WARWICK
ECONOMICS

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Wiji Arulampalam & Andrea Papini

June 2018 No: 1169

Warwick Economics Research Papers

ISSN 2059-4283 (online)

ISSN 0083-7350 (print)

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Wiji Arulampalam* and Andrea Papini†

This version: June 13, 2018

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 1993-2011. 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, with an increase of about 11.5 percent in net inflow into self-employment.

JEL codes: H24; H25; J24; C41.

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

*Department of Economics, University of Warwick, Coventry, CV4 7AL, UK. Email: wiji.arulampalam@warwick.ac.uk. Additional affiliations: IZA, Oxford CBT, and OFS Oslo.

†ISER, University of Essex, Email: andrea.papini@essex.ac.uk

Acknowledgements: This paper is part of the research of Oslo Fiscal Studies supported by the Research Council of Norway. We are grateful to Statistics Norway (SSB) for providing us with access to the administrative data used in the paper. The paper has benefited from comments from many individuals. We are very grateful to Thor O. Thoresen for his detailed comments on multiple drafts of the paper. The paper has also much benefited from comments received from Ben Lockwood, Frank Fossen, the participants at the workshop 'Workshop on Self-Employment/Entrepreneurship and Public Policyt' held at the University of Oslo, Sept 2016, and the participants at the 'Skatteforum' held in Hadeland, June 2017.

1 Introduction

Numerous studies show that reductions in marginal tax rates increase the labour supply of wage earners, both at the extensive and intensive margin (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 the differences in tax schedules. Hence, the interplay between the occupational choices is usually not part of labour supply models for wage earners, and, as a result, agents do not respond to tax changes along the occupational choice margin.

This contrasts sharply with the modelling of the decisions of the self-employed. This literature is dominated by perspectives in which decisions regarding self-employment are based on implicit or explicit comparisons to the wage earner sectors. One obvious reason for this asymmetry is the sheer sizes of the sectors. For example, the self-employment rate (as a percentage of total employment) in Norway is 7 percent, while the European Union average is approximately 15 percent (OECD, 2018).

The relationship to the wage sector is only one factor that complicates the assessment of effects of taxation on self-employment. From a theoretical perspective, the effects are ambiguous. For instance, deductibility of businesses losses can act as a type of risk sharing with the government, and hence, can foster self-employment (Domar and Musgrave, 1944), while, a progressive tax schedule can discourage successful risk-neutral business owners (Gentry and Hubbard, 2000). Therefore, one 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; this is because a tax cut reduces taxes saved from possible losses through loss offsets (Cullen and Gordon, 2007).

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)).[1] Studies for other countries include, Hansson (2012) who analyses the case of Sweden; Fossen (2007, 2009), and Fossen and Steiner (2009), who analyse the situation in Germany; and Wen and Gordon (2014), who analyse the situation in 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.[2]

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.[3] 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), and Wen and Gordon (2014), authors have taken a more structural approach to derive tax variables. Both papers focus on the difference in expected utilities as governing decision making. Yet, the two papers differ in many respects, employing different, (i) models (logit transition vs. probit), and (ii) variables to capture the effects of non-linearities in the tax schedule to deal with differing utility functions and assumptions regarding the distribution of pre-tax income. The conclusions drawn are different.

Fossen (2009) models the transitions between wage and self-employment using data from the German Socio-Economic Panel (GSOEP) over the period 2002-2006 using 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 variance of the post-tax income distribution 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 1999-2005 to estimate the probability of self-employment in a probit model.[4] They assume risk neutrality and a log-normal distribution for the pre-tax income. Their 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 earnings, expressed as a proportion of their disposable income'.[5]

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;[6] Wen and Gordon find a 'small' positive effect on the probability of finding someone in self-employment.[7]

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. We also find the pre-tax income variables to be better approximated by a log-normal distribution, as in Wen and Gordon (2014).

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 1993-2011. 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. 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 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*. In our base model, the magnitude of the *convexity* parameter is about 10 times as large as the *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 understand the net effect better, we simulate a tax experiment that replaces the personal income tax structure in the year 2000 with a less-progressive, revenue-neutral tax schedule. We find that the overall effect of this policy change is positive on the self-employment rate, implying a 11.5 percent higher inflow.

The rest of the paper is organised as follows: Section 2 describes the taxation of self-employment income and wages during the time period from which the data are derived. Section 3 provides data descriptions. Section 4 explains our econometric model. Section 5 presents the procedure used for estimating the tax variables. Section 6 presents the estimation results, the results of policy simulation, and robustness checks. Section 7 presents

conclusions.

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.[8] A flat-rate tax, 28 percent 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 percent until it becomes equivalent to a rate of 7.8 percent on the whole income. The flat tax on ordinary income (28 percent 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 percent 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.[9] 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 percent in 2005).

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.[10] 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).

[Figures 2 and 3 here]

3 Data, variable definitions and sample

The present study benefits from rich longitudinal Norwegian administrative data for the period 1993-2011. The main data source is the *Income and Wealth Statistics for Persons and Families* (Statistics Norway, 2005). The data contain information from the annual tax returns, and from the education register (years of education and fields of studies). The data also include other socio-demographic characteristics about the individual and the family. To focus our analysis on individuals with strong attachment to the labour market, we restrict our analysis to the Norwegian citizens aged 25 to 61.[11] Our focus is on wage earners and the

self-employed; we exclude those who have reported any income from agricultural, forestry or fishing activities.

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).[12] Additionally, we restrict our sample to those who have been classified as either being in wage employment or self-employment during the observation period 1993-2011.[13] (In Subsection 6.3, we return to checks for robustness of our main conclusions to both classifications.)

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 percent, as shown by Figure 4. Including all wage earners in the estimation would have resulted in a huge computational burden; hence, we randomly select 10 percent of individuals from the original sample of 935,604 individuals, and we use this to generate our tax variables. From this sample, we next randomly select 2 percent of individuals who have never been categorised as self-employed, and select 20 percent 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 471,962 individual-year unweighted observations.[14] All analyses presented use sample weights to account for this selection.

[Figure 4 here]

Summary statistics for the main estimation sample are provided in Table 1. On average, in the sample, the proportion of individuals exiting out of a period of work and into a period of self-employment is less than 1 percent, whereas the average share of exits out of a period of self-employment is 10 percent. 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).

[Table 1 here]

4 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). For notational simplicity, we do not distinguish between duration time and calendar time below, although the estimated model does. The duration time random variable is denoted as Υ.

The probability that individual i would leave the spell in sector j ($j = s$ for self-employment and e for wage employment) at the *end* of time t, conditional on not having left in $t-1$, is a discrete time hazard $\lambda(t)$ given by:

$$\begin{aligned} \lambda_{i,j}(t|.,\omega_{i,j}) &= \Pr(\Upsilon_i = t|\Upsilon_i > t-1, taxation_i(t), x_{i,j}(t), \omega_{i,j}) \\ &= \mathrm{F}\big(h_j(t) + x_{i,t}\beta_j + \alpha_j' \; taxation_{i,t} + \omega_{i,j}\big) \end{aligned} \tag{1}$$

where h_j is the duration dependence function, $x_{i,t}$ 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.[15]

Unobserved heterogeneity is assumed to be distributed independently across individuals, but fixed over spells. However, we allow these to be correlated across the two employment states for each individual. We follow the semi-parametric approach pioneered by Heckman and Singer (1984), and assume that the vector characterising the unobserved heterogeneity

$\Omega = (\omega_s, \omega_e)$ follows a discrete multinomial distribution with three points of support. We estimate a set of support points and the probability that an individual is at each of these support points. In our case, we have three types of individuals ($m = 1, 2, 3$): $(\omega_{s,1}, \omega_{e,1})$, $(\omega_{s,2}, \omega_{e,2})$, and $(\omega_{s3}, \omega_{e,3})$ with three different associated probabilities p_1, p_2, and p_3 where, $p_3 = 1 - p_1 - p_2$. We set $\omega_{s,1} = 0$ and $\omega_{e,1} = 0$ for identification, since all three support points cannot be identified when an intercept is present in each of the hazards (see equation (1)).

