probability of self-employment can be written as a function of the tax schedule using two representations of the effects of taxation.[18] These are (i) *netincdiff,* which is the difference in log of expected net incomes in self-employment and wage employment; and (ii) *convexity* which is a measure of how the tax liability changes due to the volatility of their self-employment income relative to the net income in wage employment (see Appendix A.1 for further details).

The construction of the two tax variables requires net-income distributions. We use a tax simulator to generate these (see Appendix A.2). The simulator takes into account the yearly rules for taxing self-employment income net of expenses, wages, and other sources of income. Other sources of income are taken to be exogenous; these are added to the predicted self-employment or wage income. The simulator also accounts for the main deductions and allowances, as well as for the system for taxation of the labour and capital parts of net self-employment income, see Section 2.

We now provide a short description of the construction of the two tax variables. This closely follows Wen and Gordon (2014). Assuming pre-tax income to be log-normally distributed,[19]

$$y_j \sim LN(\mu_j, \sigma_j), \text{ where } j = s \text{ for self-employment, and } \ j = e \text{ for wage employment}$$

we have,

$$\overline{y}_j \equiv E(y_j) = \exp(\mu_j + \frac{1}{2}\sigma_j^2). \tag{2}$$

The first tax variable, *netincdiff*, that enters the occupational choice probability is given by

$$netincdiff = [(1-\tau_s)\ln(\overline{y}_s)]/[(1-\tau_e)\ln(\overline{y}_e)] \simeq \ln\left[netincome_s/netincome_e\right] \tag{3}$$

where τ is a tax parameter from the tax function (see Footnote 18). For each individual, we first estimate the selectivity corrected *expected* pre-tax income ($\overline{y}_j$) for each occupation in each time period.[20] We then use the tax simulator to generate the individual specific net incomes in both occupations, $netincome_s$ and $netincome_e$.

Next, we define the second tax variable representation: *convexity*. This variable is defined as the difference between the expected tax liability $E[T(y_s)]$, and the tax liability at the expected income $T(\bar{y}_s)$, relative to the expected net income $(\bar{y}_s - T(\bar{y}_s))$.[21] Wage employment is generally less riskier than self-employment. Hence, following Wen and Gordon (2014), we derive our *convexity* variable by setting the coefficient of variation for wage income equal to 0, so that *convexity* is associated with uncertainties in self-employment income only.

The *convexity* variable for each individual in each time period is calculated as:

$$convexity = \frac{E[T(y_s)] - T(\bar{y}_s)}{\bar{y}_s - T(\bar{y}_s)}. \tag{4}$$

4.3 Summary statistics

Summary statistics for the main estimation sample are provided in Table 1. On average, in the weighted sample, the proportion of individuals exiting out of a period of work and into a period of self-employment is less than 1%, whereas the average share of exits out of a period of self-employment is 11%. We next turn to our tax variables.

[Table 1 here]

The overal distributions of the two tax variables are provided in Figures 5 and 6. *netincdiff* is predominantly negative, indicating that, for the majority of observations in the sample, the predicted net wage income is higher than the predicted net self-employment income.[22] *convexity* is as expected, estimated to be mostly positive. Both distributions are approximately symmetric around the respective means.[23] The average value of predicted *netincdiff* of -0.365 implies that the *net* income in self-employment is about 70% of net income in wage employment. The average estimated value of *convexity* is 0.010 (s.d.= 0.008) which is similar to the *convexity* value of 0.011 (s.d. 0.16) reported by Wen and Gordon (2014) for Canada.

Box-and-whisker plots in Figures 7 and 8, show how these estimated tax variables change over time. The median *netincdiff* remains stable over time without experiencing a clear trend, and the spread decreases over time. A slightly declining trend is observed for *convexity* which complies with the reduced progressivity of the taxation during the sample period (Section 2).[24]

[Figures 5, 6, 7 and 8 here]

In addition to the two tax variables, the models also include time-varying and time-invariant control variables. The time-invariant variables are: sex, age at the start of the spell, indicator variables for highest education level achieved, and regional dummies to account for local labour market conditions. Calendar time dummies control for macro effects. The data are an unbalanced panel, see descriptive information in Table 1. Self-employed individuals are on average older and less educated than individuals who are paid wages, and there is a lower proportion of females among the self-employed. Self-employment is also highly concentrated in the more densely populated areas of Eastern Norway (the region of Oslo) and western Norway (the region of Bergen).

5 Results

5.1 Main Results

Prior to discussing the parametric model estimation results, we provide the non-parametric hazard estimates in Figure 9.[25] The raw data self-employment (*SE*) hazard consistently lies above the wage-employment (*WE*) hazard, implying that the conditional exit rate from *SE* is higher relative to an exit from *WE*. However, the *WE* hazard is quite low and stable over the spell duration. The probability of exiting from *SE* into *WE* is around 0.23 in the first year, compared to 0.02 from *WE* into *SE*. Given the shape of this raw data hazard and the discussion in Baker and Melino (2000), we specify $h_j(t)$ in equation (1) as $\ln(t)$ in all four hazards.[26]

[Figure 9 here]

Our base model estimates are presented in Table 2.[27] All four hazard functions are estimated simultaneously. The conditional hazards are estimated to be decreasing with duration for both the *SE* and the *WE* spells. The estimated hazards are constant for the left-censored *SE* spells, *ceteris paribus*. This is consistent with the observation that the probability of exiting from *SE* is almost zero for high duration *SE* spells and the sample of left-censored spells has a higher probability of containing large-duration spells.

[Table 2 here]

We focus our discussions on the interpretation of the estimated effects of the tax variables. The theory predicts a positive (negative) effect of the *netincdiff* variable on the probability of exit from *WE* (*SE*). For example, the higher the proportionate increase in the net-income differential with respect to the net income from *WE*, the higher the exit rate from *WE* (Wen and Gordon, 2014; Taylor, 1996; Fossen, 2009). On the other hand, the theoretical prediction of the effect of *convexity* is negative on exit rate from *WE* since higher '*convexity*' would be expected to discourage *SE*. The estimated effects of the two tax variables conform to these theoretical predictions.

These estimated coefficients are also found to be higher in absolute value for *WE* exit probabilities (Columns [2] and [4]). These results suggest that, compared to exits from *SE*, the probability of an exit from *WE* is more sensitive to changes in both expected net-income differences and tax progressivity. This is consistent with the fact that the *SE* tend to continue their business activities even if they experience lower earnings growth (Hamilton, 2000).

The estimated effect of *convexity* on both exit rates is larger than the effect of *netincdiff*. This implies that a 1 percentage point increase in *convexity* requires approximately an increase of 7 to 14 percentage points in *netincdiff* to keep the self-employed from quitting and also to encourage wage earners to enter *SE*. Note that increases in *convexity* in this calculation are assumed to take place via changes to the volatility of *SE* income (equation (A.4) in the Appendix) as we assume no uncertainty in *WE* income in the calculation of this variable. Similarly, increase in *netincdiff* is assumed to work either via a reduction in the pre-tax income in *WE* or via an increase in the expected pre-tax *SE* income (not altering the variance of the *SE* income distribution).

5.2 Results from a policy experiment

So far, we have looked at the effects of partial changes in the tax variables *netincdiff* and *convexity*. To gain further understanding of how these related changes may be achieved through taxation, we consider a hypothetical reform in the year 2000. This particular year was chosen because the Norwegian government introduced two changes in the taxation of gross income from wage and self-employment, in that year. The threshold for the 1999 surtax rate of 13.5% was increased from $269,100$ NOK to $277,800$ NOK. More importantly, an additional surtax was introduced for income exceeding $762,700$ NOK (dashed line in Figure 10). These changes increased the overall progressivity of the Norwegian income tax system.[28]

[Figure 10 here]

The policy experiment considered is the following: instead of using the two surtaxes applied to personal income, the hypothetical tax reform implements a flatter tax schedule, with one surtax rate (solid line in Figure 10). The surtax value of 11% on gross income above $200,000$ NOK is chosen to ensure revenue neutrality, given a 'no behavioural reaction' assumption. Other features of the taxation are held constant. New values of *netincdiff* and *convexity* were generated under the hypothetical scenario using our tax simulator, and the transition rates predicted from the estimated models.

The average values of the *netincdiff* and *convexity* variables in our weighted sample are -0.320 and 0.0073 under the new policy regime, compared to the original figures for the year 2000 of -0.326 and 0.0088, respectively. As expected, the less-progressive tax schedule leads to a decrease of 0.17 percentage points in *convexity.* The hypothetical policy also leads to a small decrease in the mean *netincdiff*, so that average ratio of net income in *SE* to net income in *WE* changes from 72.2% to 72.6%.

