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Risky Earnings, Taxation and Entrepreneurial Choice – A Microeconometric Model for Germany[1]

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Abstract:

Which role do individual income prospects play in the decision to be an entrepreneur rather than an employee? In a model of occupational choice, higher expected after-tax earnings attract people to self-employment, while more risky net earnings deter risk-averse individuals. In this paper I analyse the expected value and variance of income in self-employment and dependent employment empirically, accounting for selection. Based on this analysis, structural models of self-employment entry and exit under risk are estimated, which include a standard risk aversion parameter. The model predicts that the German income tax reduction of 2000 induced smaller exit rates out of self-employment for men and smaller entry rates for women.

JEL classification: J23, H24, D81, C51

Keywords: Entrepreneurship, Risk, Returns to Self-Employment, Taxation

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1 Introduction

The factors that induce people to start up or close small entrepreneurial ventures have received increasing attention among academics and politicians alike recently. Entrepreneurs are agued to introduce new products and new technology, enter new markets and keep the market economy innovative, dynamic and competitive. Small firms are also often regarded as an engine for the creation of new jobs, which has made entrepreneurship a key topic in countries with high unemployment. In Germany, for example, slow economic growth and high unemployment have been attributed to the lack of start-ups: "In Germany, too few companies are being born. [..] What is lacking are [..] small entrepreneurial start-ups that have been the secret of so much development in Britain, America and elsewhere" (The Economist 2006). Consequently, governments in Germany and elsewhere have implemented various policies to promote entrepreneurship. As among the various potential determinants of entrepreneurship, taxation is under direct control of the government, tax policy is frequently suggested as an instrument to stimulate entrepreneurship.

The dominating research approach to analyse the impact of income taxation on entrepreneurial choice has been the ex-post analysis of certain tax reforms (recent studies include Moore 2004; Parker 2003; Bruce 2002; Cullen and Gordon 2002; Georgellis and Wall 2002; Bruce 2000; Schuetze 2000; Fossen and Steiner 2006; see Schuetze and Bruce 2004 for a survey). This branch of research brought about mixed results about the responsiveness of entrepreneurial choice to taxation. These ex-post studies are however only of limited applicability for the evaluation of future tax reform options ex-ante, as often demanded by policy makers. This is a motivation for developing and estimating a structural model of entrepreneurial choice.

Income taxation may influence entrepreneurial choice, which is understood here as the decision between dependent employment and self-employment, through its impact on net (after-tax) earnings in both alternatives. Thus, to understand the effect of income taxation, it is necessary to analyse the influence of net earnings on this decision. In models of entrepreneurship as an occupational choice, the probability of choosing self-employment can be represented as a function of the differential in expected earnings from self-employment and wage employment. Empirical studies analysing this earnings differential include Fraser and Greene (2006) and Taylor (1996), who confirmed that higher expected earnings in self-employment relative to paid employment significantly increase the probability of becoming self-employed, Dolton and Makepeace (1990) and Rees and Shah (1986), who also found a positive, but insignificant effect, and Hamilton (2000), who in contrast concluded that factors other than earnings induce people to become self-employed. All these studies only looked at gross earnings, however, so they did not consider the impact of taxes.

Not only preferences of individuals over net returns, but also over risk may play a role in entrepreneurial choice, as higher risk associated with income from self-employment may deter risk-averse individuals from choosing this option. This idea is related to Kanbur (1982) and Khilstrom and Laffont (1979) who modelled entrepreneurial choice as trading off risk and returns. They suggested that the less risk-averse become entrepreneurs and may receive a risk premium as compensation of the greater variance of their earnings. The historical roots of these models are in the work of Knight (1921), according to whom the central role of the entrepreneur is to bear risks. Recent empirical works found evidence that risk attitudes play a significant role in the decision to become self-employed (Cramer *et al.* 2002; Caliendo, Fossen and Kritikos 2006).

Taxation alters both the expected value and the variance of net earnings. A progressive income tax reduces expected net returns of a risky project such as starting up a business (Gentry and Hubbard 2000), but also flattens the stream of net returns over years, which reduces the risk associated with self-employment (Domar and Musgrave 1944). The first effect may discourage, but the second may encourage an entrepreneurial venture. The overall effect of taxation on entrepreneurial choice remains unclear as long as it is not understood to what extent both the expected value of net income and the risk associated with it (in terms of the variance) influence this choice.

A structural model is needed to approach this problem. Attempts to estimate a structural model of entrepreneurial choice incorporating earnings and risk have been very rare. Rees and Shah (1986) formulated a model of the probability of being self-employed assuming a utility function with constant relative risk aversion, but used a much simplified model without an explicit risk parameter in their empirical estimation. Pfeiffer and Pohlmeier (1992) specified a similar model and actually estimated its parameters using the first waves of the German Socio-Economic Panel (SOEP waves 1984-1989, limited to West Germany). They only considered gross incomes, however, and left out the role of taxation, which is the main motivation for this paper. Moreover, mean income and variance curves will be estimated individually in this paper, and duration dependence will be controlled for in the transition models (see section 3). Rosen and Willen (2002) used the Panel Study of Income Dynamics and found that in comparison to wage employment, self-employment both comes with an increase in mean yearly consumption and an increased variance of returns, which is consistent with a risk premium for the self-employed. They used the measured level and variance of income in the two occupational modes to asses a theoretical model of self-employment choice, but came to the conclusion that the risk premium was too large to be rationalized by conventional measures of risk aversion. A possible explanation may be that the authors used yearly income and did not take into account that the self-employed work more weekly hours on average than wage employees. They also only looked at gross incomes and neglected the impact of taxes.

In this paper I develop a structural model of transition probabilities between dependent employment and self-employment, which takes into account both expected net earnings and net earnings variance in the two alternative employment states. These first and second moments of random earnings are estimated empirically for both income from self-employment and dependent employment, controlling for non-random selection into these states. Not only one period's income, but lifetime income matters for the significant decision to enter or exit self-employment. This is taken into account by predicting the curves of future expected earnings and earnings variance over each individual's lifetime conditional on the choice to be an entrepreneur or a wage worker. Summary statistics of these predicted curves enter the structural transition models, which enables me to estimate the model parameters empirically. These parameters include the standard Arrow-Pratt measure of relative risk aversion, which can be related to results in the existing literature. The estimated model allows calculating elasticities of the transition probabilities with respect to the expected value and the variance of net income. To illustrate the results, the model is applied to simulate the effects of the German Tax Reduction Act 2000 on the self-employment entry and exit rates.

The structural transition model is developed in section 2 of this paper, and translated into empirical discrete time hazard rate models in section 3.1. Section 3.2 briefly introduces the data. The methodology for the estimation of gross earnings and their variance, controlling for selection, is described in sections 3.3 to 3.5. Sections 3.6 and 3.7 deal with the tax rate function and the calculation of annuities. The empirical results are presented in section 4, along with the simulation of the tax reform and a sensitivity analysis, and section 5 concludes.

2 The Structural Model

The model presented here is based on a binary representation of the decision to be self-employed or dependently employed. In a given period, an individual *i* makes a rational choice to be an entrepreneur instead of working in a wage job in the next period if his/her expected utility in self-employment (*se*) is higher than in dependent employment (*e*):

$$E(U_{se}(y_{i,se})) > E(U_e(y_{i,e})),$$

where $y_{i,se}$ is agent *i*'s net return from self-employment and $y_{i,e}$ is his/her net return from wage work. Both $y_{i,se}$ and $y_{i,e}$ are random variables because future income is risky. Empirically earnings of entrepreneurs are significantly more volatile than those of employees with comparable characteristics (Heaton and Lucas 2000; Borjas and Bronars 1989). In this model, it is assumed that people know the probability distribution of their future income in both occupational states. Thus, there is no complete uncertainty, but people do not know the realisation of their income in future periods. The expected utility with respect to y is approximated by a second order Taylor series expansion around μ_y:

$$\begin{aligned} E(U(y)) &\approx U(\mu_y) + U'(\mu_y)E(y-\mu_y) + \frac{1}{2}U''(\mu_y)E((y-\mu_y)^2) \\ &= U(\mu_y) + \frac{1}{2}U''(\mu_y)\sigma_y^{\,2} \end{aligned}, \qquad (1)$$

where $\mu_y = E(y)$ and $\sigma_y^2 = Var(y)$ and the subscripts of y are suppressed for simplicity. The equation demonstrates that $E(U(y)) < U(E(y))$ if agents are risk-averse ($U''(y)<0$).[2]

In the following, I assume constant relative risk aversion (CRRA), as *inter alia* in Kanbur (1982), Rees and Shah (1986), and Pfeiffer and Pohlmeier (1992). This implies that the utility function must satisfy

$$-\frac{yU''(y)}{U'(y)} = \rho \qquad (2)$$

where the constant ρ is the coefficient of CRRA (Pratt 1964). The following random utility function satisfies the CRRA condition, yields increasing utility for money $y>0$, and allows utility to vary across individuals depending on observable characteristics x_i and an error term ε_{ij}:

$$U_j(y_{ij}, x_i, \varepsilon_{ij}) = \begin{cases} \alpha \dfrac{y_{ij}^{\;1-\rho}}{1-\rho} + \beta_j' x_i + \varepsilon_{ij}; & \rho \neq 1. \\ \alpha \ln y_{ij} + \beta_j' x_i + \varepsilon_{ij}; & \rho = 1. \end{cases} \qquad (3)$$

The parameter $\alpha>0$ reflects the weight of risk adjusted income in the utility function. This specification implies risk preference for $\rho < 0$, risk neutrality for $\rho = 0$ and risk aversion for $\rho > 0$. The error term ε_{ij} captures unobservable tastes influencing utility that might be different across observations and in the two alternative employment states $j \in \{se; e\}$ (self-employment

[2] This general result follows directly from Jensen's inequality.

and dependent employment). These tastes are unobservable for the researcher and thus treated as a random variable, but they are known to the individuals in the sample, in contrast to the error in future earnings *y*. Unobserved factors influencing utility in self-employment might include the desire to be independent (Taylor 1996) or the believe in the power of one's own actions (Evans and Leighton 1989). The first and second order partial derivations of *U* with respect to *y* (suppressing subscripts *j* and *i*) are

$$
\begin{aligned}
U'(y,x,\varepsilon) &= \begin{cases} \alpha y^{-\rho}; & \rho \neq 1. \\ \alpha y^{-1}; & \rho = 1. \end{cases} \\
U''(y,x,\varepsilon) &= \begin{cases} -\alpha\rho y^{-\rho-1}; & \rho \neq 1. \\ -\alpha y^{-2}; & \rho = 1. \end{cases}
\end{aligned} \tag{4}
$$

Plugging *U''* into equation (1) yields expected utility with respect to *y*:

$$
E(U(y,x,\varepsilon)) \approx \begin{cases} \alpha\left(\dfrac{\mu_y^{1-\rho}}{1-\rho} - \dfrac{1}{2}\rho\mu_y^{-\rho-1}\sigma_y^2\right) + \beta' x + \varepsilon; & \rho \neq 1. \\ \alpha\left(\ln\mu_y - \dfrac{1}{2\mu_y^2}\sigma_y^2\right) + \beta' x + \varepsilon; & \rho = 1. \end{cases} \tag{5}
$$

With $\alpha > 0$, the equation reflects that given expected earnings, for risk-averse agents expected utility decreases with greater variance of earnings. For risk-neutral agents the variance does not matter, and for risk-loving individuals, greater variance actually increases expected utility. Taking the expectation with respect to the random earnings variable *y* did not remove the utility error term ε.