We explain the model using a simpler specification. Consider a model for a single spell and single state, with just two support points for the unobserved heterogeneity. In the case of an inflow sample with right censoring, the individual contribution to the *unconditional* likelihood function is the sum of contributions arising for the two types, weighted by the probability of observing each type (omitting the conditioning variables):[16]

$$\mathcal{L}_i = p\mathcal{L}_i(\omega_1) + (1 - p)\mathcal{L}_i(\omega_2) \tag{2}$$

where for $m = 1, 2$

$$\mathcal{L}_i(t|\omega_m) = \left(\frac{\lambda_{i,j}(t|\omega_m)}{1 - \lambda_{i,j}(t|\omega_m)}\right)^c \prod_{k=1}^{t}[1 - \lambda_{i,j}(k|\omega_m)], \tag{3}$$

The indicator c is equal to 0 for right censored spells. For each individual, we observe whether the length of the employment spell is a completed spell or a right-censored spell at duration t years. As before, if there is an intercept present in the hazard function, one needs a normalisation, such as $\omega_1 = 0$.

The likelihood function is more complicated notationally for the case of a multi-spell two-state duration model. For example, take a hypothetical individual with the first left censored spell of three years in self-employment, a subsequent fresh spell of four years in wage employment, and finally a fresh spell in self-employment, which is censored after six years. For this individual, the *unconditional* likelihood contribution (omitting i) with three

masses in each state ($m = 1, 2, 3$) is:

$$\mathcal{L} = \sum_{m=1}^{3} p_m \Bigg[\lambda_s(\ 3\ |\omega_{s,m}) \prod_{t=1}^{2} [1 - \lambda_s(\ t|\omega_{s,m})] \times \lambda_e(\ 4\ |\omega_{e,m}) \prod_{t=1}^{3} [1 - \lambda_e(\ t|\omega_{e,m}) \times \prod_{t=1}^{6} [1 - \lambda_s(\ t|\omega_{s,m})] \Bigg]. \tag{4}$$

The sample likelihood function will be the product of all individual likelihoods $\mathcal{L}_i$ as given in equation (4). The hazard function is assumed to be a complementary log-log distribution function.[17]

Approximately 53 percent 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 but allow them to have a different hazard function, and we treat the unobserved heterogeneity to be the same as in the non-left censored spells.[18] However, we shall check for sensitivity of our conclusions with respect to this choice by obtaining estimates when omitting these left censored observations from the estimation sample.

5 Defining and estimating the tax variables

As discussed in the Introduction, our analysis is influenced by 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[19], 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. 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. Appendix A.1 provides further details on the construction of these two tax representations.

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 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 two tax variables. This closely follows Wen and Gordon (2014). Assuming pre-tax income to be log-normally distributed,[20]

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

we have,

$$\overline{y}_j \equiv E(y_j) = \exp(\mu_j + \frac{1}{2}\sigma_j^2). \tag{5}$$

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

$$netincdiff = [(1-\tau_s)\ln(\overline{y}_s)]/[(1-\tau_e)\ln(\overline{y}_e)] \simeq \ln[netincome_s/netincome_e] \tag{6}$$

where τ is a tax parameter from the tax function (see Footnote 19). For each individual, we first estimate the selectivity corrected *expected* pre-tax income ($\overline{y}_j$) for each occupation. We then use the tax simulator to generate the individual specific net incomes in both occupations, $netincome_s$ and $netincome_e$.

We expect a positive (negative) coefficient for this variable in the wage employment (self-employment) hazard. For example, the higher the proportionate increase in the net-income differential with respect to the net income from wage employment, the higher the exit rate from wage employment to self-employment (Wen and Gordon, 2014; Taylor, 1996; Fossen, 2009).

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 $\bar{x}_s$.[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:

$$convexity = \frac{E[T(y_s)] - T(\bar{y}_s)}{\bar{x}_s}. \tag{7}$$

Expected net income $\bar{x}_s$ is the net of tax income at $\bar{y}_s$, i.e., $\bar{x}_s = \bar{y}_s - T(\bar{y}_s)$. The coefficient on this variable is predicted to be negative in the exit hazard from wage employment into self-employment since higher '*convexity*' would be expected to discourage self-employment.

6 Results

6.1 Main Results

Figures 5 and 6 show the variations in the estimated weighted averages of the *netincdiff* and *convexity* variables over time. *netincdiff* is generally stable over the sample period, with some small year-to-year variations, whereas a downward trend is observed for *convexity* which complies with the reduced progressivity of the taxation during the sample period, see Section 2. The average value of predicted *netincdiff* of -0.37 implies that the *net* income in

self-employment is about 70 percent of net income in wage employment. Interestingly, the average estimated value of *convexity* here is quite low, 0.006 (s.d.=0.0062), compared to the *convexity* value of 0.011 (s.d. 0.16) reported by Wen and Gordon (2014) for Canada. Figures 7 and 8 show the distributions of the tax variables. *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. *convexity* is as expected, estimated to be mostly positive with a bunching at around zero, since for large values of estimated self-employment income, the expected tax liability ($E[T(y_s)]$) and tax liability ($T(\bar{y}_s)$) will be approximately the same, even if the predicted variance is substantial.[22]

[Figures 5, 6, 7 and 8 here]

Before discussing the parametric model estimation results, we provide the non-parametric hazard estimates in Figure 9.[23] The raw data self-employment hazard consistently lies above the wage employment hazard, implying that the conditional exit rate from self-employment is higher relative to an exit from wage employment. However, the wage employment hazard is quite low and stable over the spell duration. The probability of exiting from self-employment into a wage employment is around 0.25 in the first year, compared to 0.02 from a wage employment into a self-employment. Given the shape of this raw data hazard, we specify $h_j(t)$, see equation (1), as $\ln(t)$ in all four hazards.

[Figure 9 here]

In addition to the two main variables, *convexity* and *netincdiff*, the models also include time-varying and time-invariant control variables. The time-invariant variables are: 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.

Our base model estimates are presented in Table 2.[24] All four hazard functions are estimated simultaneously. The conditional hazards are estimated to be decreasing with duration for both the self-employment and the wage employment spells. However, the hazards are

constant for the left-censored self-employment spells, *ceteris paribus*. This is essentially picking up the fact that the probability of exiting from self-employment into a wage employment is almost zero for high duration self-employment spells and the sample of left-censored spells has a higher probability of containing large-duration spells.

We focus our discussions on the interpretation of the estimated effects on the tax variables. As expected, the coefficient on *netincdiff* is positive in the wage employment hazard and negative in the self-employment hazard, whereas we find the opposite for *convexity*. These estimated coefficients are also found to be higher in absolute value for the left-censored spells (columns [3] and [4]) and for wage employment exit probabilities (columns [2] and [4]). These results suggest that, compared to exits from self-employment, the probability of an exit from wage employment to self-employment is more sensitive to changes in both expected net-income differences and tax progressivity. This is consistent with the fact that the self-employed tend to continue their business activities even if they experience lower earnings growth (Hamilton, 2000).

With respect to the uncensored spells reported in columns [1] and [2] in Table 2, we see that the estimated effect of *convexity* on both exit rates is approximately 10 to 12 times larger than the effect of *netincdiff*. This implies that a 1 percentage point increase in *convexity* requires approximately an increase of 10 percentage points to 12 percentage points, in *netincdiff* to keep the self-employed from quitting and also to encourage wage earners to enter self-employment. Note that increases in *convexity* in this calculation are assumed to take place via changes to the volatility of self-employment income (equation (A.4) in the Appendix), since as already discussed, the model assumes no uncertainty in wage employment 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 wage employment or via an increase in the expected pre-tax self-employment income (not altering the variance of the self-employment income distribution).

In summary, our results conform to theoretical predictions. We find that, as *convexity*

increases, the estimated increases in *netincdiff* that is required to encourage the wage earners to enter self-employment, and to discourage the self-employed to quit, are similar in size and quite large.

6.2 Results from a policy experiment

So far, we have looked at the 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. We choose this particular year because in that year the Norwegian government introduced two changes in the taxation of gross income from wage and self-employment. The threshold for the 1999 surtax rate of 13.5 percent was increased from 269,100 NOK to 277,800 NOK. More importantly, an additional surtax was introduced for income exceeding 762,700 NOK (see the dashed line in Figure 10). These changes increased the overall progressivity of the Norwegian income tax system.[25]

The policy experiment we consider is the following: Instead using the two surtaxes applied to personal income, the hypothetical tax reform implements a flatter tax schedule, with one surtax rate (see solid line in Figure 10). The surtax value of 11 percent 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 in this experiment. 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 are -0.319 and 0.0039 under the new policy regime, compared to the original figures for the year 2000 of -0.324 and 0.0058, respectively. As expected, the less-progressive tax schedule leads to a decrease of 0.19 percentage points in *convexity*. The hypothetical policy also lead to a small increase in the mean *netincdiff*, so that average ratio of net income in self-employment to net income in wage employment changes from 72.3 to 72.7 percent.