The predicted transition probabilities under the old and the new tax regimes are reported in Table 3. In the benchmark year 2000, the model predicts that around 9.29% of self-employed individuals will transit out of *SE* to *WE* (Case [A]).[29] However, the reform reduces this figure to 9.14% (Case [B]). Under the new regime, the predicted transitions from *WE* to *SE* are higher at 0.68% compared to 0.57% in the base model. Since a very large proportion of individuals are in *WE* compared to *SE*, even this small increase in the exit rates out of

WE can generate a substantial net inflow into *SE.*

[Table 3 here]

To further explore how the model predicts responses to separate changes in the two tax variables, we look at these effects separately. In Case [C], we hold the *convexity* variable fixed, at a value that is the same as in the base case scenario, and let the *netincdiff* variable change. Conversely, in Case [D] there is a change in the *convexity* variable only. Table 3 shows that the partial effect of a change in *netincdiff* is an increase in transitions out of both *SE* and *WE.* This result is consistent with the fact that mean *netincdiff* experience a decrease in the reform scenario for the self-employed, whereas it increases for wage earners. A possible explanation for this effect is that the reduced progressivity of the tax system would encourage a larger share of wage earners who expect to be successful in self-employed, to transit into *SE*. On the other hand, since majority of self-employed individuals have been predicted to have a higher post tax income in regular employment, a flatter tax scenario would increase the proportion of them leaving *SE* for *WE*. In contrast, the decrease in *convexity*, common to both *WE* and *SE* observations, reduces the transitions from *SE* and increases the exit from *WE*. In summary, the hypothetical tax scenario is found to encourage the net inflow into *SE*. Translating these estimates to numbers, we find that such a policy would have resulted in an increase from 2.99% to 5.39% in the net inflow into *SE.*

Finally, we briefly compare our results to the findings of Wen and Gordon (2014), given that the same variables are used to capture the effects of taxes and uncertainty. Wen and Gordon (2014) also simulated the effect of a flatter tax schedule in the year 2000. Their policy reform implied changes in the average values of (i) *netincdiff* from −22.5% to −23.3% (an increase of 4%), and (ii) *convexity* from 1.2% to 0.8% (a reduction of 33%). The policy reform we considered changed the average values of (i) *netincdiff* from −32.6% to −32.0% (an increase of 2%), and (ii) *convexity* from 0.88% to 0.73% (a reduction of 17%). From the simulated policy reform, Wen and Gordon (2014) estimate an increase in the number of the self-employed of 0.78% (5.76 to 5.80 %); thus substantially below our estimate of 2.2% (our experiment implies an increase of the self-employment share in 2001 from 4.54% to 4.64%). One should however note that Wen and Gordon (2014) do not model transitions.

5.3 Sensitivity checks

In this sub-section we present results of some of the investigations we have carried out to assess the effects of some key assumptions of our empirical approach. We consider the following:(i) re-definition of a self-employment spell; (ii) estimation based only on the inflow sample; (iii) trimming the *netincdiff* with respect to outliers; (iv) controlling for local unemployment rates; (v) including a dummy variable for individuals receiving some unemployment insurance during the year; (vi) allowing for the share of capital in *SE* income to be non-zero; and (vii) allowing our two tax variables to have different effects over the spell duration. Table 4 reports the results of these investigations. The full set of results is available from the authors.

[Table 4 here]

Our first investigation examines the influence of the definition of a *SE* spell. In our base model we included individuals in the sample if they had at least 3 years of labour market attachment, i.e., if the net *SE* income or *WE* is larger in absolute value than basic amount for at least 3 year over the years the individual is observed in data. We now redefine the sample requiring only one year of labour market attachment. The results from using this new definition, are presented in Panel [B] of Table 4. The effects are qualitatively similar to the results in our base case, as reported in Panel [A].

The base model was estimated using both the left censored as well as fresh spells. We now re-estimate our model using only the inflow sample. This reduces the total number of unweighted observations to $229,036$. The definition of an *SE* spell is the same as the one used in our base model. The results are presented in Panel [C] of Table 4. The results are relatively similar to our base model results.

The third investigation involves omitting observations with extreme predicted values for the variable *netincdiff*. As shown in Figure 5, the distribution of *netincdiff* exhibits some lumpiness in the tails. To assess the effect of extreme values on our estimates, we exclude individuals with *netincdiff* values that are lower than first percentile or higher than the ninety-ninth percentile of the distribution.[30] The definition of a *SE* spell is the same as the one used in our base model. Estimates are reported in Panel [D] of Table 4, and we see that the results are not much influenced by this. The effect of *netincdiff* remains stable for the *SE* exits, and is stronger on the *WE* exits.

The next investigation examines the influence of local labour market conditions. In the main specification we use 5 regional dummies to partially control for labour market conditions. A better control for local labour market conditions would be the use of local unemployment rates. Unfortunately, such information is only available from 1996. We therefore report two sets of results. In Panel [E], we substitute the regional dummies with regional unemployment rates. In Panel [F] instead, we re-estimate our base model using the restricted sample of 1996 to 2011. The results are very similar to each other, and qualitatively similar to the baseline results.[31]

As described in Section 4, in our base model, we drop individuals who were in receipt of social security benefits which was larger than their self-employment income or wages in any year. However, it can be the case that individuals are unemployed for a short period and the unemployment insurance is small enough so that the individual is still defined as a self-employed or a wage earner. Individuals with an interruption in their work might behave differently from individuals directly transiting from *WE* to *SE*. We therefore include a dummy variable for those indviduals in receipt of unemployment insurance during the year. As Panel [G] shows, the results are similar to those from the base model.

In Norway, self-employed individuals have the option of having a share of the self-employed income declared as capital income, which is taxed at a lower rate relative to labour income, as explained in Section 2. Tax variables used in our main model is generated under the assumption that the share of capital income in total income is zero (see Appendix A.2) We believe our assumption is reasonable for the following reasons. First, it is not clear what is an appropriate assumption regarding the proportion of capital income used in the generation of counter-factual *SE* income distributions for the wage earners, which is also exogenous. Second, during our sample period, the share declared as capital income is either 0 or a very small (median value is 0.037). Hence, we check for sensitivity by regenerating our tax variables allowing for 3.7% of the predicted SE income to be reported as capital income instead of 0. The results are in Panel [H]. The effect of convexity is slightly stronger on the SE exit rates, while the rest of the estimated effects remain similar to the base model estimates.

Our last investigation involves allowing the effects of the tax variables to change over the duration of the spell. However, we could not reject the model with constant tax effects. Hence, we do not report these separately in the Table.

6 Conclusion

This paper looks at the effect of taxation on self-employment and wage employment durations. Our work complements the existing literature in many dimensions. First, in contrast to many existing studies, our definitions of self-employment and wage employment are based on income reported in Norwegian tax returns. The rest of the variables used come from various other registry data. Norwegian registry data are considered to be exceptional in terms of coverage and reliability (Blundell, Graber and Mogstad, 2015). Second, we look at the evolution of self-employment and wage employment spells over a very long period, from 1993 to 2011. We model these transitions using a two-state multi-spell duration model allowing for correlated unobserved heterogeneity, and controlling for a rich set of socio-demographic characteristics.

We focus on the effects of two tax variables: *netincdiff* and *convexity*, obtained from Wen and Gordon (2014). *netincdiff* is defined as the difference in log net income in the two occupations, and *convexity* is an individual-specific measure that captures the interaction between the progressivity of the tax schedule and the volatility of self-employment income relative to wage income. We use the model to predict the transitions under a simulated tax regime that reduced the progressivity of the tax schedule in the year 2000. We also provide some sensitivity checks with respect to the definition of self-employment, the selection of the estimation sample, etc. We do not find the estimated effects of our two tax variables of interest, to be sensitive to various model assumptions and sample selections.

The main finding is that, as predicted by theory, higher expected net earnings in self-employment relative to wage employment, reduces the probability of exiting out of a self-employment spell. The entry into self-employment - or equivalently the exit out of wage employment - is found to be more sensitive to changes in the two variables than exit from self-employment. In our base model, the estimated effect of changes to *netincdiff* that are required when *convexity* changes by a percentage point, to encourage self-employment, is about 10 to 14 times larger in percentage point terms. To shed further light on this, we also carried out a policy experiment that reduced the progressivity of the tax schedule, which resulted in a flatter tax schedule in the year 2000. The hypothetical scenario was found to encourage both entry into and exit from self-employment with the estimated inflow into Self-employment increasing to 5.4% from the base model prediction of 3.0%.

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A Appendix (on-line material)

A.1 The generation of tax variables[32]

In the following, we discuss how the two tax variables *netincdiff* and *convexity*, are derived. We omit the individual index to simplify the notation.

Assume gross income y_j in occupation j ($j = s$ for self-employment and e for *WE)* is log normally distributed with parameters μ_j and σ_j. i.e. $y_j = exp(Y_j) \sim LN(\mu_j, \sigma_j)$ which implies that $Y_j = \ln y_j \sim N(\mu_j, \sigma_j^2)$

The mean and the variance of y_j are respectively:

$$\overline{y}_j \equiv E(y_j) = \exp(\mu_j + \frac{\sigma_j^2}{2}) \tag{A.1}$$

$$Var(y_j) = \left[\exp(2\mu_j + \sigma_j^2)\right] [\exp(\sigma_j^2) - 1]. \tag{A.2}$$

Under risk-neutrality and an expected utility maximisation framework, Wen and Gordon (2014) show that the occupational choice is dependent on the following two terms which they call *netincdiff* and *convexity* respectively:

$$netincdiff = (1 - \tau) \ln [\overline{y}_s / \overline{y}_e] \simeq \ln [netincome_s / netincome_e] \tag{A.3}$$

and[33]

$$convexity = \frac{1}{2}(1 - \tau_s)\tau_s\sigma_s^2 \simeq \frac{E[T(y_s)] - T(\overline{y}_s)}{\overline{x}_s} \tag{A.4}$$

The net incomes $netincome_s$ and $netincome_e$ are evaluated at the estimated expected values of the pre-tax income ($\overline{y}_j$) from each of the occupations. $(1 - \tau)$ is the elasticity of after-tax income with respect to pre-tax income. $\overline{y}_j$ is the expected income in occupation j, i.e. $\overline{y}_j = E(y_j)$ and $T(y_j)$ is the tax burden defined as $(y_j - x_j)$. Finally, $\overline{x}_j$ is the net-of-tax income evaluated at $\overline{y}_j$. The *convexity* variable measures the increase in tax liability taken on by the individuals in self-employment due to the volatility of their earnings, expressed as a proportion of their net income.[34] The higher the *convexity* the lower the probability of choosing self-employment relative to wage employment.