As the agent chooses the employment state which gives him/her the highest utility, the probability that agent *i* decides to be an entrepreneur in the next period is

$$
\begin{aligned}
\text{Prob}(se|\, y_{i,se}, y_{i,e}, x_i) &= \text{Prob}(E(U_{se}(y_{i,se}, x_i, \varepsilon_{i,se}) > E(U_e(y_{i,e}, x_i, \varepsilon_{i,e})) \\
&= \text{Prob}(\varepsilon_{i,e} - \varepsilon_{i,se} < \alpha(V(y_{i,se}) - V(y_{i,e})) + (\beta_{se} - \beta_e)' x_i) \\
&= F(\alpha(V(y_{i,se}) - V(y_{i,e})) + \beta' x_i)
\end{aligned} \tag{6}
$$

where $\beta = \beta_{se} - \beta_e$, *F* is the cumulative density function of the error term $\varepsilon_i = \varepsilon_{i,e} - \varepsilon_{i,se}$, and

$$
V(y_{ij}) = \begin{cases} \dfrac{\mu_y^{1-\rho}}{1-\rho} - \dfrac{1}{2}\rho\mu_y^{-\rho-1}\sigma_y^2; & \rho \neq 1. \\ \ln\mu_y - \dfrac{1}{2\mu_y^2}\sigma_y^2; & \rho = 1. \end{cases} \tag{7}
$$

can be interpreted as risk adjusted income. This random utility model is the basis for the empirical transition models that will be outlaid next.

3 Empirical Methodology

3.1 Transition Models

Equation (6) represents a structural model of binary choice between self-employment and dependent employment that gives the probability of being self-employed in the next period t+1. To avoid the strong assumption that the self-employment probability in period t+1 is the same for somebody who is dependently employed in period t and for somebody who is already self-employed in t, I condition the model on the current employment state. Thus I focus on transitions and estimate separate models of the probability of entering self-employment conditional on being dependently employed and the probability of switching to dependent employment conditional on being self-employed. Moreover, the probability of being self-employed not only depends on the current employment state, but the literature has also shown that the duration of an individual's spell in dependent employment significantly influences the probability of entering self-employment, and equally the spell duration in self-employment influences the probability of exit (Evans and Leighton 1989; Taylor 1999; Fossen and Steiner 2006). Thus, I additionally condition equation (6) on the duration of the current spell in self-employment or dependent employment by including a flexible function of the respective spell duration t in the x vector. This function, the baseline hazard, is specified as a cubic polynomial (higher order polynomials were not significant, see also section 4.4):

$$\beta' x_i = \beta^{1\prime} x^1_i + \delta_1 t_i + \delta_2 t_i^2 + \delta_3 t_i^3. \qquad (8)$$

The models are estimated using the maximum likelihood method. In the following, the model of transition from dependent employment to self-employment (entry model) is taken as an example.[3] The likelihood contribution of an observation i is given by equation (6) if a transition occurs between t and t+1, which is now written as

$$\text{Prob}(trans_i = 1 \mid y_{i,se}, y_{i,e}, x_i) = F(\alpha(V(y_{i,se}) - V(y_{i,e})) + \beta^{1\prime} x^1_i + \delta t_i + \delta t_i^2 + \delta t_i^3). \qquad (9)$$

If no transition occurs, the likelihood contribution is the complementary probability

$$\text{Prob}(trans_i = 0 \mid y_{i,se}, y_{i,e}, x_i) = 1 - \text{Prob}(se \mid y_{i,se}, y_{i,e}, x_i) = 1 - F(\cdot), \qquad (10)$$

where $trans_i$ is a binary indicator variable that equals 1 if a transition is observed, and 0 otherwise. The log likelihood function for the sample is thus given by

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[3] The model of transition from self-employment to dependent employment (exit model) is specified analogously. The only difference is that the coefficient α of the risk-adjusted income differential (defined as the difference between self-employment and dependent employment in all models) is expected to be negative in the exit model. In the likelihood maximization, α is left unconstrained, so a check if α has the expected sign in all models serves as a test for the models' consistency.

$$\ln L = \sum_{i=1}^{N} \left(trans_i \ln F(\cdot) + (1 - trans_i) \ln \left(1 - F(\cdot)\right) \right). \tag{11}$$

Individuals can experience multiple spells in self-employment or dependent employment in the observation period. If the person-period observations i are indexed by person, spell number and spell duration, the model can be written as a discrete time hazard rate model where the hazard rate

$$\begin{aligned} \lambda_{pk}(t) &= \text{Prob}(t{=}T_{pk} \mid T_{pk} \geq t, y_{pk,se}(t), y_{pk,e}(t)_{,e}, x_{pk}(t)) \\ &= \text{Prob}(trans_{pk}(t) \mid y_{pk,se}(t), y_{pk,e}(t)_{,e}, x_{pk}(t)) \end{aligned} \tag{12}$$

is the probability that spell k of person p ends in period t, i.e. a transition occurs, conditional on survival until the beginning of t. The discrete non-negative random variable T_{ik} describes the duration of the k-th spell of person p; when a spell terminates in period t (measured from the beginning of the spell), T_{ik} takes on the value $T_{ik} = t$. The maximum likelihood method allows to consistently take into account not only completed spells, but also both right-censored and left-censored spells in the estimation. Right-censored spells (where the end of a spell is not observed) contribute to the likelihood function through equation (10). For left-censored spells (spells that had started before the person entered the panel) retrospective employment history information in our data make it possible to recover the spell duration t correctly and to include these spells consistently in the likelihood function, too (see Fossen and Steiner (2006) for a more detailed discussion of this hazard rate model). To complete the specification of the likelihood function, F is assumed to be the cumulative logistic probability distribution. The implications of alternatively assuming the cumulative normal distribution are tested in section 4.4.

The vector x_i controls for observable individual characteristics and covariates that may shift taste with respect to self-employment. It includes variables that emerged as important determinants of self-employment in prior studies: age, education, work experience, unemployment experience, number of children, region, and a constant (for example, see Taylor, 1996; Evans and Leighton, 1989; for German data see Georgellis and Wall, 2004; Holtz-Eakin and Rosen, 1999). Furthermore, Brown *et al.* (2006), Parker (2005) and Bruce (1999) all find evidence that an individual's household context has an influence on the decision to be self-employed. I account for this by controlling for the marital status, the spouse's employment type, if applicable, and the income of other household members in x_i. A sensitivity analysis with regard to the chosen control variables is conducted in section 4.4.

Before the transition models can be estimated by maximising the likelihood function with respect to its parameters (the coefficient of the risk adjusted income differential α, the coefficient of relative risk aversion ρ, the parameters of the baseline hazard δ_1, δ_2 and δ_3 describing the duration dependence, and the parameter vector of the characteristics influencing taste, β^1), the expected value of income μ_y and its variance σ_y^2 in the two alternative employment states are required for each individual in each period, as these statistics enter the likelihood function through V. The strategy for estimating μ_y and σ_y^2 is described in sections 3.3 and 3.5, after the data basis for this analysis is shortly described in the next section.

3.2 Data

This analysis is based on the German Socio-Economic Panel (SOEP) provided by the German Institute of Economic Research (DIW Berlin). The SOEP is a representative yearly panel survey covering detailed information about the socio-economic situation of about 22,000 individuals living in 12,000 households in Germany. I use all 22 waves currently available which cover the years from 1984 to 2005. The SOEP Group (2000) gives a detailed description of the data.

For the purpose of this analysis, the sample is restricted to individuals between 18 and 64 years of age and excludes farmers, civil servants, and those currently in education, vocational training, or military service. The individuals excluded presumably have a limited occupational choice set, or they have different determinants of earnings (e.g. subsidies in the case of farmers) and of occupational choice that could distort our analysis. Family members working for a self-employed relative are also excluded from the dataset because they are not entrepreneurs in the sense of running their own business. After removing observations with missing values for any of the relevant variables, 117 321 person-year observations are left for the analysis. Table A 1 in the appendix shows how these observations are distributed over the possible employment states dependent employment, self-employment, and unemployment or non-participation, further split by full-time and part-time work (full-time is defined as a minimum of 35 hours per week) and gender. Working individuals are classified as self-employed or dependently employed based on whether they report self-employment or dependent employment as their primary activity. A transition can be identified in the data when a person is observed in different employment states in two consecutive years t and t+1.

This paper focuses on the choice between full-time dependent employment and full-time self-employment, because the attention is on the comparison of earnings in the two alternative employment states, not on the decision to work full-time or part-time or the decision to work or not to work. Thus, as in Taylor (1996) and Rees and Shah (1986), the structural transition models are based on full-time working individuals. I control for possible selectivity effects arising from selection into the full-time working categories with a two-step procedure (see section 3.4). As a robustness check, the analysis is repeated taking into account transitions into part-time dependent employment or self-employment as well (see section 4.4).