The predicted transition probabilities under the old and the new tax regimes are re-

ported in Table 3. In the benchmark year 2000, the model predicts that about 7.55 percent of self-employed individuals will transit out of self-employment to wage employment (Case [A]). However, the reform increases this figure to 7.62 percent (Case [B]). Under the new regime, the predicted transitions from wage employment to self-employment are also somewhat higher, 0.56 percent compared to 0.54 percent. Since a very large proportion of individuals are in wage employment compared to in self-employment, even this small increase in the exit rates out of wage employment can generate a substantial net inflow into self-employment.

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 self-employment, without any discernible change in the predicted exit from wage employment. This result is consistent with the fact that the majority of the self-employed individuals experience a decrease in *netincdiff* in the reform scenario. In contrast, the decrease in *convexity*, common to both wage employment and self-employment observations, reduces the transitions from self-employment to 7.41 percent, and increases the exit from wage employment to 0.56 percent. In summary, the hypothetical tax scenario is found to encourage both entry into and exit from self-employment. Translating these estimates to numbers, we find that such a policy would have resulted in an increase of 11.5 percent in the net inflow into self-employment.[26] This would have increased the share of the self-employed from 5.01 percent to 5.76 percent.

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 percent to

−23.3 percent (an increase of 4 percent), and (ii) *convexity* from 1.2 percent to 0.8 percent (a reduction of 33 percent). The policy reform we considered changed the average values of (i) *netincdiff* from −32.4 percent to −31.9 percent (an increase of 2 percent), and (ii) *convexity* from 0.58 percent to 0.39 percent (a reduction of 33 percent). From the simulated policy reform, Wen and Gordon (2014) estimate an increase in the number of the self-employed of 0.78 percent (5.76 to 5.80 percent); thus substantially below our estimate of 13 percent (5.01 percent to 5.76 percent). One should however note that Wen and Gordon (2014) do not model transitions.

6.3 Robustness checks

In this sub-section we present results of some of the checks for robustness 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; and (iv) allowing our two tax variables to have different effects over the spell duration. Table 4 reports the results of the main robustness check; the full set of results is available from the authors.

Our first set of robustness checks examines the influence of the definition of a self-employment spell. In our base model we defined an observation as self-employment if the major source of income is self-employment income, i.e., if the net self-employment income is larger in absolute value than the combination of wage income and government transfers. Individuals who report self-employment income or wages lower than the threshold, represented by the Basic amount (see Footnote 12), in all observed years are also excluded. As a robustness check, we now redefine an observation as self-employment if the reported net self-employment income (net of expenses) is larger in absolute value than the combined sum of transfers from the government and the Basic amount. The new definition does not account for the size of the wage income component in the definition of self-employment. Thus, a wage earner might have moved into a spell of self-employment some time during the tax

year, and, hence, this individual would have reported both wage and self-employment income. Hence, compared to the base sample, observations that display high wage income (possibly larger than reported self-employment income) are also defined as self-employment if net self-employment income is higher than the Basic amount and transfers from government. By this definition, the number of unweighted observations is increased by 9,146. The results from using this new definition, are presented in panel (A) of Table 4; we see that the effects are qualitatively similar to the results in our base case in Table 2.

In our base model specification, we used both the left censored as well as fresh spells in the estimation. Hence, in our second set of robustness checks we omit the left censored spells and just use the fresh spells, i.e., we re-estimate our model using only the inflow sample. This reduces the total number of unweighted observations to 20,476. In our original sample, 60 percent of the observation started a fresh spell. The definition of an self-employment spell is the same as the one used in our base model. The results are presented in panel (B) of Table 4. Again the results are relatively similar to our base model results.

The third robustness check involves omitting observations with extreme predicted values for the variable *netincdiff*. As shown in Figure 8, the distribution of *netincdiff* has fat left and right 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. This implies that we lose about 10 percent of the observations, resulting in 30,810 individuals in our unweighted sample. The definition of an self-employment spell is the same as the one used in our base model. Estimates are reported in panel (C) of Table 4, and we see that the results are not much influenced by this. The effect of *netincdiff* remains stable for the self-employment exits, and is stronger on the wage employment exits.

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

7 Conclusion

This paper looks at the effect of taxes 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 incomes 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 robustness 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 variables of interest, to be sensitive to model assumptions.

The main finding is, as predicted by theory, that higher expected net earnings in self-employment relative to wage employment, reduce the probability of exiting out of an 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 12 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 an implied net increase of about 12 percent in the inflow into self-employment.

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A Appendix (on-line material)

A.1 The generation of tax variables[27]

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[28]

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

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.[29] 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.[30] The variables that enter the selection equation but not the income equations are binary indicators for the presence of children, family members and head of family.[31] [32]

Step 2: Add other types of income to this predicted income to get $\widetilde{y}_j$.

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

$$\sigma_j^2 = \sigma_{0j}^2 \exp(z'\delta) \tag{A.5}$$

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 set of individual specific characteristics and the correction term (*inverse Mills ratio).* σ_{0j} is estimated as the standard error of the ln(*income*) regression used in *step 1.* $\widehat{\sigma_j^2}$ 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 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 (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 of the 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 1993-2004, which saw high incomes from self-employment exempted from personal income taxation. For example, self-employment income from non-liberal professions were only subject to the flat capital tax rates for amounts exceeding a certain threshold.[33] [34] 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 self-employment income. However, only approximately 2% of our sample members report self-employment income that exceeds the thresholds, and just for a handful of observations this problem arises when predicted self-employment 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 self-employment would follow the same schedule as wage income. Another difference in labour income taxation 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 an 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. 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 self-employment income is coming from the the labour income component of the net self-employment 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 more than 75 percent of the total net self-employment income. This Figure rises to 95 percent for almost half the self-employed individuals.

Tables

Table 1: Summary statistics - mean (std deviation)

	All	***WE Sample***	***SE Sample***
Individual specific variables			
Females	0.44 (0.50)	0.46 (0.50)	0.29 (0.45)
Lower secondary school and less	0.37 (0.48)	0.37 (0.47)	0.39 (0.49)
Upper secondary school	0.30 (0.46)	0.30 (0.44)	0.31 (0.41)
University	0.33 (0.48)	0.32 (0.48)	0.30 (0.42)
Time-varying variables			
Age	42.37 (10.27)	42.03 (10.26)	44.42 (9.57)
Years 1993-1998	0.30 (0.46)	0.30 (0.45)	0.34 (0.40)
Years 1999-2002	0.22 (0.41)	0.21 (0.41)	0.23 (0.47)
Years 2003-2007	0.27 (0.44)	0.27 (0.44)	0.25 (0.44)
Years 2008-2011	0.21 (0.40)	0.22 (0.40)	0.18 (0.38)
Eastern Norway	0.49 (0.50)	0.48 (0.49)	0.56 (0.50)
Southern Norway	0.06 (0.23)	0.07 (0.23)	0.06 (0.23)
West Norway	0.26 (0.44)	0.26 (0.44)	0.22 (0.42)
Central Norway	0.10 (0.30)	0.10 (0.30)	0.08 (0.27)
Northern Norway	0.08 (0.27)	0.09 (0.27)	0.08 (0.35)
convexity	0.0061 (0.0062)	0.0059 (0.0062)	0.0087 (0.0053)
netincdiff	-0.366 (0.178)	-0.347 (0.152)	-0.572 (0.201)
Proportion of exits from		0.007	0.106

Notes:(i) Definitions of wage employment and self-employment and the sample selection criteria used are provided in Section 3. (ii) All averages and proportions are based on the weighted sample (see Section 3 for further details). (iii) The number of unweighted observations are 471,962, of which 359,60 classified as wage employment, and 112,354 as self-employment. (iv) The number of unweighted individuals is 33,897.