Steps involved in the estimation of netincdiff and convexity

We need three terms for each occupation:

1. $\overline{y}_j$ which is the $E(y_j)$;
2. $T(y_j)$ and hence $E[T(y_j)]$;
3. $\overline{x}_j$ which is $\overline{y}_j - T(\overline{y}_j)$.

i.e. we need a distribution for y_j and a distribution for the corresponding $T(y_j)$. Remember $\ln y_j$ is assumed to be lognormally distributed. The steps followed are listed below.

Estimation of *netincdiff*

Step 1: Using the actual reported *pre-tax* self-employment income and wage-employment income for each time period separately, estimate a log linear switching regression model that accounts for selection into the two occupations (self-employment and wage employment), and calculate the predicted income ($\widehat{y}_j$) using equation A.1 in each occupation. The variables used in the income regressions are: quadratic polynomial in age, labour regional dummies, dummies accounting for both the level and the field of education and gender dummy.[35] The variables that enter the selection equation and not the income equations, are binary indicators for the presence of children, family members and head of family.[36] The results are provided in online Appendix A.3.

Step 2: Add other types of income to this predicted income to get $\widetilde{y}_j$. We include interest income, dividends, capital gains, and other capital incomes.

Step 3: Estimate individual specific variances under the assumption that errors are heteroskedastic and given by

$$\sigma_j^2 = \exp(z'\delta) \tag{A.5}$$

We use the selection corrected log earnings equations to estimate $z'\delta$ using the predicted values from a regression of ln(residual^2) on a constant term, a set of individual specific characteristics. $\widehat{\sigma_j^2}$ then follows from equation (A.5).

Step 4: Use the tax simulator to generate the tax payments $T(\widetilde{y}_j)$ and hence the net incomes $(\widetilde{y}_j - T(\widetilde{y}_j))$. The tax simulator takes into account the different rules in each year for taxing labour income, self-employment income and capital income and the most relevant deductions rules in each year for individual tax returns.

Step 5: log difference in the net incomes provides the estimate of *netincdiff* as per equation (A.3). For example, the relevant variable for the self-employment decision would be $\ln(\widetilde{y}_s - T(\widetilde{y}_s)) - \ln(\widetilde{y}_e - T(\widetilde{y}_e))$.

Estimation of *convexity*

As discussed earlier, we only estimate the *convexity* variable for the self-employment occupation. We have the mean (predicted income $\widehat{y}_s$ from *step 1*) and the variance of the distribution of $\ln(y_s)$ (σ_s^2 from *step 3*) for each individual. The relevant equations are (A.1) and (A.5).

Step 6: Using the expected income and variance estimated in *steps one* and *two* as before, we generate *200* draws from $N(\widehat{\ln y_s}, \widehat{\sigma_s^2})$. The exponentiated values of each draw is added to the "other income" which is then used to generate the $T(y_s)$ using the tax-simulator. $\overline{y}_s$ is the mean of the values that feed into the tax-simulator. The corresponding $T(\overline{y}_s)$ is calculated next.

Step 7: The expected after tax income is calculated as $\bar{x}_s = \bar{y}_s - T(\bar{y}_s)$.

Step 8: $E[T(y_s)]$ is estimated as the sample mean of the generated $T(y_s)$ calculated from the draws.

Step 9: We then generate the *convexity* variable as given in equation (A.4) for each individual.

A.2 Main features of the Tax Simulator

Given some limitations of the information we had in the tax returns data, a simplified tax simulator that takes into account the most important tax rules, deductions, and allowances, was developed. We briefly discuss the simplifications here.

The initial intention of the 1992 reform was to tax "labour income" similarly for wage earners and self-employed individuals. However, many modifications were introduced during the period 1993 to 2004, which saw high incomes from self-employment (*SE*) exempted from personal income taxation. For example, *SE* income from non-liberal professions were only subject to the flat capital tax rates for amounts exceeding a certain threshold.[37] [38] We are not able to identify the type of occupation from our tax returns register and hence we do not take into account these differences in taxation of *SE* income. However, only approximately 2% of our sample members report *SE* income that exceeds the thresholds, and just for a handful of observations this problem arises when predicted *SE* income is used in the calculation of our tax-variables. This distinction between liberal and non-liberal occupation was dropped in year 2005, and labour income from *SE* would follow the same schedule as wage income. Another difference, that we are able to simulate, between the self-employed and wage earners is related to the social security contribution, as social security contribution are lower for employees relative to self-employed individuals.

There are two tax classes in Norway and the difference between the two is the level of the personal allowance. The personal allowance in class 2 is higher than in class 1, and, in some years, the surtax. The vast majority of individuals are taxed under class 1 schedule. However, single parents and individuals supporting their spouses with low income, can be placed in tax class 2, and hence be subject to a higher personal allowance. Because we were unable to identify couples and ages of children in our dataset, we assume that all individuals have only one source of income which is the wage income and have standard allowances. Furthermore, we were not able to allow for deductions based on the ages of the children.

In our simplified tax simulator, we set the capital income component within the net self-employment income to zero. That is, we assume that all the *SE* income is coming from the the labour income component of the net *SE* income. We believe this simplification is a good approximation for the following reason. Among the self-employed group, about two thirds report a labour income component which is at least 85% of the total net *SE* income. Table 4, Panel [H] reports the results from our investigation where we replace the zero capital income component with the median value of 3.7% in our generation of the tax variables.

A.3 Wage and Self-employment income equations

Tables

Table 1: Summary statistics - mean (std deviation)

	All	***WE Sample***	***SE Sample***
Individual specific variables			
Females	0.47 (0.50)	0.48 (0.50)	0.27 (0.44)
Lower secondary school and less	0.39 (0.49)	0.35 (0.49)	0.53 (0.50)
Upper secondary school	0.30 (0.46)	0.31 (0.46)	0.27 (0.45)
University	0.32 (0.47)	0.34 (0.47)	0.20 (0.40)
Time-varying variables			
Age at the start of the spell	35.06 (9.24)	34.84 (9.20)	39.80 (8.80)
Years 1993-1998	0.30 (0.49)	0.30 (0.46)	0.34 (0.47)
Years 1999-2002	0.22 (0.41)	0.22 (0.41)	0.21 (0.41)
Years 2003-2007	0.27 (0.44)	0.27 (0.44)	0.27 (0.44)
Years 2008-2011	0.21 (0.41)	0.21 (0.41)	0.18 (0.39)
Eastern Norway	0.50 (0.50)	0.49 (0.50)	0.55 (0.50)
Southern Norway	0.05 (0.22)	0.05 (0.22)	0.06 (0.24)
West Norway	0.26 (0.44)	0.26 (0.44)	0.24 (0.42)
Central Norway	0.09 (0.28)	0.09 (0.29)	0.07 (0.26)
Northern Norway	0.10 (0.30)	0.10 (0.30)	0.08 (0.27)
Local Unemployment Rate	2.73 (0.83)	2.73 (0.83)	2.78 (0.83)
convexity	0.010 (0.008)	0.010 (0.008)	0.013 (0.007)
netincdiff	-0.365 (0.18)	-0.346 (0.15)	-0.764 (0.24)
Proportion of exits from		0.006	0.106

Notes:(i) Definitions of wage employment and self-employment and the sample selection criteria used are provided in Section 4. (ii) All averages and proportions are based on the weighted sample (see Section 4 for further details). (iii) The number of unweighted observations are 476,275, of which 362,217 classified as wage employment, and 114,058 as self-employment. (iv) The number of unweighted individuals is 34,746.

Table 2: Hazard model estimates, main sample

	Uncensored spells		**Censored spells**	
	SE	***WE***	***SE***	***WE***
	[1]	**[2]**	**[3]**	**[4]**
netincdiff	−0.431	1.512	−0.775	1.650
	(0.058)	(0.084)	(0.118)	(0.093)
*convexity**100	0.059	−0.154	−0.005	−0.168
	(0.016)	(0.016)	(0.032)	(0.022)
Male	−0.020	0.603	0.171	0.808
	(0.026)	(0.030)	(0.051)	(0.037)
Age at the start of the spell	−0.012	0.030	−0.034	−0.047
	(0.001)	(0.002)	(0.002)	(0.002)
High School	−0.009	0.103	−0.137	−0.018
	(0.029)	(0.035)	(0.048)	(0.038)
University	0.217	0.103	0.044	0.122
	(0.028)	(0.036)	(0.052)	(0.037)
ln(duration)	−0.517	−0.490	−0.017	−0.243
	(0.016)	(0.018)	(0.037)	(0.032)
Constant	−1.151	−3.251	−0.894	−2.006
	(0.092)	(0.100)	(0.185)	(0.115)
Support points	−0.533	−3.099	−1.330	−1.837
	(0.048)	(0.071)	(0.214)	(0.093)
Probability masses				
p1 (constants + support points)	0.805			
	(0.019)			
p2 (constants only)	0.195			
	(0.019)			
N obs (unweighted)	476,275			
N individuals (unweighted)	34,746			
Maximised log likelihood value	-105743.7			

Notes: (i) MLE standard errors in parentheses; (ii) The models are estimated using a random sample of individuals as detailed in Section 4 of the paper; (iii) Omitted education category is no-education/high-school drop-out. (iv) The model additionally includes region and time indicators, see Table 1.