All estimations (except for the tax rate regression) are conducted separately for men and for women because of the well documented differences in male and female wage equations, and because a separate analysis might help explain why the share of the self-employed is much lower among women than among men, at least in Germany. Table A 3 in the appendix shows descriptive statistics for full-time self-employed and dependently employed men and women in the sample. For a description of the variables used in this analysis, see Table A 2.

3.3 Estimation of Expected Hourly Income

A key variable in the models of transition between dependent employment and self-employment developed above is an individual's expected net income μ_y. It is understood here as expected *hourly* net income in order to focus attention on the differential in monetary compensation for work and not on differences in hours worked (as, for instance, in Hamilton, 2000, and Taylor, 1996). For each individual μ_y must be estimated for the two alternatives self-employment and wage employment. Therefore, I first estimate separate Mincer-type regressions of hourly gross income from dependent employment (using the full-time dependently employed) and from self-employment (using the full-time self-employed) on a vector of demographic and human capital and work related variables $z^{earn}{}_i$:

$$y^{gross}{}_{ij} = \theta_j' z^{earn}{}_i + \sigma_j \lambda_{ij} + u_{ij}, \tag{13}$$

where $y^{gross}{}_{ij}$ are individual i's hourly gross earnings[4] in employment state $j \in \{se;e\}$, θ_j is the coefficient vector, $\sigma_j\lambda_{ij}$ controls for selection (see section 3.4), and u_{ij} is the error term. Conceptually, human capital variables clearly determine gross incomes, not net incomes, as the latter depend on the tax legislation. Thus, gross incomes are estimated here, and estimations of net incomes are derived later (see section 3.6). The variables vector $z^{earn}{}_i$ includes age, education, the duration of the spell in the current employment state, lifetime work and unemployment experience, region, and a constant. Moreover, as predictions of

[4] Income information for year t is obtained from retrospective questions in wave t+1 about a respondent's average monthly gross income in t, differentiated by income from dependent employment and self-employment. Income from self-employment (employment) is only averaged over months in which the respondent was actually self-employed (employed), so the information remains accurate if the respondent switched between employment states. Incomes are deflated using the Consumer Price Index. Earnings levels rather than log(earnings) are used in the regression to avoid excluding people who report zero earnings, which is sometimes observed for the self-employed during temporary periods (cp. Hamilton 2000).

income enter the structural transition models, for identification some variables should be included in the earnings, but not in the transition equations. I follow Fraser and Greene (2006), Taylor (1996) and Rees and Shah (1986) by including industry dummies, which are well proven determinants of earnings, in z^{earn}_i only.[5]

The estimated income models are then used to obtain individual predictions for gross earnings in the two alternative states self-employment and dependent employment, one of which is counter-factual, for every individual and period in the sample of the full-time working population. If there are unobservable factors that both influence selection into full-time self-employment or full-time dependent employment and income, it is necessary to control for selection.

3.4 Selection

A two-step procedure is applied to control for selection effects in the earnings regressions (13) (and also in the estimation of earnings variance (18) as will be described in the next section). The earnings regressions are the 2nd step after the estimation of a 1st step equation of selection into the 5 possible employment states spread out in Table A 1: full-time and part-time self-employment, full-time and part-time dependent employment and unemployment/inactivity. The probability of being observed in each of these 5 employment states j is estimated by a reduced form multinomial logit:

$$\text{Prob}(J_i = j | z_i) = F\left(\gamma_j' z_i\right) = \frac{\exp(\gamma_j' z_i)}{\sum_{k=1}^{5} \exp(\gamma_k' z_i)}, \tag{14}$$

where γ_j are the coefficient vectors[6] and z_i is the vector of regressors. This vector consist of the variables z^{earn}_i used in the earnings regression (13) (excluding spell duration), and for identification, it additionally includes variables indicating a self-employed father[7], the number of children, and the marital status.[8] After estimation of (14) an individual sample selection

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[5] Additionally dummy variables for German nationality and physical handicap are added to the earnings equations, as these variables turn out to be important for the prediction of earnings. Year dummies are also included to account for the business cycle.

[6] γ_j is normalised to 0 for the base category j="unemployment/inactivity"

[7] Having a self-employed father is used as an exclusion restriction as this characteristic is likely to have an impact on the probability of being self-employed (e.g. Dunn and Holtz-Eakin 2000), e.g. through an inherited business, but is not expected to have an influence on earnings after controlling for other relevant factors (cp. Taylor 1996). In Germany, self-employed mothers were rare in the generation of most respondents' parents, so only self-employed fathers are used.

[8] The number of children and marital status are well known to influence the decision to participate in the labour market and the choice between part-time and full-time work, especially for women (e.g. Mroz 1987), but are not expected to influence gross earnings (cp. Rees and Shah, 1986).

term λ_{ij} (similar to the "inverse Mill's ratio") is calculated for the two states of interest $j \in \{se;e\}$ (full-time self-employment and dependent employment):

$$\lambda_{ij} = \phi\left(\frac{\Phi^{-1}\left(F\left(\gamma_j' z_i\right)\right)}{F\left(\gamma_j' z_i\right)}\right), \tag{15}$$

where ϕ and Φ^{-1} are the standard normal density function and the inverse of the cumulative standard normal density function. Then the term λ_{ij} enters the earnings equation (13) for earnings in employment state $j \in \{se;e\}$, which allows to estimate its coefficients σ_j. For the subsequent prediction of an individual's earnings in each of the two employment states, $\sigma_j\lambda_{ij}$ enters the prediction equation if individual i is actually observed in that state, and in the counter-factual case, $\sigma_j\lambda_{ij,cf}$ enters the equation with

$$\lambda_{ij,cf} = -\phi\left(\frac{\Phi^{-1}\left(F\left(\gamma_j' z_i\right)\right)}{1-F\left(\gamma_j' z_i\right)}\right). \tag{16}$$

For a detailed description of the two-step procedure for polychotomous-choice models and selectivity bias see Maddala (1983).

3.5 Estimation of Earnings Variance

Along with an individual's expected income μ_y, the first moment of random earnings, the individual variance of earnings σ_y^2, i.e. the second moment, is also required to estimate the transition models between dependent employment and self-employment. The literature on the earnings differential has mostly analysed the first moment only, and if the second moment is taken into account, as in Pfeiffer and Pohlmeier (1992) and in Rosen and Willen (2002), the variance is usually modelled as a population parameter and not estimated on an individual basis, which implies the assumption that income is homoscedastic. This assumption is relaxed here, allowing the variance of earnings to differ not only between self-employment and dependent employment, but also with individual characteristics and covariates.[9] The point made in this paper is that individuals do not only worry about the first, but also the second moment of their *individual* probability distribution of income in the two alternative employment states when they consider a transition.

As the error term in the earnings equation (13) u_{ij} has an expected value of 0, the variance of gross random earnings conditional on the explanatory variables is

[9] Therefore, heteroscedasticity robust (White) standard errors are reported in the earnings regression (13).

$$\sigma^{gross}{}_{y}{}^{2} = Var(y^{gross}{}_{ij}) = E(u_{ij}{}^{2}) . \quad (17)$$

Thus, the squared residuals from the earnings regression can be used to specify a flexible heteroscedasticity function and estimate $\sigma^{gross}{}_{y}{}^{2}$. The natural logarithm of the squared residuals are regressed on the explanatory variables of the earnings model $z^{earn}{}_{i}$ and the selection term λ_{ij} from (15) to control for selection, separately for the two employment states $j \in \{se;e\}$:

$$\ln(\hat{u}_{ij}{}^{2}) = \pi_{j}{}' z^{earn}{}_{i} + \sigma^{var}{}_{j}\lambda_{ij} + e_{ij} , \quad (18)$$

where e_{ij} is the error term. Taking the logarithm of the squared residuals is the common approach to ensure that predicted values for the variance are strictly positive.[10] For the prediction of the variance in the counter-factual employment state, λ_{ij} is replaced by $\lambda_{ij,cf}$ from (16) as in the earnings regression. This procedure yields individual predictions of the variance of gross earnings, which is the basis for the calculation of the variance of net earnings, as will be described in the next section.

3.6 Estimation of the Tax Function

As individual utility depends on net (after-tax) income, the relevant variables in the structural transition models are the expected value and the variance of net income. To derive net income from gross income, the German progressive income tax schedule must be approximated. As the SOEP provides information about both a respondent's gross and net income,[11] individual and period specific average tax rates τ_i, can be calculated:

$$\tau_{i} = \frac{grossinc_{i} - netinc_{i}}{grossinc_{i}} , \quad (19)$$

where $grossinc_i$ and $netinc_i$ are gross and net income per year. These tax rates τ_i, are regressed on a vector $z^{tax}{}_{i}$ of variables relevant for the tax code:

$$\tau_{i} = \kappa' z^{tax}{}_{i} + v_{i} , \quad (20)$$

where κ is the coefficient vector and v_i is the error term capturing specifics of the tax legislation which cannot be taken into account in this approximation.[12] The vector $z^{tax}{}_{i}$ includes polynomials of the first, second and third degree of gross yearly income to model the

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[10] To obtain consistent predictions for the squared residuals, the predicted values from the log model must be exponentiated and multiplied with the expected value of $\exp(e_{ij})$. A consistent estimator for the expected value of $\exp(e_{ij})$ is obtained from a regression of the squared residuals on the exponentiated predicted values from the log model through the origin. This procedure does not require normality of e_{ij} (see Wooldridge 2003).

[11] Respondents are asked to state their gross and net income in the week before the interview.

[12] All working respondents, no matter if full-time or part-time, provide information that is used to estimate this tax function.

non-linear nature of the tax function, a “married” dummy, additionally interacted with a “female” dummy (to account for the effect of income splitting), the number of children, a “disabled” dummy, and a “self-employed” dummy (to allow for differential tax treatment).
After this tax function is estimated, it can be used to predict average tax rates dependent on the predicted gross incomes in both the true and the counter-factual employment state and individual characteristics.[13] This allows deriving the expected value and variance of net incomes in both alternatives.