Table 2: Hazard model estimates, main sample

	Uncensored spells		**Censored spells**	
	SE	***WE***	***SE***	***WE***
	[1]	**[2]**	**[3]**	**[4]**
netincdiff	−0.47	1.48	−0.73	1.84
	(0.059)	(0.086)	(0.11)	(0.097)
*convexity**100	0.058	−0.14	0.0065	−0.28
	(0.022)	(0.022)	(0.043)	(0.030)
Male	−0.0055	0.65	0.12	0.72
	(0.028)	(0.032)	(0.051)	(0.037)
Base age	−0.014	0.030	−0.035	−0.043
	(0.0014)	(0.0016)	(0.0024)	(0.0019)
High School	−0.032	0.13	−0.12	0.14
	(0.031)	(0.038)	(0.047)	(0.040)
University	0.19	0.089	0.100	0.24
	(0.030)	(0.039)	(0.051)	(0.039)
ln(duration)	−0.47	−0.45	0.019	−0.27
	(0.022)	(0.018)	(0.037)	(0.031)
Constant	−1.30	−1.87	−1.49	−0.19
	(0.13)	(0.16)	(0.20)	(0.17)
Support points				
a1	0	$p1$	0.0088	
b1	0		(0.0021)	
a2	0.39	$p2$	0.22	
	(0.13)		(0.032)	
b2	−2.00			
	(0.10)			
a3	−0.64	$p3$	0.77	
	(0.13)		(0.033)	
b3	−4.04			
	(0.16)			
N obs (unweighted)	471,962			
N individuals (unweighted)	33,897			
Maximised log likelihood value	-103989.2			

Notes: (i) MLE standard errors in the parentheses; We calculated 'bootstrapped' standard errors for estimates reported in this table. However, the change in the new 'bootstrapped' standard errors did not change the significance of any of the coefficients estimated. The table with the bootstrapped standard errors are available from the authors.
(ii) The models are estimated using a random sample of individuals as detailed in Section 3 of the paper;
(iii) Omitted education category is no education or high-shook drop-out; Base age is the age a the start of the spell.
(iv) Coefficients related to 4 binary indicators for grouped years and 4 labour market regions are estimated but not reported in the table;
(vi) Support points a1-a3 (b1-b3) are in the self-employment (wage employment) hazards; See Section 4.

Table 3: Average predicted exit probabilities in baseline and a tax reform scenarios

Case	**Tax scenario**	**Probability of exit**	
		from *SE*, %	**from *WE*,** %
[A]	Base scenario year 2000, two surtaxes	7.55	0.54
[B]	Reform Scenario year 2000, one surtax	7.62	0.56
[C]	*convexity*: baseline *netincdiff*: reform	7.77	0.54
[D]	*netincdiff*: baseline *convexity*: reform	7.41	0.56

Notes: (i) Average predicted exit probabilities are based on the estimated model from Table 2.(ii) The percentage are calculated with respect the stock of self-employment and wage employment (iii) 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. (iv) 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. (iv) Case [C] considers values of *convexity* from the baseline scenario and values of *netincdiff* from the reform scenario. (vi) Case [D] considers values of *netincdiff* from the baseline scenario and values of *convexity* from the reform scenario.

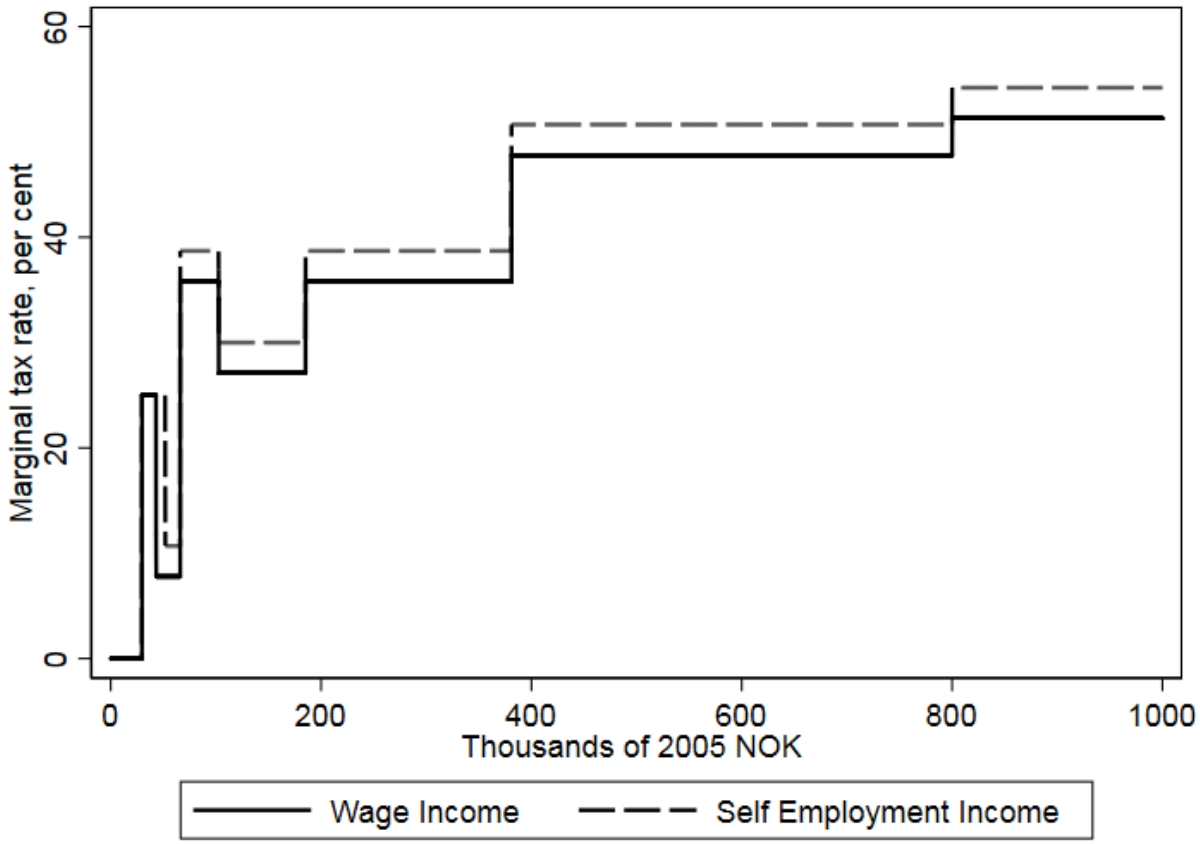
Table 4: Hazard model estimates, sensitivity checks

	Uncensored spells		**Censored spells**	
	SE	***WE***	***SE***	***WE***
	[1]	**[2]**	**[3]**	[4]
(A) - Changes to base definition of SE				
netincdiff	−0.56	0.81	−1.00	1.15
	(0.077)	(0.035)	(0.19)	(0.048)
*convexity**100	0.056	−0.071	0.052	−0.018
	(0.014)	(0.012)	(0.031)	(0.017)
(B) - Using trimmed netincdiff				
netincdiff	−0.44	2.75	−1.04	4.06
	(0.078)	(0.12)	(0.18)	(0.15)
*convexity**100	0.058	−0.12	−0.12	−0.26
	(0.025)	(0.025)	(0.055)	(0.035)
(C) - Without any censored spells				
netincdiff	−0.57	1.62		
	(0.057)	(0.088)		
*convexity**100	0.073	−0.23		
	(0.021)	(0.023)		

(i) See notes to Table 2.
(ii) In panel (A) an alternative specification of self-employment and wage employment are considered, as detailed in section 6.3;
(iii) In panel (B) Individuals with at least one observation of *netincdiff* lower than the first percentile or higher than the 99th percentile have been drops;
(iv) In panel (C)we only consider fresh spell and exclude all left censored spells;