Table 3: Average predicted exit probabilities (%) in baseline and a tax reform scenario

Case	**Tax scenario**	**Probability of exit** from ***SE***, %	from ***WE***, %
[A]	Base model: year 2000, two surtaxes	9.288	0.571
	(s.e)	(0.007)	(0.0001)
[B]	Reform Scenario: year 2000, one surtax	9.139	0.675
	(s.e)	(0.008)	(0.0001)
	Change [A]- [B]	0.149	-0.104
	(s.e)	(0.004)	(0.0001)
	Sample size in year 2000	6,043	130,019
[C]	*convexity*: unchanged from baseline		
	netincdiff: reform	9.579	0.580
	(s.e)	(0.007)	(0.0001)
[D]	*netincdiff*: unchanged from baseline		
	convexity: reform	8.858	0.667
	(s.e)	(0.007)	(0.0001)

Notes: (i) Actual exit rates in 2000 were 9.813% and 0.595% (ii) Predicted exits are based on the estimated model from Table 2.(iii) The percentage exits are calculated with respect to the stocks in each of the occupational categories; (iv) Case [A] refers to the actual situation as it was in year 2000 with two surtaxes; Calculated *convexity* and *netincdiff* in this scenario were used in the estimation of the main model. (v) Case [B] refers to a hypothetical reform scenario that replaces two surtaxes with just one surtax. New values of *convexity* and *netincdiff* are recalculated given the new tax rules. (vi) Case [C] considers values of *convexity* from the baseline scenario and values of *netincdiff* from the reform scenario. (vii) Case [D] considers values of *netincdiff* from the baseline scenario and values of *convexity* from the reform scenario. (viii) The standard errors are calculated using the delta method in STATA; (ix) All calculations are based on the weighted sample.

Table 4: Hazard model estimates, sensitivity checks

Variables	Uncensored spells *SE* [1]	Uncensored spells *WE* [2]	Censored spells *SE* [3]	Censored spells *WE* [4]
[A] - Base case				
netincdiff	−0.431	1.512	−0.775	1.650
	(0.059)	(0.084)	(0.118)	(0.093)
*convexity**100	0.056	−0.154	0.005	−0.168
	(0.016)	(0.016)	(0.032)	(0.022)
[B] - Changes to sample definition				
netincdiff	−0.824	2.286	−0.587	1.690
	(0.061)	(0.079)	(0.139)	(0.091)
*convexity**100	0.055	−0.208	0.035	−0.139
	(0.018)	(0.018)	(0.036)	(0.021)
[C] - Excluding left censored spells				
netincdiff	−0.412	1.686		
	(0.058)	(0.084)		
*convexity**100	0.062	−0.181		
	(0.016)	(0.016)		
[D] - Using trimmed netincdiff				
netincdiff	−.335	2.257	−0.888	3.001
	(0.074)	(0.115)	(0.153)	(0.147)
*convexity**100	0.054	−0.119	−0.075	−0.238
	(0.0181)	(0.018)	(0.036)	(0.025)
[E] - Including regional unemployment rate 1996-2011				
netincdiff	−0.531	0.923	−0.704	1.214
	(0.062)	(0.087)	(0.119)	(0.089)
*convexity**100	0.063	−0.148	0.081	−0.120
	(0.018)	(0.018)	(0.031)	(0.020)
[F] - Regional dummies estimated over 1996-2011				
netincdiff	−0.521	0.959	−0.749	1.254
	(0.062)	(0.088)	(0.116)	(0.088)
*convexity**100	0.054	−0.162	0.072	−0.138
	(0.018)	(0.018)	(0.031)	(0.020)
[G] - Including unemployment benefits dummy				
netincdiff	−0.417	1.519	−0.744	1.653
	(0.058)	(0.084)	(0.117)	(0.093)
*convexity**100	0.059	−0.157	0.004	−0.174
	(0.016)	(0.016)	(0.032)	(0.022)
[H] - 3.7% capital income from SE				
netincdiff	−0.425	1.495	−0.756	1.656
	(0.057)	(0.084)	(0.117)	(0.092)
*convexity**100	0.075	−0.143	0.011	−0.171
	(0.017)	(0.017)	(0.033)	(0.023)

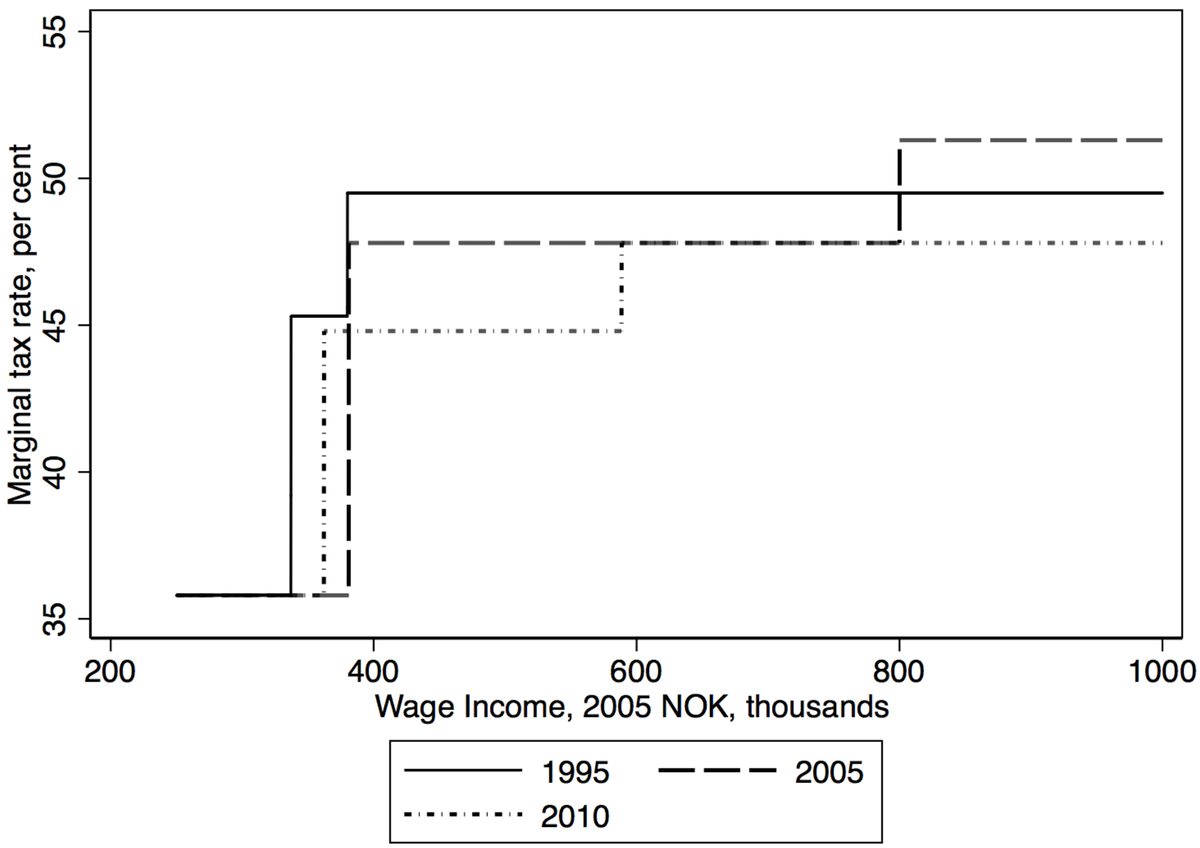
Notes: (i) Standard errors in parenthesis. (ii) See Section 5.3 for further details; (iii) Panels [E] and [F] report results with no unobserved heterogeneity (see footnote 31); (iv) Also see notes to Table 2. (v) Full set of results are available from the authors.