3.7 Calculation of Annuities

In the model developed above, agents considering a transition between the two employment states dependent employment and self-employment compare the expected value μ_y and the variance σ_y^2 of net income in the two alternatives. Rational agents will not only take into account next year’s returns when they consider a decision as important as starting or giving up a self-employed venture, they will rather take into account the future curves of expected income and income variance over the remaining years of their economic activity; the horizon is assumed to be reached at 65 years (the retirement age in Germany). Thus, equations (13), (18) and (20) are used to predict the expected net income and net income variance for each individual in each of the two alternative employment states for all years until the individual reaches the age of 65 by adjusting the duration in the respective employment state within the explanatory variables. Then the capital value method is applied to calculate an annuity of expected income:

$$\mu_y = \frac{q^{n_i}\left(q-1\right)}{\left(q^{n_i}-1\right)} \sum_{k=1}^{n_i} \frac{y^{net}{}_{ij,k}}{q^k}, \tag{21}$$

where q is the real interest rate plus one[14], and n_i is the number of remaining years of economic activity for individual i. The difference between net income derived from actual gross income and net income derived from predicted net income in an individual’s actual employment state j_i in the year of observation is added to $y^{net}{}_{ij,k}$ for $j=j_i$, as this residual contains additional information about an individual’s productivity in state j_i. An annuity of income variance is calculated analogously. These annuities finally enter the utility function and thus the structural transition model (9).

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[13] Predicted $y^{gross}{}_{ij}$ are hourly incomes, whereas the tax function requires yearly income. For the conversion, the average number of hours worked in the sample of full-time working people is used.
[14] The real interest rate is assumed to be 5%. The sensitivity with respect to q is tested in section 4.4.

4 Empirical Results

4.1 Expected Value and Variance of Earnings

The reduced form multinomial logit equation of selection into the different employment states (14) is estimated first. Table 1 reports the estimated marginal effects of the variables on the probabilities of the outcomes "full-time self-employment" and "full-time dependent employment" for men and women.[15] The significant marginal effects of *fatherse* indicate that the probability of being full-time self-employed is 7.2 percentage points higher for men with a self-employed father and 0.8 %-points for women. The higher probability confirms results found in the literature (e.g. Dunn and Holtz-Eakin 2000; Taylor 1996). A child significantly reduces the probability of being full-time dependently employed (21.9 %-points for women, but only 1.8 %-points for men); the probability of being full-time self-employed is not affected as much, it decreases for women whereas for men it even increases. Married men and women have a lower probability of being full-time self-employed, whereas the effect for dependent employment differs strongly between genders: Married women have an 18.8 %-points lower probability of working full-time in dependent-employment, whereas men have a 13.8 %-points higher probability.

INSERT TABLE 1 ABOUT HERE

Now the selectivity terms λ_{ij} can be calculated using (15), and the 2nd step earnings equation (13) can be estimated. The results from the earnings regressions are shown in Table 2. Unemployment experience has a significant negative effect on earnings in dependent employment and even more so in self-employment for both men and women. A university degree strongly increases earnings for men, especially in self-employment. For women, the positive effect is smaller in both employment states, and it is insignificant in self-employment. The duration of the spell in the current employment state has a positive and significant influence on earnings for self-employed and dependently employed men and for dependently employed women (the income curves over time will be discussed in detail below). The coefficient of the selectivity term λ is negative in all models, which indicates that the error terms in the selection equation (14) and the earnings equation (13) are negatively correlated. It is significant in the models of dependent employment only. Insignificant and sometimes

[15] The multinomial logit coefficients and the marginal effects for the outcome categories "part-time self-employment" and "part-time dependent employment" are available upon request.

negative selection terms in regressions of earnings from self-employment are often reported in the literature (Brock and Evans 1986; Rees and Shah 1986; Evans and Leighton 1989; Dolton and Makepeace 1990; and Borjas and Bronars 1989), suggesting that there is no significant selection on unobservables; Taylor (1996), in contrast, reports positive and significant selection effects.

INSERT TABLE 2 ABOUT HERE

Table 3 shows the estimation results of the earnings variance equation (18). For both employment states and genders, the explanatory variables are jointly significant at conventional significance levels, which confirms the hypothesis that earnings are heteroscedastic (Breusch-Pagan test). This result shows that the variance of earnings not only differs between dependent employment and self-employment, but also between individuals, dependent on their characteristics and covariates. The coefficient of the selectivity term λ is significant and positive in dependent employment, which indicates a positive correlation between the error terms in the selection and the variance equations, and insignificant in self-employment, like in the earnings regression.

INSERT TABLE 3 ABOUT HERE

Using the estimated earnings and earnings variance equations, the individual expected value and variance of gross earnings in both dependent employment and self-employment can be predicted. Before net earnings and the corresponding variance can be calculated, which are needed for the structural transition models, the tax rate function (20) must be estimated. The results of this estimation are given in Table 4. They show that the individual average tax rate increases with gross income at diminishing rates, which reflects the progressive income tax code in Germany. The coefficient of the self-employment dummy indicates that the average tax rate of the self-employed is roughly 3.4 percentage points lower than the rate of their dependently employed counterparts (see Fossen and Steiner (2006) for details on the differential tax treatment of the self-employed).

INSERT TABLE 4 ABOUT HERE

As argued in section 3.7, not only the income in the next year, but in all future years of economic activity are relevant for an individual considering a transition from dependent employment to self-employment or vice versa. The predicted gross and net hourly income curves over the duration of a spell in self-employment or dependent employment are plotted for self-employed men and women in Figure 1, and for dependently employed men and women in Figure 2 (at mean values of the other explanatory variables). The net income curves run below the corresponding gross income curves (the gap is the tax paid), and they are also flatter, which reflects the progressive income taxation in Germany. In each diagram, the income curves in the actual employment state and in the counter-factual employment state can be directly compared. For reference, the scatter dots mark the mean gross hourly incomes of people actually observed with the respective spell duration. The numbers at the dots indicate how many observations with the respective spell duration are available in the sample.

Figure 1 shows that on average, self-employed men would initially earn higher hourly gross income in dependent employment than in self-employment, but self-employment is rewarded higher for them after about 15 years. Interestingly, net income is higher for them in self-employment almost from the beginning on. This finding supports the hypothesis that higher net earnings in self-employment induce the self-employed to choose this state. The picture is similar for self-employed women, although women have to endure a considerable period of slightly lower net earnings in self-employment before these exceed the counter-factual wages from dependent employment.

INSERT FIGURE 1 ABOUT HERE

Dependently employed people would on average earn more if they were self-employed, both in gross and in net terms, as Figure 2 shows. On its own, this finding could be interpreted as a sign that earnings do not play a role in the choice of the employment state, or even of irrational behaviour. The structural model developed in this paper offers a different explanation, however: If employees do not only have a higher expected value of earnings in the counter-factual state of self-employment, but also a higher variance of earnings, it may be rational for them to choose dependent employment if they are risk-averse.

INSERT FIGURE 2 ABOUT HERE

Figure 3 and Figure 4 shed light on the variance of earnings in the two different employment states. For better comparability, the variation coefficient (the standard deviation over the mean) is plotted. Again, the curves are drawn by varying the spell duration and keeping the explanatory variables fixed at their mean values, and the scatter dots indicate the actual mean variation coefficients of earnings at the respective spell durations. The four diagrams show that the variation coefficient is larger in self-employment for all groups, i.e. for actually self-employed and dependently employed men and women, and both before and after tax. The difference between the earnings variation in self-employment and dependent employment is more pronounced for those actually dependently employed than for those actually self-employed. Thus, switching to self-employment would require the dependently employed to tolerate a much higher earnings risk, and risk aversion could explain why employees do not switch to self-employment in spite of the higher expected value of earnings.

INSERT FIGURE 3 ABOUT HERE

INSERT FIGURE 4 ABOUT HERE

4.2 Estimation Results of the Transition Models

After the individual net earnings and net variance profiles over time (till the age of 65) are summarised as annuities (see section 3.7), the structural models of transition probabilities between the alternative employment states dependent employment and self-employment (9) can be estimated. Table 5 shows the coefficients resulting from the likelihood maximisation and the marginal effects in brackets where applicable. For each gender, the model of entry into self-employment from dependent employment is shown in the left and the model of exit from self-employment towards dependent employment in the right column. A positive sign of a coefficient indicates that the corresponding variable increases the probability of a transition to the alternative employment state, and the marginal effects show by how many percentage points. A university degree, for example, increases the probability of entering self-employment ceteris paribus by 0.26 percentage points for dependently employed men.

The estimates for the structural parameters ρ and α are given at the bottom of the table. The coefficient of the risk adjusted differential between net income from self-employment and from dependent employment α is significant in all models and positive in the models of entry into self-employment and negative in the models of exit. The four models thus consistently confirm the hypothesis that a higher risk adjusted net income in self-employment in comparison to dependent employment induces people both to become and to remain self-employed as the probability of entry is increased and the probability of exit is decreased.

The coefficient of constant relative risk aversion ρ is positive in all models, indicating risk aversion, and significant except for self-employed women, for whom the null hypothesis of risk neutrality cannot be rejected. The estimated degrees of risk aversion are low for self-employed men, moderate for dependently employed men and high for dependently employed women and lie in the range reported by the literature (e.g. Holt and Laury 2002; Binswanger 1980). Considering that far more women are dependently employed than self-employed, this finding is also in line with Dohmen *et al.* (2005), who found that women are generally more risk-averse than men. Self-employed men and women are clearly less risk-averse than employees, which is consistent with the hypothesis that risk aversion deters people from choosing self-employment. The finding that self-employed women may even be risk-neutral, and thus less risk-averse than self-employed men, could be explained by the low share of the self-employed among women in Germany, which may imply that only the least risk-averse women choose self-employment.