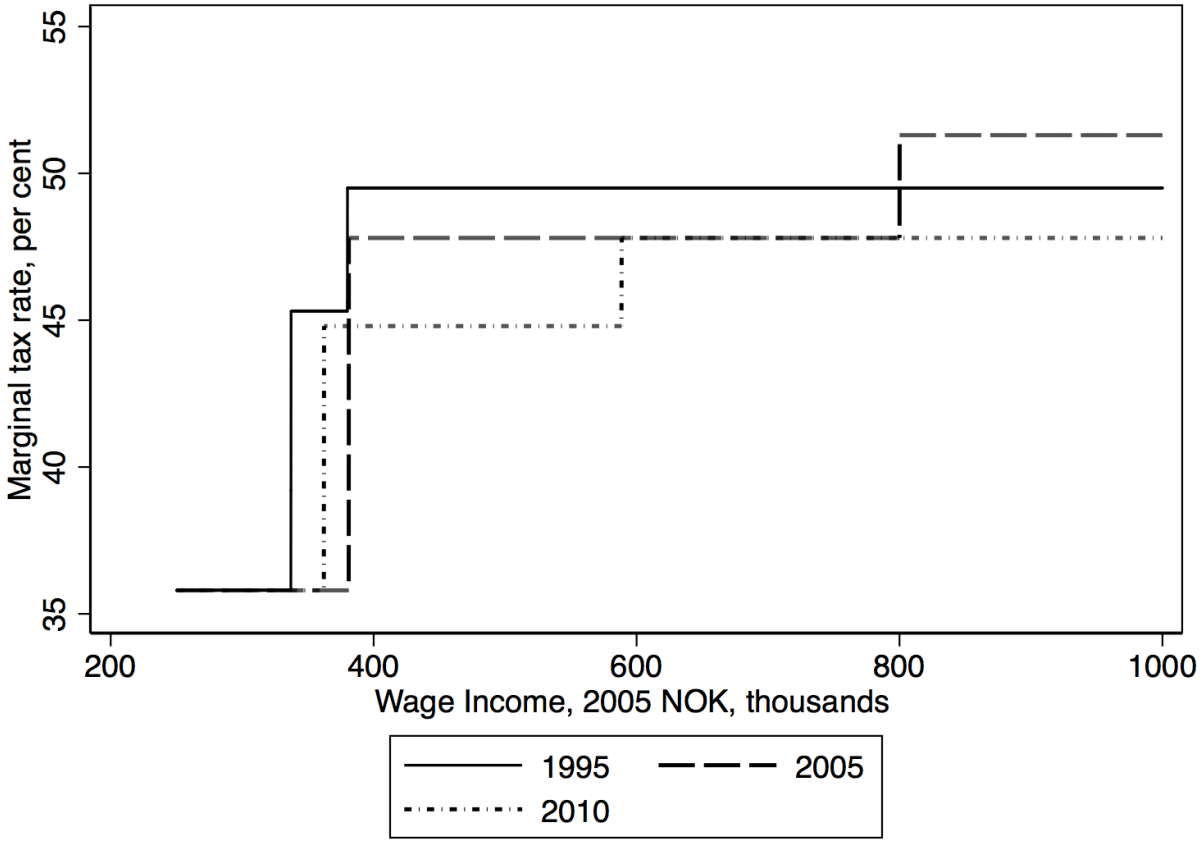
Graph

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



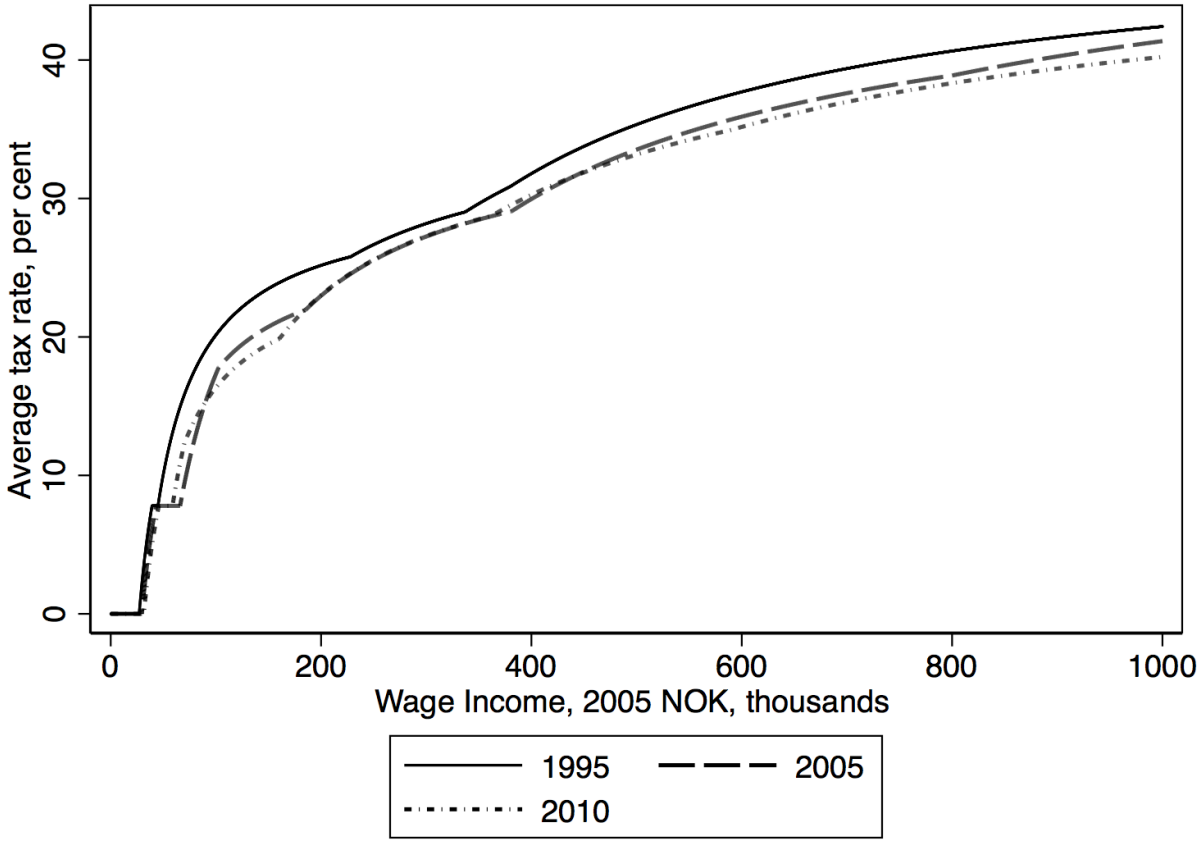
Notes: (i) Solid line: Marginal tax rate for a wage earner in tax class 1 with only wage income in year 2005. Employer's social security contribution are excluded (ii) Dashed line: Marginal tax rate for a self-employed individual in tax class 1 with only self-employed income in year 2005, and no capital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

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



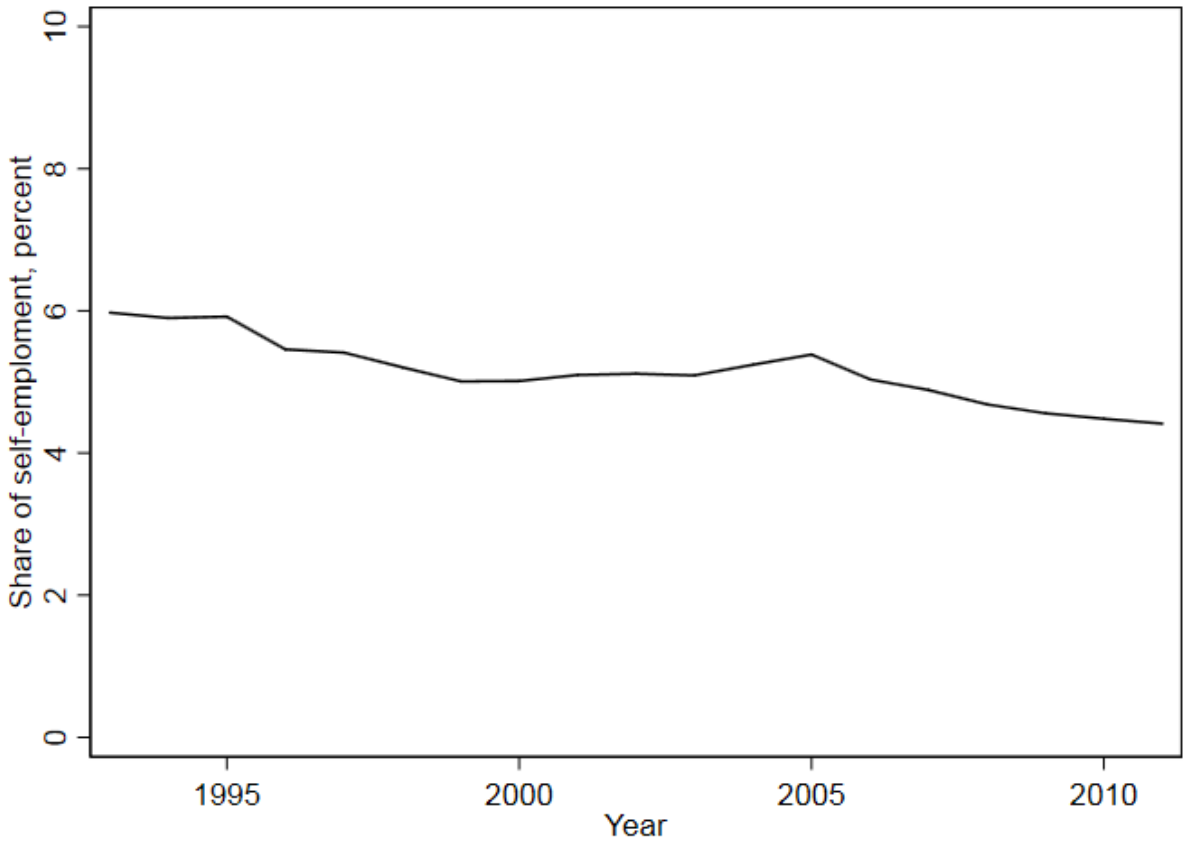
Notes:(i) Marginal tax rate for a wage earner in tax class 1 with only wage income in year 1995, 2005 and 2010. Employer's social security contribution are excluded. Thresholds are adjusted to take into account income growth during the period (base year is 2005). Marginal tax rate are reported only for 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