Figures

Figure 1: Marginal tax rate for wage and self-employment incomes, year 2005

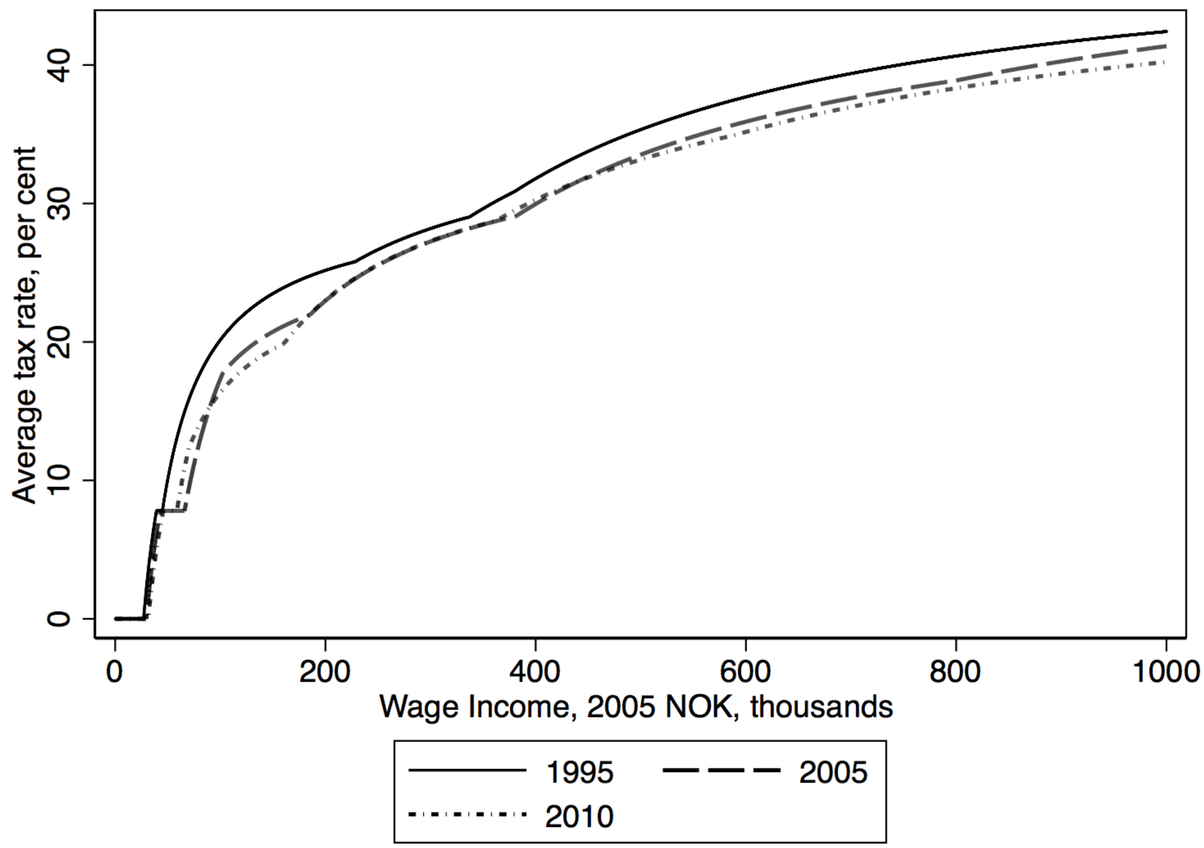
Notes: (i) Solid line: Marginal tax rate for a wage earner in tax class 1 with only wage income in year 2005. Employer's social security contribution are excluded (ii) Dashed line: Marginal tax rate for a self-employed individual in tax class 1 with only self-employed income in year 2005, and no capital invested in the firm.

Figure 2: Marginal tax rate for wage income, years 1995, 2005 and 2010



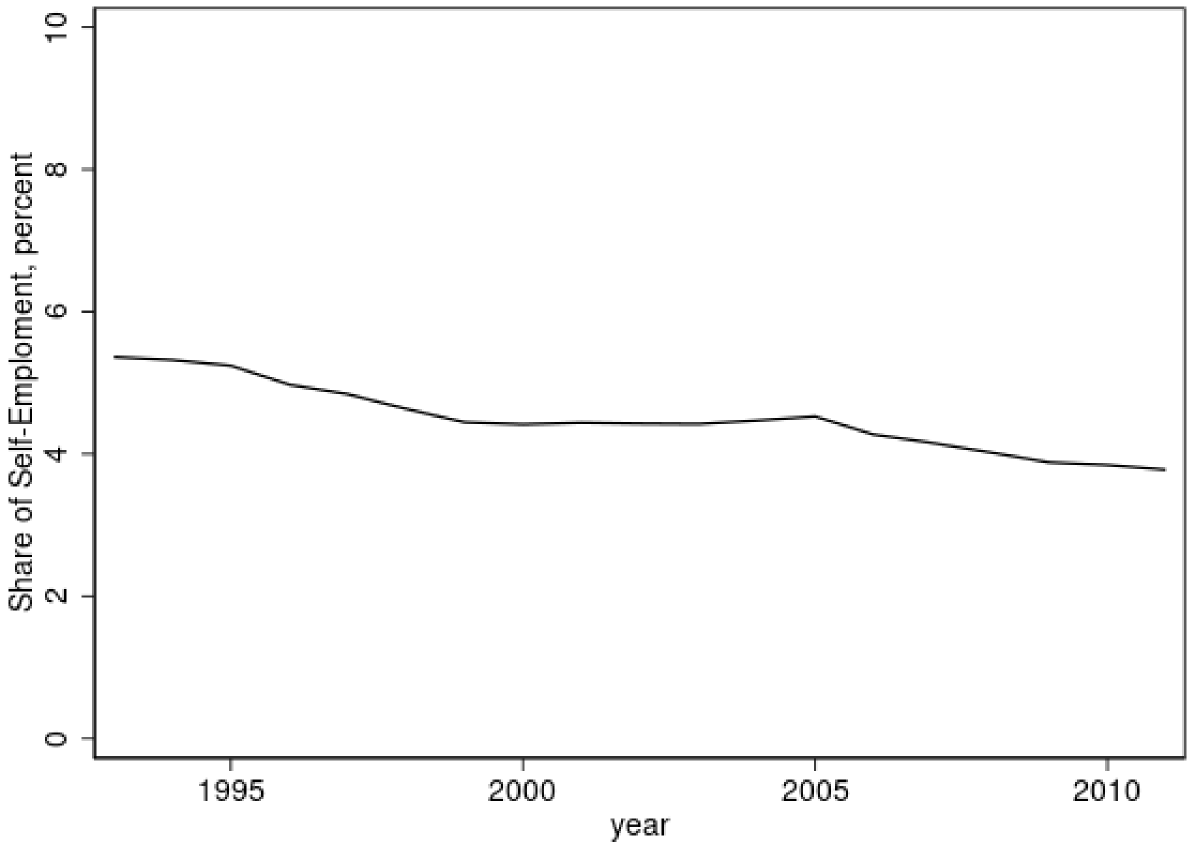
Notes:(i) Marginal tax rate for a wage earner in tax class 1 with only wage income in year 1995, 2005 and 2010. Employer's social security contribution are excluded. Thresholds are adjusted to take into account income growth during the period (base year is 2005). Marginal tax rate are reported only for income larger than 200,000 NOK. (ii) To improve readability, the case for self-employment income is not reported, as it would only imply a proportional vertical shift of each of the three curves presented, see Figure 1.

Figure 3: Average tax rate for wage income, years 1995, 2005 and 2010



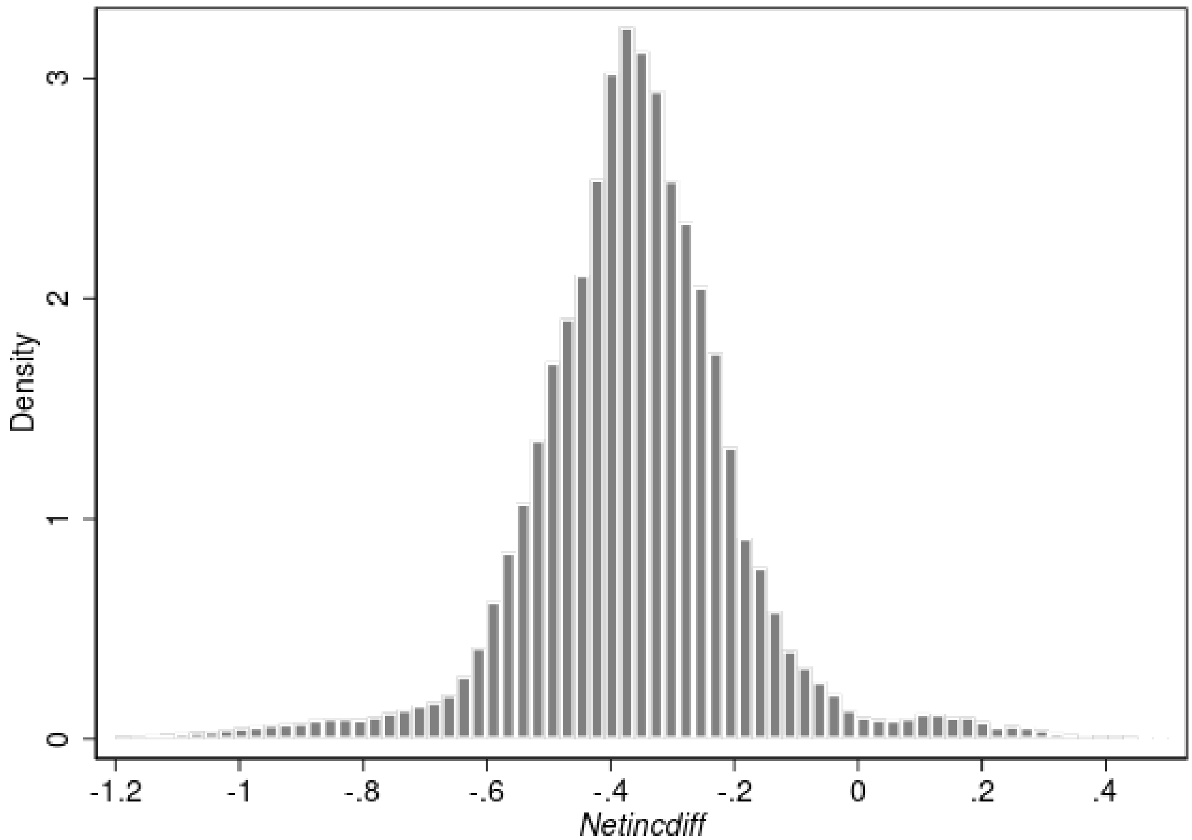
Notes: (i) Average tax rate for a wage earner in tax class 1 with only wage income in year 1995, 2005 and 2010. Employer's social security contribution are excluded. Thresholds are adjusted to take into account income growth during the period (base year is 2005). (ii) To improve readability, the case for self-employment income is not reported, as it would only imply a proportional vertical shift of each of the three curves presented, see Figure 1.