INSERT TABLE 5 ABOUT HERE

Table 6 reports point elasticities of the transition probabilities with respect to the expected value μ_y and the variance σ_y of net income in self-employment and in dependent employment. They were calculated by evaluating the estimated structural transition model at the mean values of the independent variables. All elasticities are significant except for the variance elasticities of the probability of exit from self-employment for women. All elasticities have the expected sign, indicating that higher net earnings in self-employment in comparison to dependent employment attract people to this state, whereas higher relative variance deters people from choosing this option. For example, the leftmost column shows that a 1 % rise in the annuity of expected hourly net income in self-employment increases the probability of entering self-employment by 1.4 % if the variance and the income in dependent employment do not change. Similarly, a 1 % drop in net wages also raises the probability of entry into self-employment by 1.15 % if the prospects in self-employment are unchanged. The elasticities do not equal in absolute terms because of the different mean variance in the two employment states. If the annuity of the net hourly income variance in self-employment increases by 1 %, the probability of entry decreases by 0.16 %, and analogously, a 1 % rise in the variance of wages increases the probability of entry by 0.05 %.

INSERT TABLE 6 ABOUT HERE

4.3 Illustration: Effect of the German Tax Reform 2000

To illustrate the results given in the previous section, in the following the estimated model is used to simulate the ex-ante effects of the German Tax Reduction Act 2000 (*Steuersenkungsgesetz 2000*) on the transition rates between self-employment and dependent employment. This reform significantly reduced income tax rates in several steps between 2001 and 2005. The top marginal income tax rate dropped from 51 % in 2000 to 42 % in 2005 and the lowest marginal tax rate from 22.9 % to 15 %. Haan and Steiner (2005) calculated the relative change of net income due to the reform by income deciles using microsimulation analysis. I draw on these results to calculate the net income individuals would have received in 2000 if the full reform had already been in effect in that year. This allows comparing the transition rates predicted by the model in the reform scenario with those in the baseline scenario (using pre-reform net incomes in 2000); the difference in the transition rates is the predicted response to the reform.[16] For the 5337 individuals observed in 2000, the post-reform expected values and variances of net incomes are calculated for both alternatives self-employment and dependent employment and all future years, and lifetime annuities enter the transition models in the same way as in the baseline scenario. Table 7 reports the simulation results. Due to the tax reform, for men the predicted exit rate out of self-employment drops by almost 2 %-points, whereas the entry rate remains nearly unchanged. For women, the exit rate virtually does not react to the tax reform, but the entry rate falls by 0.3 %-points. Altogether, the tax reform promoted male self-employment and discouraged female self-employment. This finding can be explained by the gender differences in tastes for risk and returns expressed by ρ and α. On the one hand, the positive net income differential between self-employment and dependent employment increases on average due to the tax reform, which makes self-employment more attractive. On the other hand, the reform makes the tax schedule less progressive, so the extent to which the high variance of earnings from self-employment is

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[16] Income information for the year 2005 is not available in the SOEP yet, so the simulation cannot be performed after the full implementation of the reform.

levelled through taxation decreases. This discourages the more risk-averse dependently employed women from entering self-employment.

INSERT TABLE 7 ABOUT HERE

4.4 Sensitivity Analysis

A number of assumptions were made in this paper in order to take the structural model developed in section 2 to the data. This section assesses the sensitivity of the results with respect to these assumptions. Table 8 shows the structural parameters α and ρ and their robust standard errors resulting from different specifications of the models. The baseline estimation results are given in the first rows for reference. Overall, the estimated parameters are similar in the different specifications and the basic results are thus found to be robust.[17] When instead of annuities over the individually remaining economically active years only the expected value and variance of net income in the next year are used in the transition models, large standard errors result and the structural coefficients in the transition models for men become insignificant. As argued in section 3.7, it seems unlikely that agents only look at next year's income prospects when making a decision as important as a transition between dependent employment and self-employment, and it would be irrational; thus, this special estimation may not be very informative.

INSERT TABLE 8 ABOUT HERE

5 Conclusion

The results of the analysis conducted in this paper show that not only the expected value, but also the variance of an individual's future after-tax income play a role in the choice between self-employment and dependent employment. The probabilities of entry into self-employment and also of exit are in general found to be significantly elastic with respect to both the first and the second moments of net income in the two alternative employment states, and the elasticities have the expected signs: Higher expected earnings in self-employment relative to dependent employment attract people to become and to remain entrepreneurs, whereas higher

[17] The probit coefficient of the risk adjusted income differential α can be multiplied by 1.6 for a rough comparison with the logit coefficient (Amemiya 1981).

variance discourages them from choosing this option. This can also be inferred from the estimated coefficient of relative risk aversion which indicates that agents are moderately risk-averse. Women's higher risk aversion in comparison to men could be an explanation for the low share of female entrepreneurs in Germany. The finding that entrepreneurial choice is at least in part determined by a trade-off between returns and risks - in the sense of Kanbur (1982) and Khilstrom and Laffont (1979) - is further supported by the empirical analysis of incomes in dependent employment and self-employment. The estimated curves show that controlling for selection, both the expected value and the variation coefficient of hourly net earnings are on average higher in self-employment than in wage work in Germany, at least after the initial years have passed.

The estimated structural models of self-employment entry and exit are relevant for policy makers wishing to estimate the effect of changes to the progressive income tax code on self-employment. An income tax reform generally influences both the mean of net income (through the change in the individual average tax rate) and the variance of net income (through the change in the progressiveness of the tax code). The effect of a reform on the transition rates between dependent employment and self-employment can be simulated ex-ante using the estimated structural transition models. This is especially interesting if the tax reform is explicitly intended to promote the creation and survival of small businesses. The model predicts that the German Tax Reduction Act of 2000 reduced the exit rates out of self-employment for men and the entry rates for women, which in effect promoted male self-employment and discouraged female self-employment.

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Tables

Table 1: Multinomial Logit Estimation of Employment State Probabilities

Variable	Marginal Effect on Outcome Probability (Robust Standard Error)			
	Men		Women	
	Full-Time Self-Employed	Full-Time Dep. Employed	Full-Time Self-Employed	Full-Time Dep. Employed
highschool	0.0057	-0.0303	0.0069	0.0258
	(0.0026)*	(0.0057)***	(0.0014)***	(0.0072)***
apprenticeship	-0.0037	0.0864	-0.0027	0.0956
	(0.0022)	(0.0042)***	(0.0010)**	(0.0056)***
highertechncol	0.0147	0.0546	0.0044	0.0927
	(0.0028)***	(0.0040)***	(0.0013)***	(0.0072)***
university	0.0005	0.0761	0.0115	0.2503
	(0.0027)	(0.0043)***	(0.0019)***	(0.0094)***
age_bgn	0.0120	-0.0002	0.0014	-0.0062
	(0.0010)***	(0.0016)	(0.0004)***	(0.0022)**
age_bgn_sq	-0.0001	-0.0002	-0.0000	-0.0003
	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***
workexp_bgn	-0.0001	0.0082	0.0017	0.0261
	(0.0005)	(0.0009)***	(0.0002)***	(0.0011)***
workexp_bgn_sq	-0.0000	-0.0001	-0.0000	-0.0002
	(0.0000)*	(0.0000)***	(0.0000)***	(0.0000)***
unemexp	-0.0140	-0.0576	-0.0054	-0.1013
	(0.0013)***	(0.0025)***	(0.0009)***	(0.0035)***
unemexp_sq	0.0005	0.0034	0.0001	0.0058
	(0.0001)***	(0.0003)***	(0.0002)	(0.0004)***
german	-0.0005	0.0551	0.0017	-0.0121
	(0.0037)	(0.0070)***	(0.0020)	(0.0096)
disabled	-0.0208	-0.0655	-0.0098	0.0057
	(0.0025)***	(0.0076)***	(0.0011)***	(0.0102)
nchild	0.0046	-0.0175	-0.0034	-0.2187
	(0.0008)***	(0.0017)***	(0.0006)***	(0.0031)***
married	-0.0117	0.1383	-0.0055	-0.1883
	(0.0022)***	(0.0047)***	(0.0012)***	(0.0057)***
fatherse	0.0721	-0.0960	0.0083	0.0270
	(0.0048)***	(0.0071)***	(0.0019)***	(0.0081)***
Fed. state dummies	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES
constant	YES	YES	YES	YES
LR χ^2	21190.336		33341.201	
Pseudo R^2	0.252		0.224	
N	54157		63164	

The table shows the marginal effects on the probabilities of the outcome categories “full-time self-employment” and “full-time dependent employment”. For dummy variables, the change in the probability caused by a discrete change from 0 to 1 are reported. The categories “part-time self-employment” and “part-time dependent employment” are not shown for brevity. The base category is “unemployment / inactivity”. Stars (* / ** / ***) indicate significance at the 5% / 1% / 0.1% level. Source: SOEP 1984-2005.

Table 2: Regression of Hourly Gross Earnings

Variable	Coefficient (Robust Standard Error)			
	Men		Women	
	Self-employed	Dependently employed	Self-employed	Dependently employed
duration	0.594	0.315	-0.305	0.358
	(0.196)**	(0.024)***	(0.378)	(0.023)***
dur_sq	-0.021	-0.005	0.039	-0.013
	(0.014)	(0.002)**	(0.033)	(0.002)***
dur_cu	0.000	0.000	-0.001	0.000
	(0.000)	(0.000)	(0.001)	(0.000)***
highschool	-1.236	2.058	0.774	2.118
	(0.938)	(0.123)***	(1.170)	(0.087)***
apprenticeship	-1.715	0.166	-1.941	0.627
	(1.075)	(0.087)	(1.209)	(0.072)***
highertechncol	-3.561	1.110	-2.020	0.726
	(1.066)***	(0.107)***	(1.096)	(0.108)***
university	6.652	3.888	1.303	2.634
	(0.990)***	(0.147)***	(1.383)	(0.106)***
age_bgn	0.367	0.179	0.216	0.095
	(0.361)	(0.041)***	(0.397)	(0.036)**
age_bgn_sq	-0.004	0.001	-0.004	-0.001
	(0.005)	(0.001)*	(0.005)	(0.001)
workexp_bgn	0.176	-0.111	-0.067	0.074
	(0.120)	(0.019)***	(0.283)	(0.016)***
workexp_bgn_sq	-0.001	-0.002	0.004	-0.002
	(0.004)	(0.001)***	(0.006)	(0.001)**
unemexp	-1.819	-1.418	-2.993	-0.877
	(0.484)***	(0.059)***	(0.887)***	(0.075)***
unemexp_sq	0.105	0.103	0.449	0.069
	(0.053)*	(0.008)***	(0.226)*	(0.016)***
german	-2.060	0.589	4.115	0.824
	(1.185)	(0.094)***	(1.812)*	(0.091)***
disabled	0.095	-1.015	-2.987	-0.466
	(1.195)	(0.116)***	(2.765)	(0.135)***
Fed. state dummies	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES
Industry dummies	YES	YES	YES	YES
λ	-1.966	-0.642	-2.082	-0.407
	(1.475)	(0.230)**	(3.789)	(0.093)***
constant	7.217	5.523	-1.275	4.833
	(9.361)	(0.704)***	(15.583)	(0.542)***
R^2	0.186	0.370	0.285	0.313
N	3075	41365	991	22076

Stars (* / ** / ***) indicate significance at the 5% / 1% / 0.1% level. Source: Full-time self-employed and dependently employed individuals in the SOEP 1984-2005.