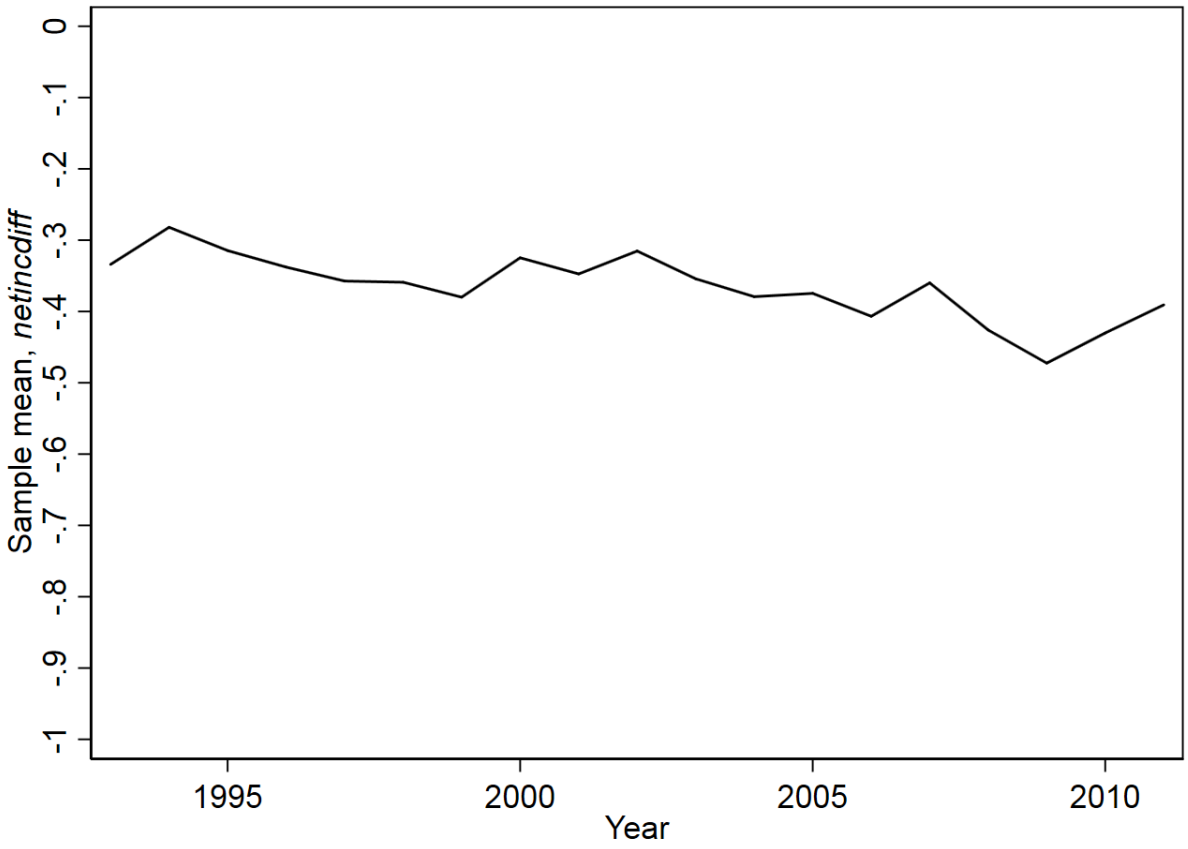
Notes: (i) Average tax rate for a wage earner in tax class 1 with only wage income in year 1995, 2005 and 2010. Employer's social security contribution are excluded. Thresholds are adjusted to take into account income growth during the period (base year is 2005). (ii) To improve readability, the case 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



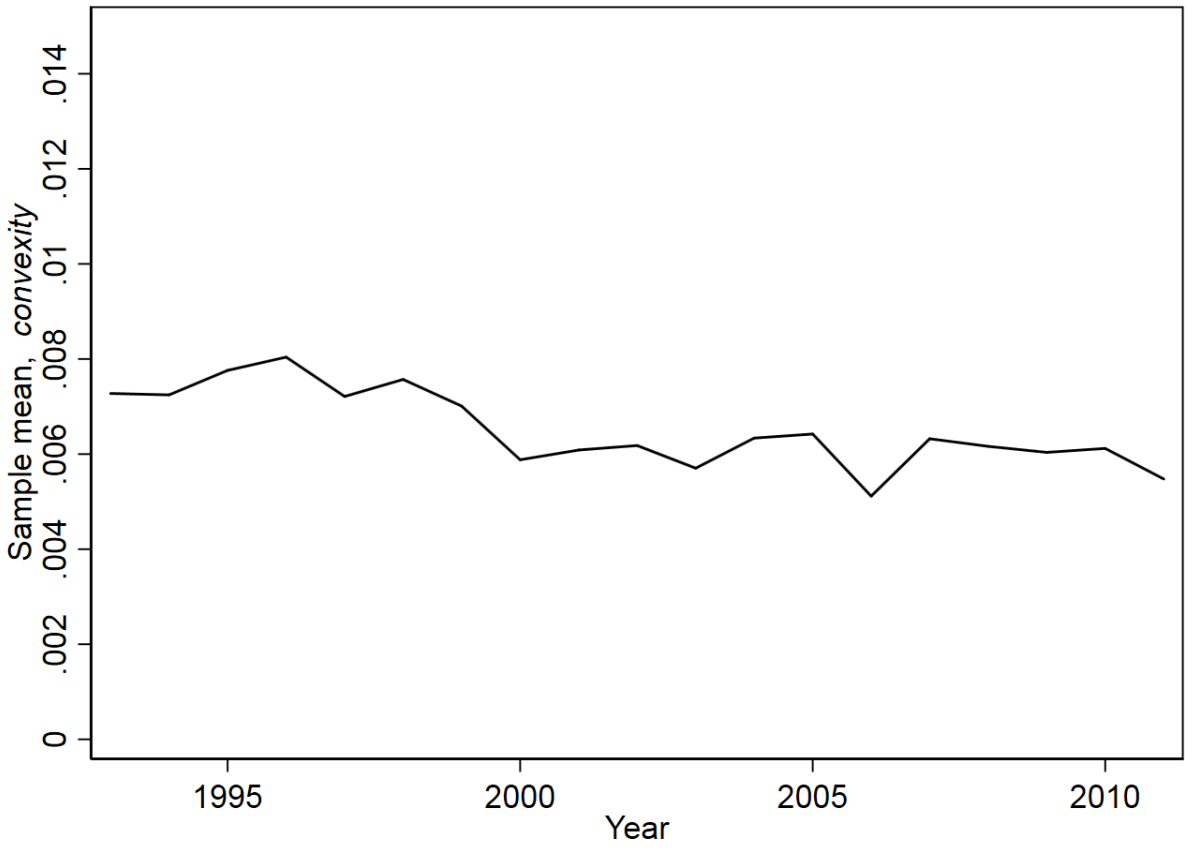
Notes: Annual self-employment observation as as share of total self-employment + wage employment observations. Categorisation into self-employment and wage employment is described in section 3.