Figure 4: Annual share of self-employment observation



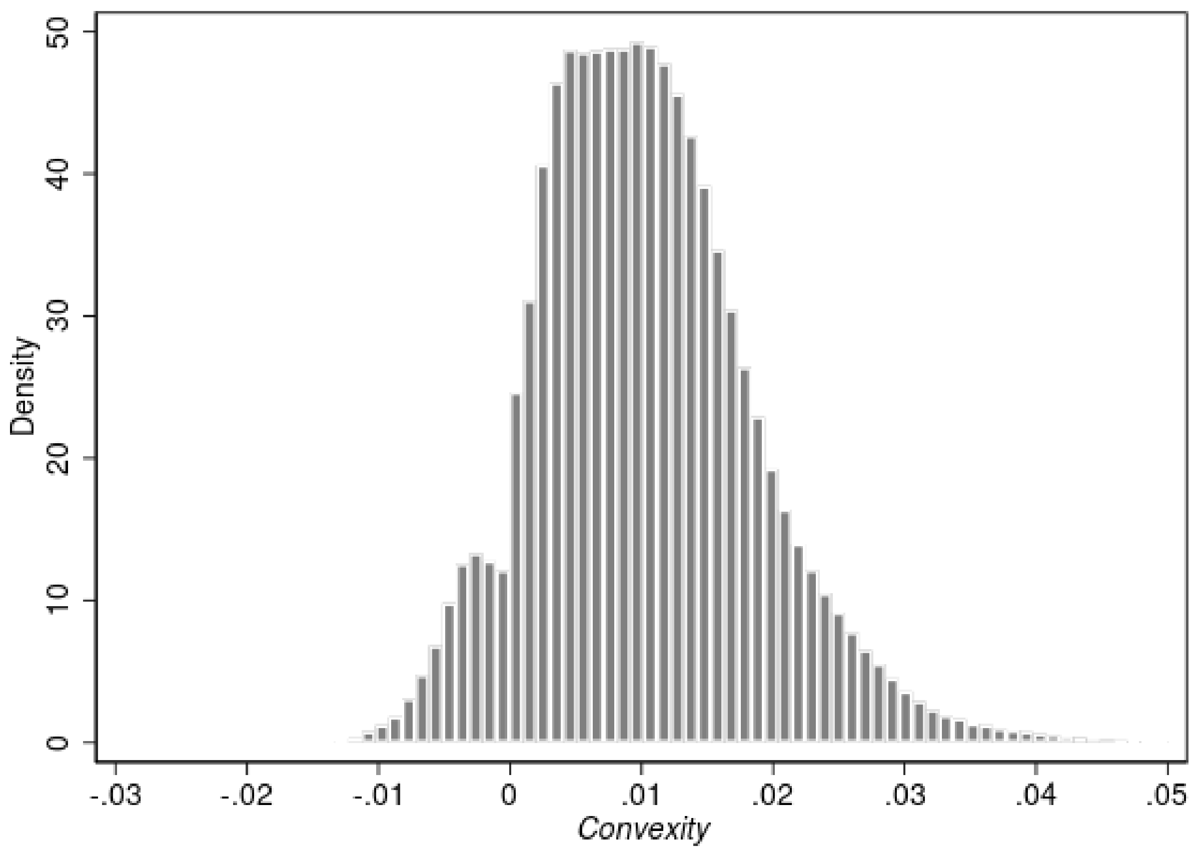
Notes: Annual self-employment observation as as share of total self-employment + wage employment observations. Categorisation into self-employment and wage employment is described in Section 3.

Figure 5: Density of *netincdiff*



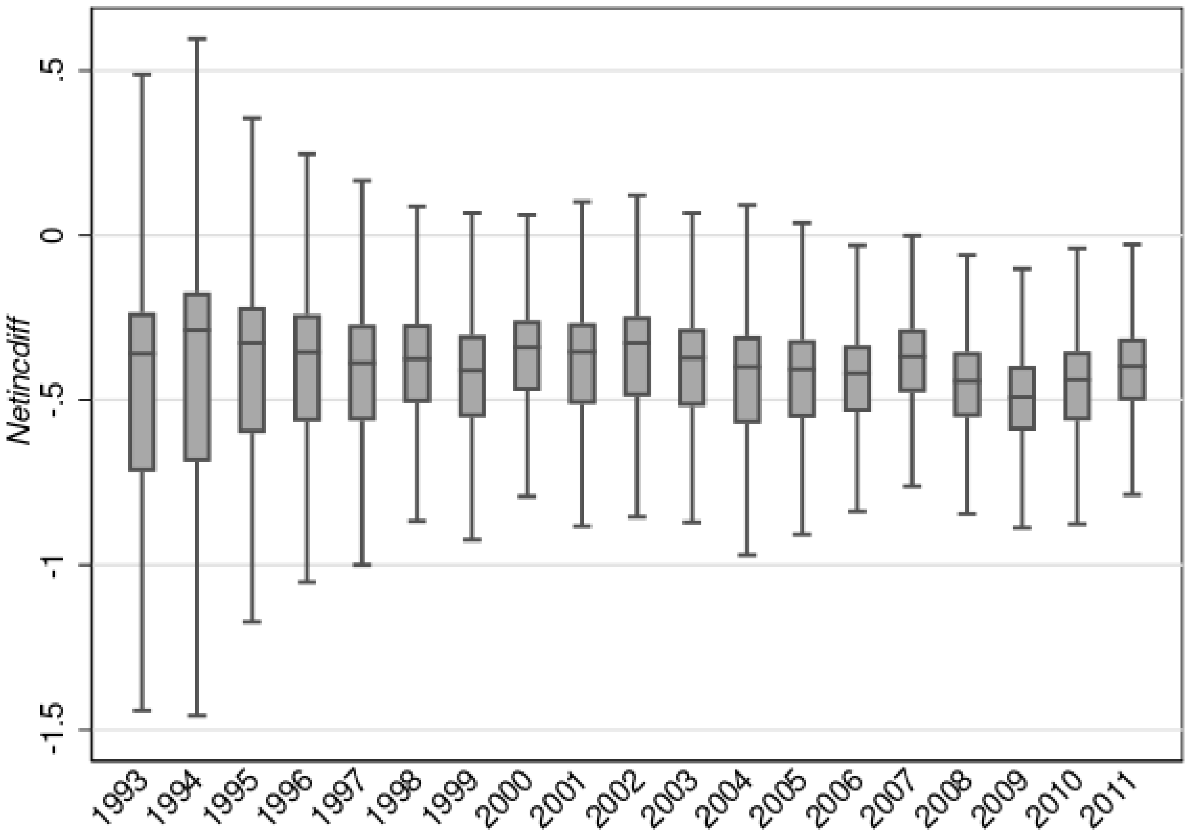
Notes: *netincdiff* distribution across all years and obvervations. *netincdiff* is defined in Section 4.2.

Figure 6: Density of *convexity*



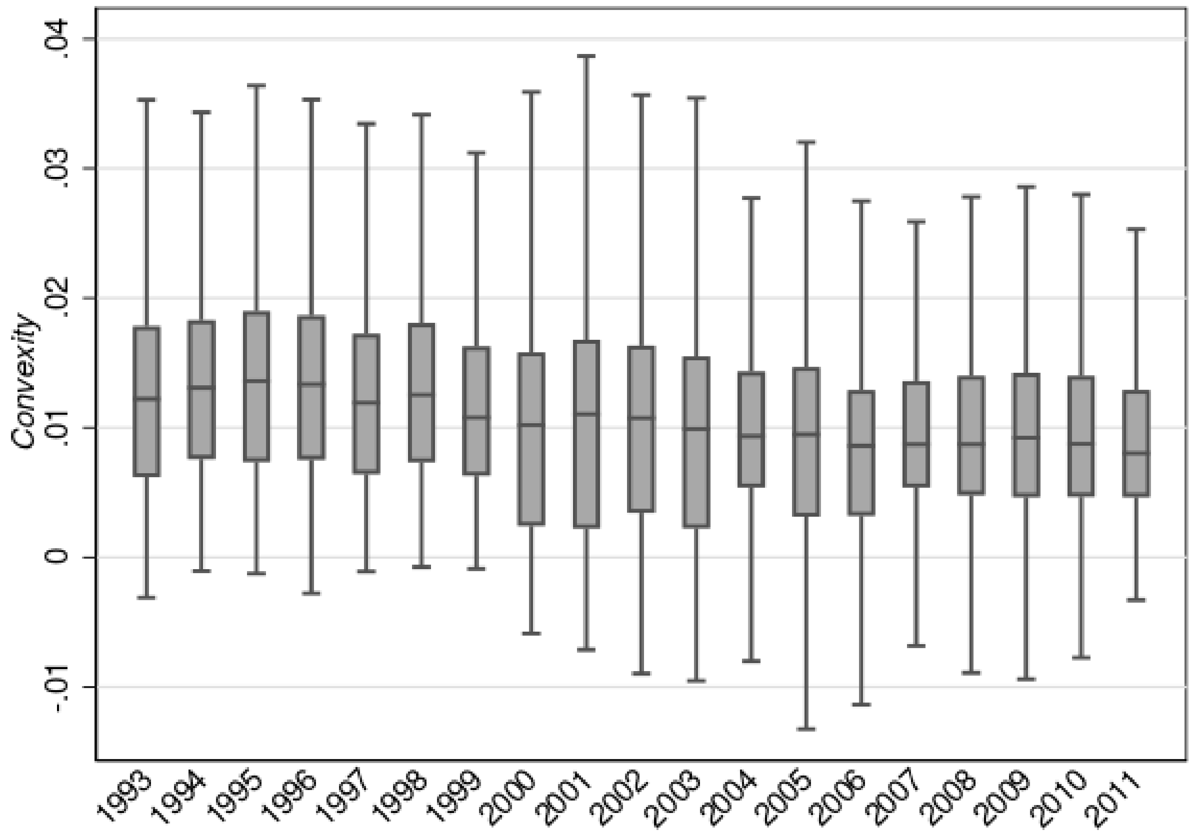
Notes: *convexity* distribution across all years and obvervation. *convexity* defined in equation (4).