Table 3: Regression of Hourly Gross Earnings Variance

Variable	Coefficient (Robust Standard Error)			
	Men		Women	
	Self-employed	Dependently employed	Self-employed	Dependently employed
duration_se	-0.033	-0.019	-0.073	0.011
	(0.033)	(0.009)*	(0.071)	(0.013)
dur_se_sq	0.004	0.003	0.005	0.002
	(0.002)	(0.001)***	(0.006)	(0.001)
dur_se_cu	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)***	(0.000)	(0.000)
highschool	-0.093	0.269	0.177	0.347
	(0.137)	(0.039)***	(0.296)	(0.046)***
apprenticeship	-0.162	-0.031	-0.368	-0.041
	(0.122)	(0.034)	(0.217)	(0.042)
highertechncol	-0.306	0.209	-0.225	0.129
	(0.145)*	(0.039)***	(0.219)	(0.049)**
university	0.672	0.512	0.126	0.523
	(0.134)***	(0.046)***	(0.267)	(0.053)***
age_bgn	-0.011	0.037	-0.051	0.028
	(0.054)	(0.014)**	(0.079)	(0.017)
age_bgn_sq	0.000	0.000	0.000	-0.000
	(0.001)	(0.000)	(0.001)	(0.000)
workexp_bgn	0.008	-0.012	0.004	0.020
	(0.019)	(0.007)	(0.046)	(0.009)*
workexp_bgn_sq	0.000	-0.001	0.000	-0.000
	(0.001)	(0.000)**	(0.001)	(0.000)
unemexp	-0.244	-0.245	-0.098	-0.262
	(0.102)*	(0.026)***	(0.174)	(0.032)***
unemexp_sq	0.025	0.014	0.057	0.017
	(0.008)**	(0.003)***	(0.025)*	(0.005)***
german	-0.723	0.199	-0.978	0.239
	(0.180)***	(0.044)***	(0.345)**	(0.064)***
disabled	0.069	-0.051	-0.218	0.037
	(0.309)	(0.049)	(0.537)	(0.077)
Fed. state dummies	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES
Industry dummies	YES	YES	YES	YES
λ	-0.366	0.502	-0.451	0.298
	(0.210)	(0.092)***	(0.556)	(0.049)***
constant	4.391	-0.359	3.654	-0.656
	(1.336)**	(0.232)	(2.432)	(0.292)*
R^2	0.115	0.075	0.162	0.068
N	3075	41365	991	22076

Stars (* / ** / ***) indicate significance at the 5% / 1% / 0.1% level. Source: Full-time self-employed and dependently employed individuals in the SOEP 1984-2005.

Table 4: Regression of Average Tax Rates

Variable	Coefficient (Robust Standard Error)
grossinc_yr	0.052
	(0.002)***
grossinc_yr_sq	-0.002
	(0.000)***
grossinc_yr_cu	1.45e-5
	(0.000)***
self-employed	-0.034
	(0.002)***
married	-0.046
	(0.001)***
married x female	0.070
	(0.001)***
nchild	-0.017
	(0.000)***
disabled	-0.008
	(0.002)***
year dummies	YES
constant	0.241
	(0.003)***
mean avg. tax rate	0.328
R^2	0.250
N	83101

Stars (***) indicate significance at the 0.1% level. Source: Self-employed and dependently employed individuals in the SOEP 1984-2005.

Table 5: Maximum Likelihood Estimation Results of Structural Transition Probabilities

Variable / Structural Parameter	Coefficient / Estimated Value [Marginal Effect]			
	Men		Women	
	Dep. employment to self-employment	Self-employed to dep. employment	Dep. employment to self-employment	Self-employed to dep. employment
duration	-0.2880***	-0.4066***	-0.3531***	0.0987
	[-0.0001]	[-0.0015]	[-0.0000]	[-0.0022]
dur_sq	0.0144***	0.0190***	0.0227**	-0.0110
dur_cu	-0.0003**	-0.0002**	-0.0004**	0.0002
highschool	0.0538	-0.3701	0.4431*	0.0367
	[0.0001]	[-0.0027]	[0.0003]	[0.0021]
apprenticeship	0.6198***	0.9552***	-0.1486	-0.2523
	[0.0012]	[0.0081]	[-0.0001]	[-0.0136]
highertechncol	1.0088***	0.7288**	0.2981	-0.5878
	[0.0043]	[0.0004]	[0.0002]	[-0.0089]
university	0.6693***	-0.1735	0.0837	-1.0398***
	[0.0026]	[-0.0001]	[0.0001]	[-0.0157]
age_bgn	0.0166	-0.1965***	0.0384	-0.0930
	[0.0000]	[-0.0015]	[0.0000]	[-0.0052]
age_bgn_sq	-0.0010	0.0018**	-0.0008	0.0005
workexp_bgn	0.0165	0.0007	0.0224	-0.0013
	[0.0000]	[0.0000]	[0.0000]	[-0.0001]
unemexp	0.0544	-0.0877	0.1293	0.0173
	[0.0001]	[-0.0007]	[0.0001]	[0.0010]
nchild	0.0664	0.0470	-0.0054	-0.3061*
	[0.0001]	[0.0004]	[-0.0000]	[-0.0170]
east	0.1622	0.1353	0.4067	0.7306*
	[0.0003]	[0.0011]	[0.0003]	[0.0446]
north	-0.0900	-0.3605	-0.0967	-0.4851
	[-0.0002]	[-0.0025]	[-0.0001]	[-0.0231]
south	-0.3366**	-0.1873	0.0756	-0.2832
	[-0.0006]	[-0.0014]	[0.0000]	[-0.0147]
otherhhinc	0.0010	0.0019	-0.0149**	0.0014
	[0.0000]	[0.0000]	[-0.0000]	[0.0001]
spouse_empl	0.2986*	-0.0356	-0.1093	-0.3820
	[0.0007]	[-0.0003]	[-0.0001]	[-0.0196]
spouse_selfempl	0.6352	0.1035	1.6111***	0.9153***
	[0.0018]	[0.0008]	[0.0023]	[0.0677]
spouse_notempl	0.1831	0.3229	0.0109	
	[0.0004]	[0.0028]	[0.0000]	
constant	-4.5106***	1.9661	-5.1964***	-0.5233
ρ	0.3901***	0.1673***	1.2878***	0.0394
α	0.2625***	-0.2338***	0.1378***	-0.3742***
Wald χ^2	140.904	132.002	81.822	38.394
log likelihood	-1579.163	-522.770	-611.151	-198.612
transitions (N)	388	232	133	78
transitions (rate)	0.009	0.075	0.006	0.083
N	41365	3075	22076	945

For self-employed women in our data, an unemployed/not working husband predicted a negative outcome (no transition) perfectly, so the 46 corresponding observations and the variable *spouse_notempl* were excluded from this estimation. Stars (* / ** / ***) indicate significance at the 10% / 5% / 1% level, based on heteroscedasticity robust standard errors. Source: Full-time self-employed and dependently employed individuals in the SOEP 1984-2005.

Table 6: Elasticities of Transition Probabilities with Respect to After-Tax μ_y and σ_y

Variable: Annuity of...	Elasticity (Robust Standard Error)			
	Men		Women	
	Dep. employment to self-employment	Self-employed to dep. employment	Dep. employment to self-employment	Self-employed to dep. employment
Hourly net earnings from self-employment	1.4359	-2.4640	1.4816	-2.7238
	(0.2501)***	(0.4600)***	(0.6664)**	(0.7734)***
Hourly net earnings from dependent employment	-1.1513	1.7619	-0.0848	2.6966
	(0.2065)***	(0.4641)***	(0.0512)*	(0.8283)***
Variance of hourly net earnings from self-employment	-0.1584	0.5169	-0.6209	0.0526
	(0.0127)***	(0.0386)***	(0.3287)*	(0.0408)
Variance of hourly net earnings from dependent employment	0.0472	-0.0043	0.0041	-0.0030
	(0.0035)***	(0.0003)***	(0.0019)**	(0.0023)

The elasticities give the percentage change of the transition probabilities induced by a discrete one percent change in the annuities of expected value or variance of income from one of the two employment types, evaluated at the mean values of the explanatory variables in the sample. Stars (* / ** / ***) indicate significance at the 10% / 5% / 1% level. Source: Full-time self-employed and dependently employed individuals in the SOEP 1984-2005.

Table 7: Predicted Transition Rates in 2000 with and without Tax Reduction Act 2000

	Predicted Transition Rate in %			
	Men		Women	
	Dep. employment to self-employment	Self-employed to dep. employment	Dep. employment to self-employment	Self-employed to dep. employment
transition rate 2000	1.105	6.303	0.744	8.909
transition rate 2000 if full tax reform had been in effect already	1.110	4.340	0.440	8.923
difference (effect of tax reform)	0.005	-1.963	-0.304	0.015
N	3301	242	1722	72

All rates reported are significant at the 1% level. Source: Full-time self-employed and dependently employed individuals in the SOEP 1984-2005.