Figure 5: Sample mean of *netincdiff* over the period



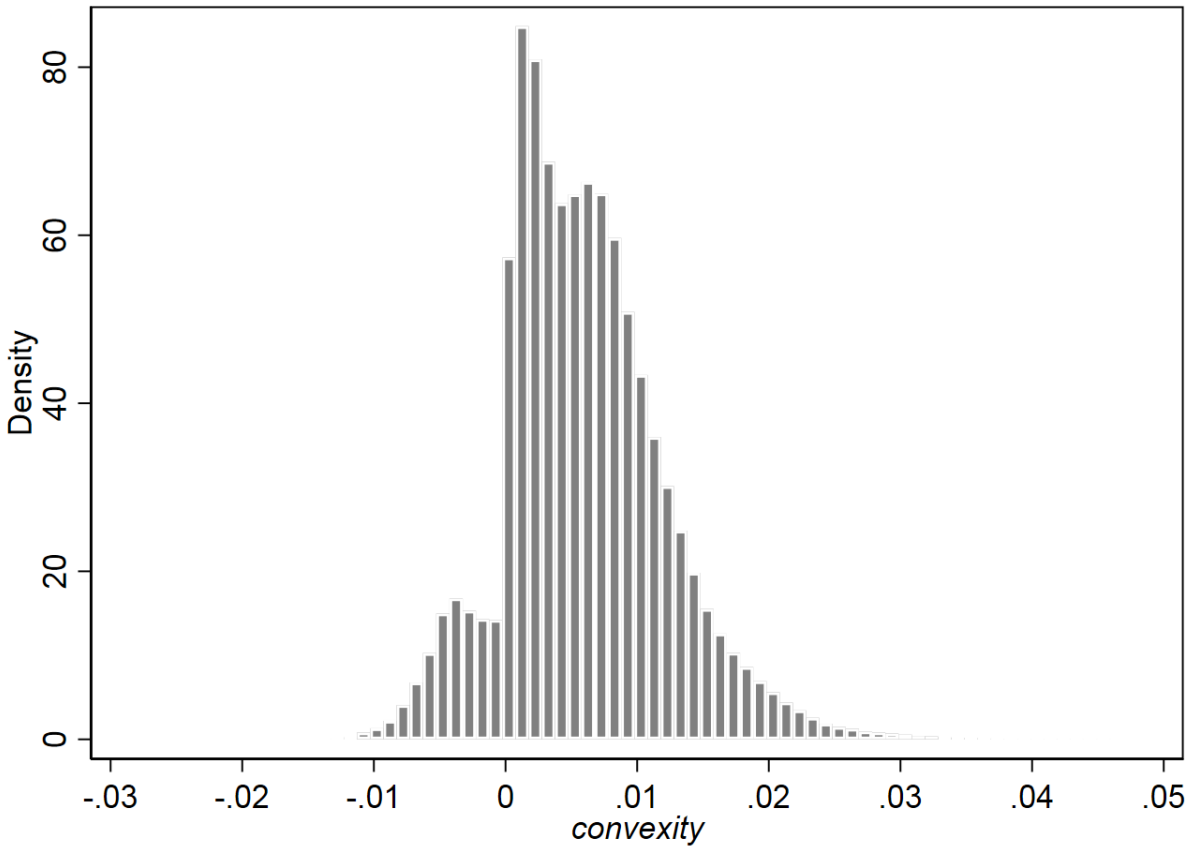
Notes:*netincdiff* : The netincdiff=ln[net income in SE (Self-Employment)/net income in WE (Wage Employment)]. See Section 5 for further details. The means are calculated using sampling weights.

Figure 6: Sample mean of *convexity* over the period



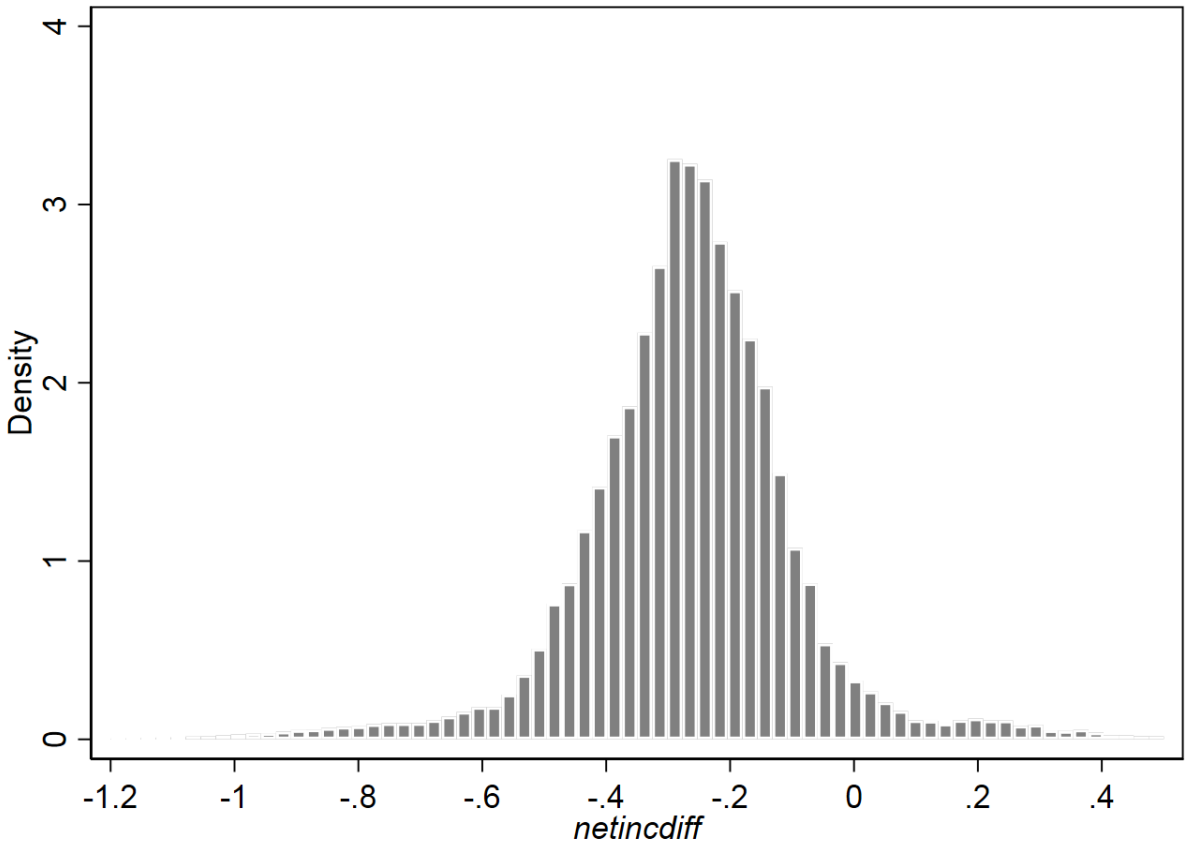
Notes: (i) See equation (7) for the definition of *convexity*; (ii) The means are calculated using sampling weights.