Figure 7: Box-and-whisker plot for *netincdiff*



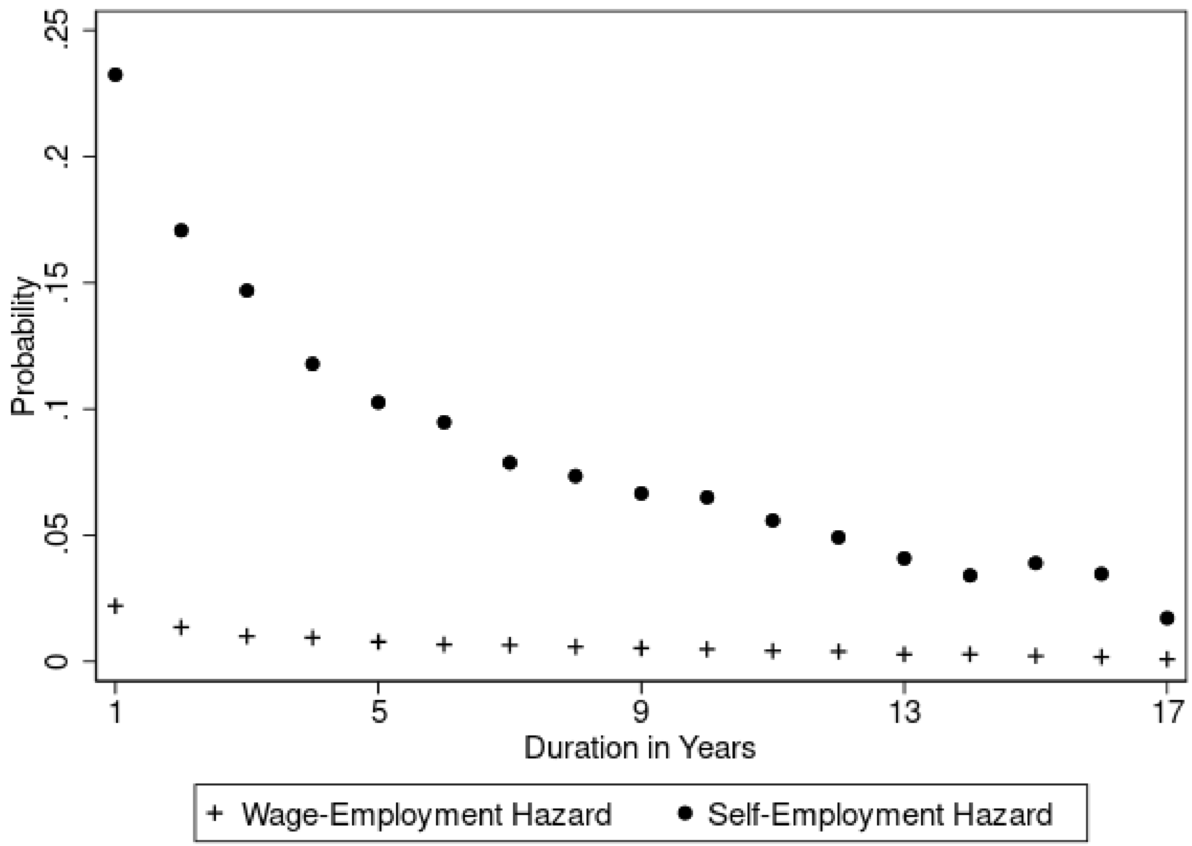
Notes: (i) *netincdiff*=ln[net income in *SE*/net income in *WE*]. See Section 4.2 for further details. (ii) The above plots show the median and the spread measured as inter-quartile range.

Figure 8: Box-and-whisker plot for of *convexity*



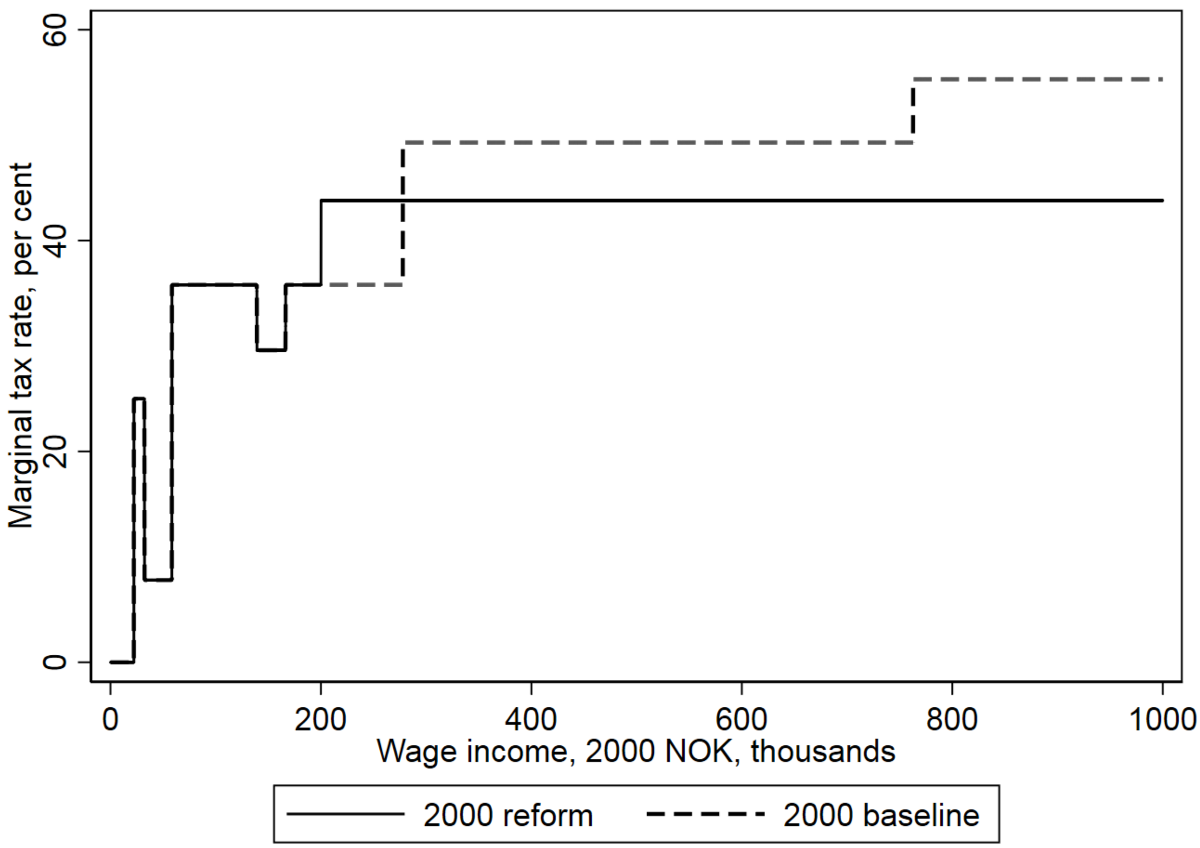
Notes: (i) See equation (4) for the definition of *convexity*. (ii) The above plots show the median and the spread measured as inter-quartile range.

Figure 9: Non-parametric hazard estimates



Notes: The figure presents the non-parametric hazard estimates for wage employment and self-employment spells. These are the OLS estimated coefficients on the duration time dummies in a linear regression of the duration variable. The duration variable takes the value of 0 if that particular year refers to an on-going spell and 1 when it is associated with an exit.

Figure 10: Marginal Tax Rate for Wage Income, Year 2000, and hypothetical unique surtax on personal income



Notes:(i) Bold line: Marginal tax rate for a wage earner in tax class 1 with only wage income in year 2000. Employer's social security contribution are excluded. (ii) Dashed line: 2000 tax experiment. The two surtaxes are replaced by a single surtax of 11% for gross incomes exceeding 200000. (iii) To improve readability, the case for self-employment income is not reported, as it would only imply a proportional vertical shift of each marginal tax curve presented, see Figure 1.