Table 8: Sensitivity Analysis of Structural Parameters in the Transition Models

Structural Parameter	Estimated Value (Robust Standard Error)			
	Men		Women	
	Dep. employment to self-employment	Self-employed to dep. employment	Dep. employment to self-employment	Self-employed to dep. employment
Main estimation				
ρ	0.390	0.167	1.288	0.039
	(0.051)***	(0.050)***	(0.229)***	(0.040)
α	0.263	-0.234	0.138	-0.374
	(0.022)***	(0.034)***	(0.025)***	(0.084)***
Exclusion of other household income				
ρ	0.390	0.168	1.287	0.039
	(0.051)***	(0.050)***	(0.219)***	(0.040)
α	0.262	-0.233	0.136	-0.374
	(0.022)***	(0.034)***	(0.023)***	(0.084)***
Exclusion of number of children, other household income and spouse's employment state				
ρ	0.394	0.167	1.213	0.042
	(0.052)***	(0.050)***	(0.240)***	(0.040)
α	0.261	-0.233	0.146	-0.367
	(0.022)***	(0.034)***	(0.027)***	(0.082)***
Exclusion of unemployment experience				
ρ	0.390	0.168	1.302	0.040
	(0.051)***	(0.050)***	(0.225)***	(0.039)
α	0.262	-0.234	0.135	-0.374
	(0.022)***	(0.034)***	(0.024)***	(0.083)***
Baseline hazard is a polynomial of forth degree				
ρ	0.390	0.166	1.284	0.039
	(0.051)***	(0.050)***	(0.224)***	(0.040)
α	0.262	-0.234	0.139	-0.374
	(0.022)***	(0.034)***	(0.024)***	(0.084)***
Probit specification of the hazard rate				
ρ	0.480		1.225	0.081
	(0.055)***	did not	(0.192)***	(0.051)
α	0.107	converge	0.068	-0.164
	(0.009)***		(0.010)***	(0.034)***
Transitions to part-time self-employment / dependent empl. counted as positive outcome				
ρ	0.389	0.175	1.233	0.068
	(0.048)***	(0.051)***	(0.199)***	(0.043)
α	0.270	-0.236	0.152	-0.362
	(0.021)***	(0.033)***	(0.024)***	(0.073)***
Real interest rate 8% (q=1.08)				
ρ	0.428	0.175	1.256	0.043
	(0.061)***	(0.046)***	(0.221)***	(0.040)
α	0.237	-0.221	0.136	-0.364
	(0.022)***	(0.031)***	(0.024)***	(0.083)***
Real interest rate 2% (q=1.02)				
ρ	0.364	0.157	1.319	0.039
	(0.045)***	(0.056)***	(0.246)***	(0.040)
α	0.288	-0.248	0.140	-0.386
	(0.022)***	(0.038)***	(0.026)***	(0.084)***
Consideration of next year's expected income only instead of lifetime annuity				
ρ	-0.489	-0.073	2.242	0.049
	(0.701)	(0.240)	(0.630)***	(0.101)
α	-0.008	-0.037	0.116	-0.310
	(0.022)	(0.051)	(0.135)	(0.075)***
Combined estimation for men and women (including dummy variable for female)				
ρ	0.477	0.123		
	(0.050)***	(0.033)***		
α	0.242	-0.256		
	(0.017)***	(0.031)***		

Stars (* / ** / ***) indicate significance at the 10% / 5% / 1% level. Source: Full-time self-employed and dependently employed individuals in the SOEP 1984-2005.

Figures

Figure 1: Predicted Hourly Earnings of the Self-employed (Euros)

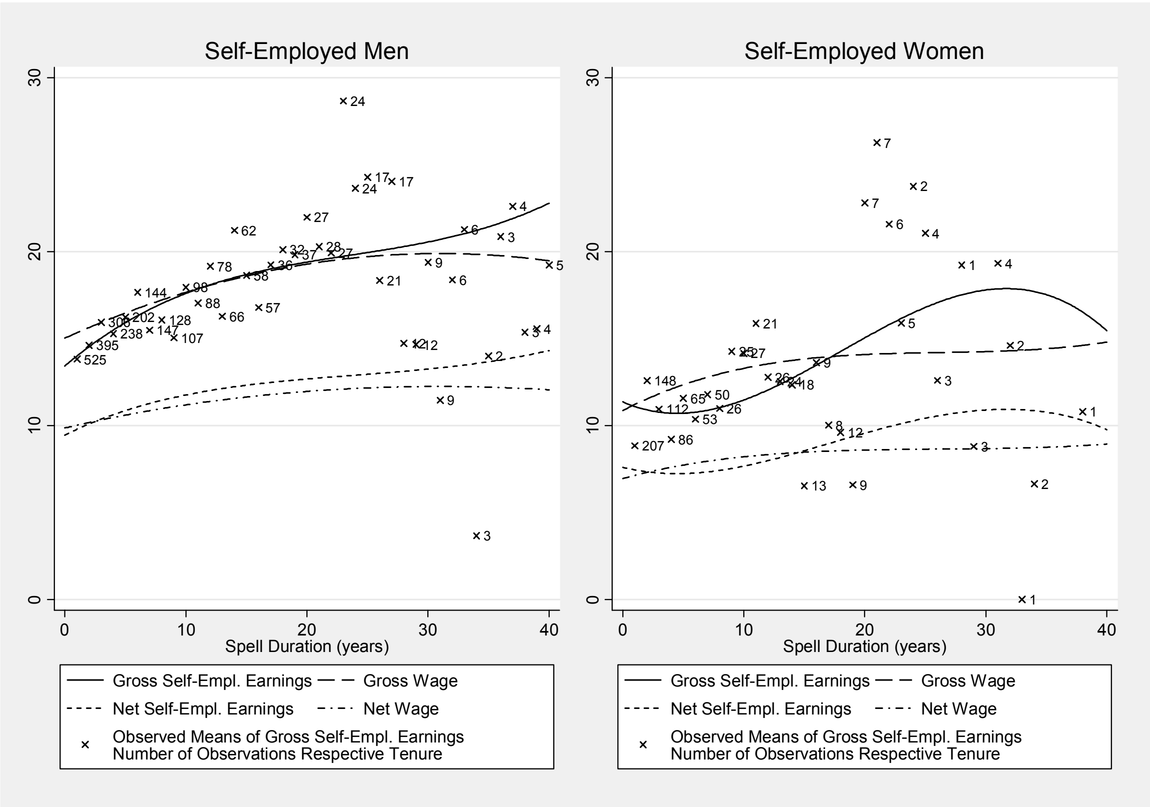


Figure 2: Predicted Hourly Earnings of Employees (Euros)

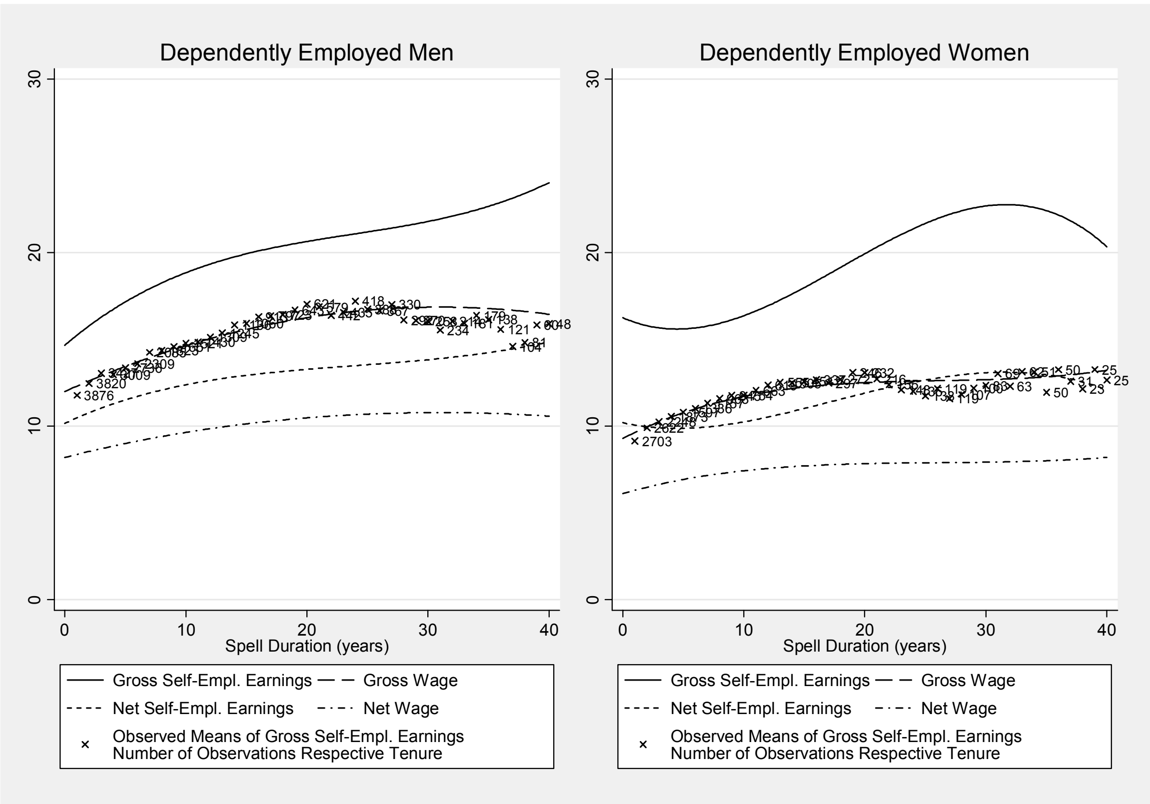


Figure 3: Predicted Variation Coefficient of Hourly Earnings of the Self-Employed