Figure 7: Density of *convexity*



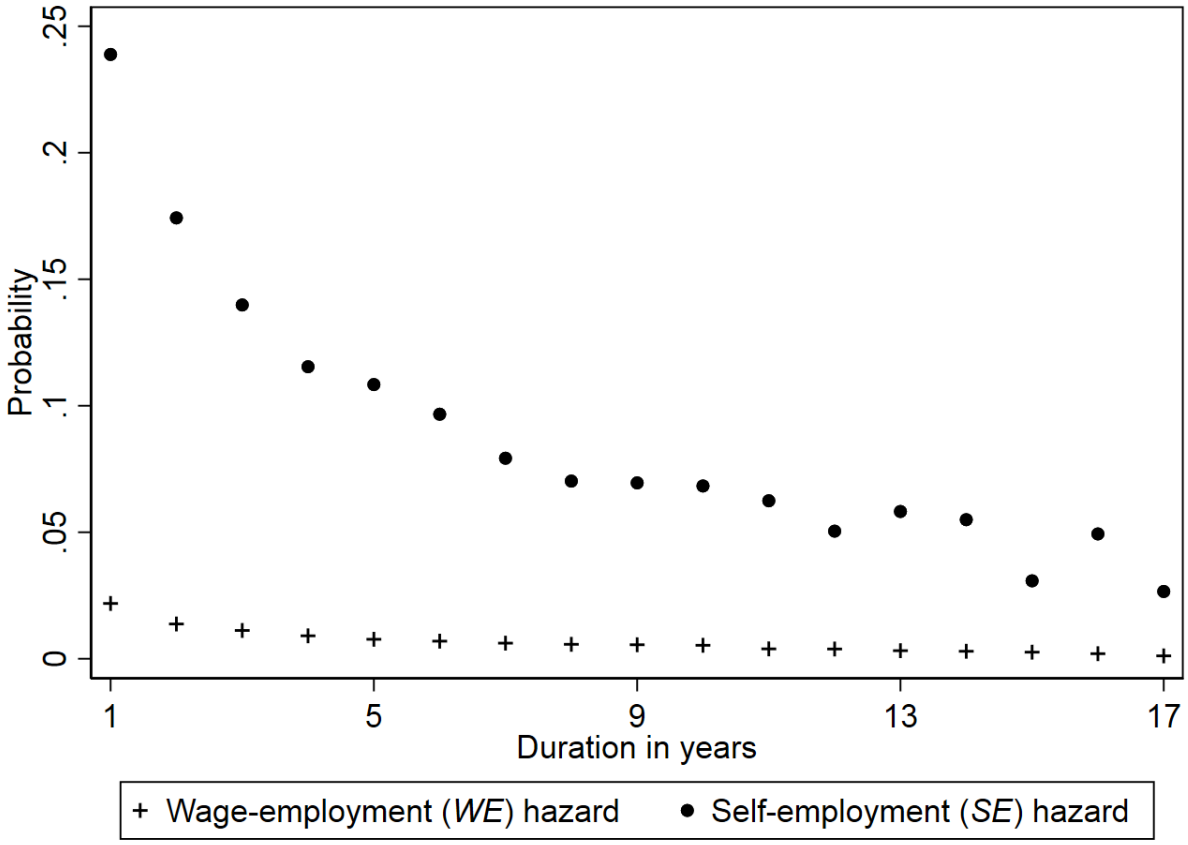
Notes: *convexity* distribution across all years and obvervation. *convexity* defined in equation (7).

Figure 8: Density of *netincdiff*



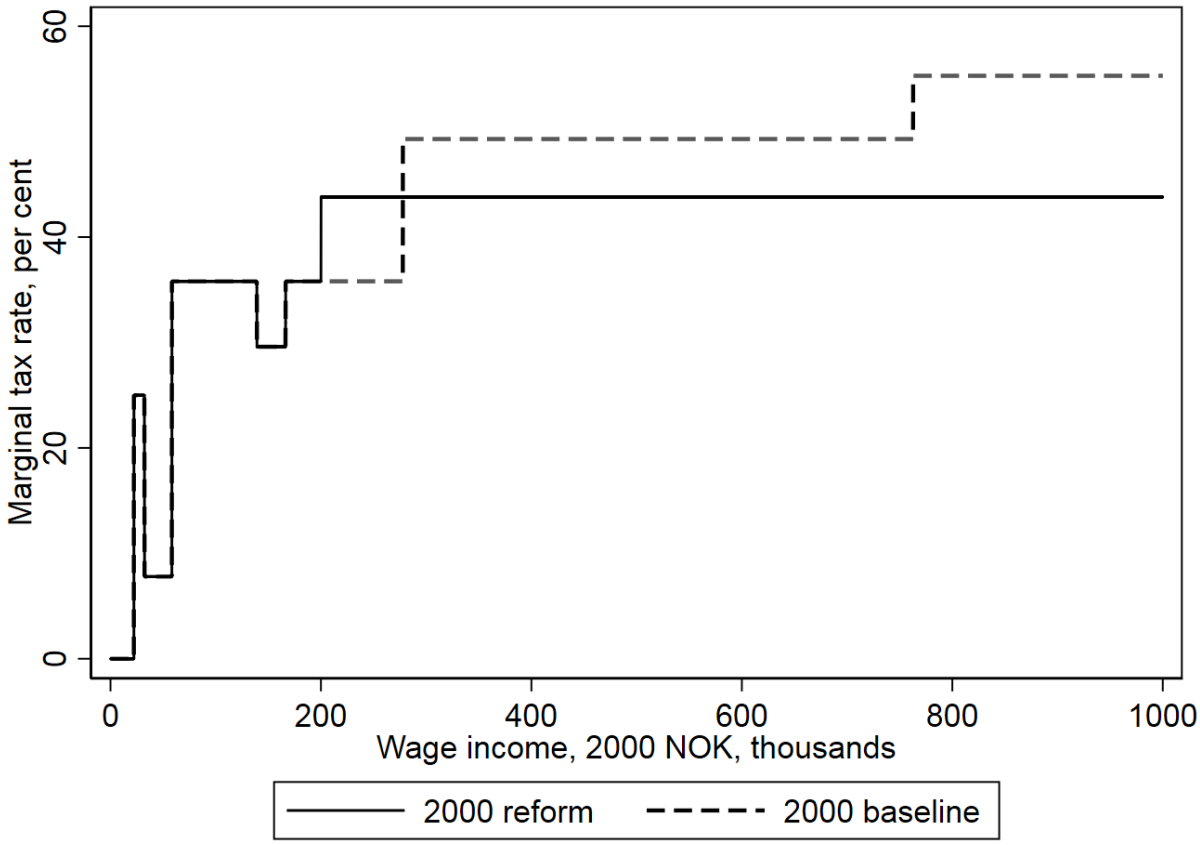
Notes: *netincdiff* distribution across all years and obvervations. *netincdiff* is defined in Section 5.

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

[2]A positive correlation between taxes and self-employment may also partly be attributed to the higher tax evasion or avoidance possibilities in self-employment than in wage employment (see, for instance, Schuetze and Bruce (2004)). Our data do not allow us to address this issue. However, if the differential evasion possibilities are relatively constant over the time period under consideration, time and individual unobservables included in our model will partially mitigate this problem. 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).

[3]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.

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

[5]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, as in 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.

[6]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.

[7]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 percent.

[8]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.

[9] 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.

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

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

[12]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. 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).

[13]Around 15 percent 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); they are omitted from the analysis.

[14]Of the total 471,962 individual-year observations, 112,354 (23.8 percent) are classified as a self-employment spell and, 359,608 (76.2 percent) as a wage employment spell. 16,789 (3.4 percent) individuals have experienced at least one self-employment spell, and 17,108 (3.6 percent) individuals have only experienced wage employment spells.

[15]Allowing for duration dependence and/or unobserved heterogeneity has been found to be important in self-employment exit hazards. For example, Evans and Leighton (1989), Taylor (1999), and DeBacker, Panousi and Ramnath (2015), find duration dependence to be important in self-employment spells and, Millán, Congregado and Román (2012), and Gurley-Calvez and Bruce (2008), find unobserved heterogeneity to be important. Our work

accounts for both.

[16]In the case of a continuously distributed unobserved heterogeneity, the unconditional likelihood function is obtained by integrating out the unobserved heterogeneity term from the likelihood function.

[17]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.

[18]This is the approach taken by Ham, Li and Shore-Sheppard (2016), who follow Heckman and Singer (1984). Twenty two percent of our left-censored observations were classified as self-employment spells.

[19]The convex tax function used by Wen and Gordon (2014) (also see Musgrave and Thin (1948) and Benabou (2000)) use is $x_j = (y_j)^{1-\tau}\widehat{y}^{\tau}$ 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.

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

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

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

[22]It is possible to have some negative *convexity* values if the tax function is not convex.

[23]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.

[24]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.

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

[26]The share of SE in 2000 is 5.01 percent (see Figure 4). Using the numbers from Table 3, in the baseline scenario, Case [A], the net-inflow is: (100-5.01)*0.0054 - 5.01*0.0755 = 0.1347 percent. Similarly, in the flat tax reform Case [B], the net-inflow is: (100-5.01)*0.0056 -5.01*0.0762=0.1502 percent. Hence, the increase in the net-inflow to self-employment is $100 * (0.1502 - 0.1347)/0.1347 = 11.5$ percent, compared to the baseline scenario.

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

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

[29]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.

[30]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.

[31]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).

[32]The detailed results from the income regressions are not presented here to preserve space but are available from the authors.

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

[34]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 approximately five times the monthly wage of a blue collar worker.