Notes

[1]'Occupational choice' here means a choice between wage-employment and self-employment.

[2]See Hansson (2012), Gale and Brown (2013), and Clingingsmith and Shane (2016) for surveys on taxation and self-employment.

[3]A positive correlation between taxes and self-employment may also partly be attributed to the higher tax evasion or avoidance possibilities in self-employment relative to wage employment (see, for instance, Schuetze and Bruce (2004)). Our data do not allow us to address this issue. Recent tax evasion estimates for Norway show that around 14% the business income is not reported (Nygård, Slemrod and Thoresen, 2019). This estimate is lower than typical estimates for the U.S., but close to what is found among the self-employed in Finland and Denmark (see Slemrod (2007) that estimates that 57% percent of U.S. non-farm business income was not reported, Kleven et al. (2011) for Denmark, and Johansson (2005) for Finland). The time and individual unobservable effects included in our model will partially mitigate this problem if the differential evasion possibilities are relatively constant over the time period under consideration. Another issue when considering self-employment and wage employment choice, is the possibility of a tax-induced organisational shift. See Papini (2018) for a recent analysis of this issue. We treat a self-employed individual who decides to incorporate, and thus, decides to earn wages from the company, as a wage earner. We also include (in addition to the time fixed effects) region fixed effects to partly control for this issue, as this organisational shift was more common in some regions and time periods (Papini, 2018).

[4]For example, Bruce (2002), and Gurley-Calvez and Bruce (2008) use expected marginal tax rates, or, alternatively, average tax rates to capture non-linearities in the tax schedule. These authors do not inculde any measure of riskiness of income received.

[5]Thus, the focus is on being in self-employment, and not on entering self-employment.

[6]The variance of the pre-tax income distribution does not enter the utility function for a risk-neutral individual under the assumption that the gross income is normally distributed,

see Fossen (2009). In contrast, the model in Wen and Gordon (2014) contains the variance of the pre-tax income distribution because of the log-normality assumption for the pre-tax income distribution.

[7]The interpretation given in Fossen (2009) is that a flatter tax schedule increases expected returns in self-employment, but at the same time it also increases the risk, since the variance of the net-income distribution also increases. The second effect is found to dominate the first one and hence, a flatter tax schedule discourages self-employment.

[8]The 'flatter-tax' reform considered is found to increase the probability of finding someone in self-employment by 0.04 percentage points, from the base model prediction of 5.76%.

[9]The deductions include a standard personal allowance; a deduction for expenses, including interest payments; and a basic allowance, which is a percentage (up to a maximum) of labour or pension income.

[10]Capital income is calculated by multiplying the invested capital in the firm with a rate of return annually established by the government. The labour income is then estimated by subtracting the imputed capital income from the net reported self-employment income.

[11]Note that the thresholds account for wage growth.

[12]This is the approach taken by Ham, Li and Shore-Sheppard (2016), who follow Heckman and Singer (1984*b*).

[13]A recent application can be found in Ham, Li and Shore-Sheppard (2016).

[14] The distribution function is given by $F(z) = 1 - \exp[-\exp(z)]$. Some other popular distributions used are the standard normal and the logistic cdfs which are symmetric distributions. The distribution we employ is not a symmetric distribution. A discrete time hazard model derived from an underlying continuous time proportional hazard model can be written in this form. See Narendranathan and Stewart (1993) for an application.

[15]Since, immigrants are a group of 'selected' individuals, we exclude them.

[16]We also exclude individuals who do not report any wage income or business income that is larger than the "Basic amount" during the observation period for at least 3 years. The

"Basic amount" is the base for calculating many of the Norwegian social insurance scheme's payments and was 78,024 NOK in 2011 (the approximate exchange rate in that year was: 1 USD≡5.67 NOK; 1 EUR ≡7.79 NOK).

[17]Around 18% of the individuals in the sample experienced at least one 'third state' spell (periods of time that cannot be defined either as wage employment or as self-employment) and are omitted from the analysis.

[18] Wen and Gordon (2014) represent the convex tax function specifying the after-tax income x_j as $(y_j)^{1-\tau}\widehat{y}^{\tau}$, where the tax parameters τ and $\widehat{y}$ are such that, $0 < \tau < 1$, and $\widehat{y} > 0$ represents the income at which the tax liability is zero. $(1 - \tau)$ is the elasticity of post-tax income with respect to pre-tax income (also see Musgrave and Thin (1948) and Benabou (2000)).

[19]$y \sim LN(\mu, \sigma)$ implies that $\ln(y) \sim N(\mu, \sigma^2)$; $E(y) = \exp(\mu + \sigma^2/2)$ and

$$Var(y) = (\exp(\sigma^2) - 1)\left[\exp(2\mu + \sigma^2)\right] .$$

[20]Online Appendix A.3 contains the full set of estimates from the equations that were used to generate the income variables.

[21]As shown in Wen and Gordon (2014), the tax liability function $T(y_j)$ in the theoretical model is given by $y_j(1 - (\widehat{y}/y_j)^{\tau})$. This term is strictly convex and hence the use of the term *convexity*, see Wen and Gordon (2014, p. 472).

[22]The paradox of the self-employment being characterized by higher uncertainty and lower earnings than wage employment is a common finding by previous studies (see for example Hamilton (2000) and Hurst and Pugsley (2011), or Berglann et al. (2011) for the case of Norway). There are several reasons to explain this puzzle. Among them: (i) the relevance of unobserved non-pecuniary benefits; (ii) unobserved under-reporting of income by the self-employed; and (iii) a over-estimation by the self-employed of their probability of success. Unfortunately, these are issues that are difficult to address due to lack of information in our data. The time and individual unobservable effects included in our model will partially mitigate these problems if these individual unobserved characteristics are constant over the

time period under consideration.

[23]Negative *convexity* values are possible if the tax function is not convex.

[24]We carried out an Analysis of Variance (anova) to assess the contribution of various factors to the variation of the two tax variables. We included all the variables (sex, marital status, education, region, kids, family-head, year dummies, two selection correction terms, and the estimated variances), that were used in the predictions of these two tax variables along with the other tax variable (convexity or netincdiff). The model R2s were 24% and 39% respectively in the netincdiff and convexity equations. The top four largest contributors explained 65% of the model SS in the netincdiff equation. These were Education, Selection into SE, the regional, and year dummies. With regard to the convexity variable, the top four largest contributors were, the year effects, education, and the estimated heteroskedastic functions, which together explained 57% of the model SS. The convexity (netincdiff) variable in the netincdiff (convexity) equation explained less than 0.5% of the model variations. The largest contributions to the model SS came from the year effects.

[25]These are the estimated OLS coefficients on the duration time dummies in a linear regression of the duration variable. The duration variable takes the value of zero if that particular year refers to an on-going spell, and one when it is associated with an exit.

[26] Baker and Melino (2000) discuss how the identification of the model parameters are generally compromised when one models time variations coming from the baseline hazard, calendar time effects, and unobserved heterogeneity, as discrete variables.

[27]The bootstrapped standard errors to account for the tax variables being 'generated regressors', did not change the significance of our variables compared to the usual maximum likelihood standard errors for our base model reported in Table 2. Hence, we only report the usual MLE standard errors in this table and subsequent tables.

[28]According to exchange rates for 2000: 1 EUR ≡ 8.11 Norwegian kroner (NOK), and 1 USD ≡ 8.81 NOK.

[29]The observed exits rates in 2000 were 9.81% and 0.60%.

[30]In order to preserve a continuous series of observations, all observations belonging to an individual is dropped if at least one *neticdiff* that is either less than the first percentile or above the 99th percentile value for that individual resulting in a loss of more than 2% of the sample. In particular, we lose about 9% of the observations, resulting in 431,398 observations in our unweighted sample.

[31]In spite of multiple attempts, we were unable to find significant unobserved heterogeneity in these models with the reduced number of years. We therefore report results from the model where we set the unobserved heterogeneity component to 0.

[32]This appendix is based on Wen and Gordon (2014). However, we allow the tax regimes to be different in the two occupations, since we model both self-employment and wage employment exits.

[33]Similar to Wen and Gordon (2014), we also set the variability of wage income to be 0 and hence only use the one related to self-employment income.

[34]Note, $x_s = (y_s)^{1-\tau} (\widehat{y})^{\tau}$ which is the after tax income. Tax liability is zero at $\widehat{y}$ and the tax liability is given by $T(y_s) \equiv (y_s - x_s)$ which is assumed to be strictly convex.

[35]The selection model is estimated as a probit and the correction term is the well known Inverse Mills Ratio (IMR) which is the generalised residual from the probit model.

[36]Household background and the presence of kids have been found to have an influence on the probability of undertaking risky entrepreneurial activities (Parker, 2008; Taylor, 1996; Berglann et al., 2011) but are not expected to influence gross earnings, so similarly to other studies, we use them as exclusion restrictions (Wen and Gordon, 2014; Rees and Shah, 1986). The selectivity correction terms as measured by rho, and the instruments, are significantly different from 0 at conventional levels of significance (see online Appendix A.3).

[37]Liberal professions include lawyers, dentists, doctors and other independent contractors delivering services to the public.

[38]The threshold varied between 16g and 32g in different year, where g is the *basic amount*. g is used as a starting point for payment related to social insurance and is defined as ap-

proximately five times the monthly wage of a blue collar worker.