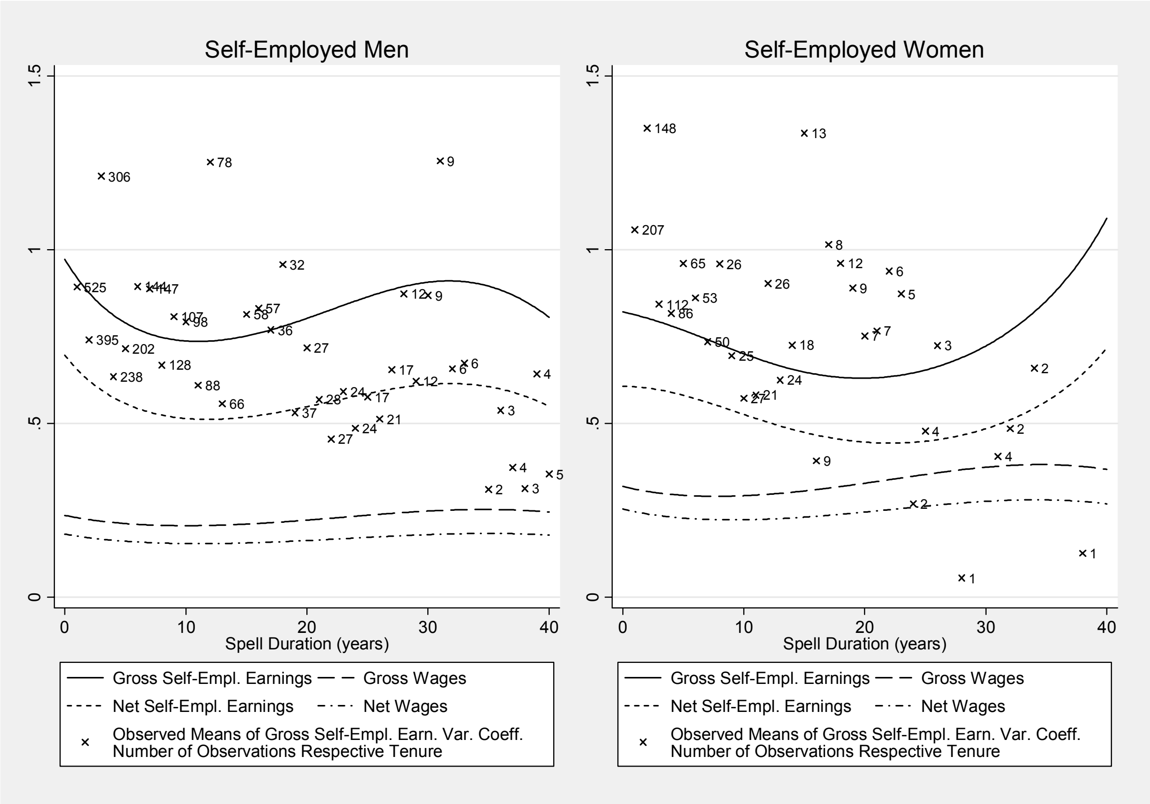
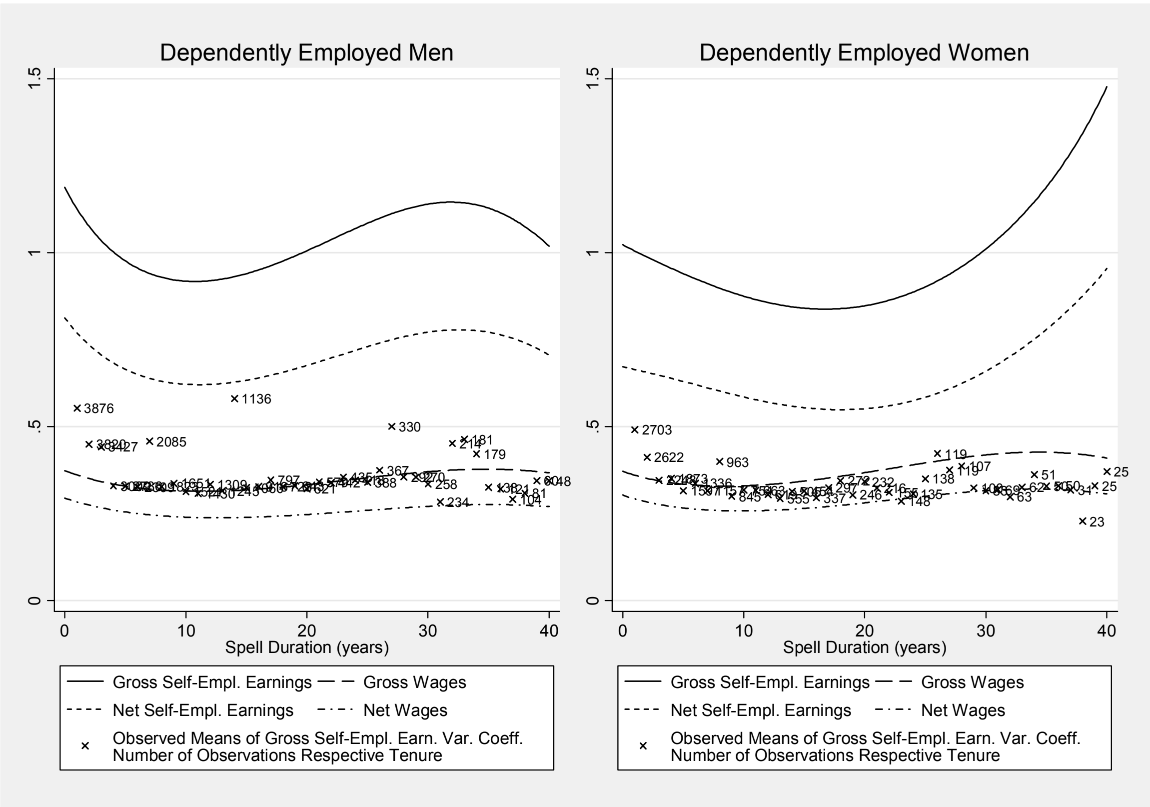


Figure 4: Predicted Variation Coefficient of Hourly Earnings of Employees



Appendix

Table A 1: Number of Person-Year Observations in the Different Employment States

Employment State Category	Men	Women
Unemployed/inactive	7976	26244
Full-time employed	41365	22076
Part-time employed	1460	13089
Full-time self-employed	3075	991
Part-time self-employed	281	764
Total	54157	63164

Source: SOEP 1984-2005.

Table A 2: Definition of Variables

Variable	Definition
duration	Duration of current spell (self-employment or employment). For left-censored spells, the duration since the last job change is reported, which may be shorter than the overall duration in the current employment state if somebody switched jobs within one of these states before entering the panel
dur_sq, dur_cu	Square and cube of duration variable
highschool	Dummy for individuals who have a high school degree ("Fachhochschulreife" or "Abitur")
apprenticeship	Dummy for individuals who finished an apprenticeship ("Lehre")
highertechnical	Dummy for individuals who finished a higher technichal college or similar ("Berufsschule", "Schule Gesundheitswesen", "Fachschule", "Meister", "Beamtenausbildung", or "Sonstige Ausbildung")
university	Dummy for individuals who have a university degree
age_bgn	Age at the beginning of the current spell in self-employment or dependent employment
workexp_bgn	Years of work experience at the beginning of the current spell
unemexp	Years of unemployement experience
nchild	Number of children under 17 in the household
east	Dummy for individuals who live in one of the 5 new eastern federal states or East Berlin
north	Dummy for individuals who live in one of the northern federal states (Schleswig Holstein, Lower Saxony, Hamburg, or Bremen)
south	Dummy for individuals who live in one of the southern federal states (Baden-Wuerttemberg or Bavaria)
female	Dummy for women
otherhhinc	Income of other individuals living in the same household per year (in € 1000)
married	Dummy for married individuals
spouse_empl	Dummy for married individuals whose spouse is dependently employed and living in the same household
spouse_selfempl	Dummy for married individuals whose spouse is self-employed and living in the same household
spouse_notempl	Dummy for married individuals whose spouse is unemployed or inactive and living in the same household
german	Dummy for individuals with German nationality
disabled	Dummy for handicapped / physically challenged individuals
fatherse	Dummy for individuals whose father is/was self-employed
grossinc_yr	Gross income per year (€ 10 000)
self-employed	Dummy for self-employed individuals

*x*_sq indicates the square and *x*_cu the cube of variable *x*. Dummy variables are equal to one if the condition holds and zero otherwise.

Table A 3: Descriptive Statistics

		Self-Employed			
		Men		Women	
Variable	Unit	Mean	Std Deviation	Mean	Std Deviation
duration	years	7.641	7.589	6.226	6.392
highschool	binary	0.349		0.306	
apprenticeship	binary	0.434		0.364	
highertechncol	binary	0.292		0.287	
university	binary	0.306		0.341	
age_bgn	years	36.838	9.204	38.532	9.567
workexp_bgn	years	13.581	9.680	13.911	9.352
unemexp	years	0.312	0.805	0.363	0.798
nchild	number	0.824	1.009	0.592	0.840
east	binary	0.228		0.386	
north	binary	0.155		0.127	
south	binary	0.264		0.210	
otherhhinc (yr)	€ 1000	12.328	30.524	15.907	20.437
married	binary	0.724		0.719	
spouse_empl	binary	0.319		0.237	
spouse_selfempl	binary	0.074		0.154	
spouse_notempl	binary	0.127		0.046	
german	binary	0.945		0.964	
disabled	binary	0.035		0.015	
fatherse	binary	0.209		0.145	
transitions (N)		232		78	
transitions (rate)		0.075		0.079	
N		3075		991	
		Dependently Employed			
		Men		Women	
Variable	Unit	Mean	Std Deviation	Mean	Std Deviation
duration	years	9.915	8.559	8.110	7.611
highschool	binary	0.215		0.200	
apprenticeship	binary	0.565		0.529	
highertechncol	binary	0.205		0.210	
university	binary	0.182		0.202	
age_bgn	years	31.043	9.402	30.692	9.284
workexp_bgn	years	9.271	9.209	8.374	8.393
unemexp	years	0.390	0.965	0.371	0.866
nchild	number	0.779	0.992	0.387	0.696
east	binary	0.244		0.358	
north	binary	0.127		0.116	
south	binary	0.286		0.243	
otherhhinc (yr)	€ 1000	12.682	20.808	16.209	20.368
married	binary	0.700		0.531	
spouse_empl	binary	0.283		0.264	
spouse_selfempl	binary	0.017		0.034	
spouse_notempl	binary	0.180		0.039	
german	binary	0.911		0.935	
disabled	binary	0.054		0.046	
fatherse	binary	0.066		0.082	
transitions (N)		388		133	
transitions (rate)		0.009		0.006	
N		41365		22076	

Standard deviations are given for continuous variables only. Source: Full-time self-employed and dependently employed individuals in the SOEP 1984-2005.