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Gender Differences in Entrepreneurial Choice and Risk Aversion – A Decomposition Based on a Microeconometric Model

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Abstract:

Why are female entrepreneurs so rare? Women have both to a lower entry rate into self-employment and a higher exit rate in Germany. To explain the gender gap, a structural microeconometric model of the transition rates is estimated, which includes a standard risk aversion parameter. As inputs into the model, the expected value and variance of earnings from self-employment and dependent employment are estimated separately by gender, accounting for non-random selection into the employment states. The gender differential in the transition rates is decomposed using a novel extension of the Blinder-Oaxaca technique for nonlinear models. Women's higher estimated risk aversion is found to explain the largest part of their higher exit rate, but only a small part of their lower entry rate.

JEL classification: J23, J16, D81

Keywords: Entrepreneurship, Self-Employment, Risk Aversion, Gender Differential, Nonlinear Blinder-Oaxaca Decomposition

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1 Introduction

In almost all OECD countries, the share of the self-employed in all employed is much lower among women than among men. The OECD averages were 18.3 % among men and only 13.4 % among women in 2007, according to the OECD Annual Labour Force Statistics. In Germany, where the overall self-employment rate is lower, the respective shares were 14.4 % versus 9.2 % (Figure 1).[2]

INSERT FIGURE 1 ABOUT HERE

The large gender difference in self-employment rates is puzzling, considering that there are reasons why self-employment may even be more attractive for women. If the well-known wage differential between men and women in dependent employment is partly explained by employer discrimination in hiring and promoting decisions, women could escape these forms of discrimination by choosing self-employment. Moreover, the greater flexibility with regard to the timing and location of work in self-employment may make self-employment comparably better combinable with child care (Budig, 2006).

The lower self-employment rate among women may be explained by discrimination from creditors and consumers against self-employed women, which may have more severe consequences than employer discrimination.[3] Higher risk aversion of women may be another explanation, as earnings of the self-employed are much more volatile than those of employees with comparable characteristics (Heaton and Lucas, 2000; Borjas and Bronars, 1989). From the literature we have considerable evidence that women are more risk averse than men (e.g. Dohmen *et al.*, forthcoming; Borghans *et al.*, 2009; Caliendo, Fossen, and Kritikos, 2009).

[2] Only in Mexico and Turkey are the female self-employment shares higher than the male shares, which may be explained by a large number of small agricultural establishments. See Blanchflower (2000) for more information on self-employment in OECD countries, including the lower female self-employment rate.

[3] Credit constraints for entrepreneurs have been discussed intensively in the literature (e.g. Hurst and Lusardi, 2004; Disney and Gathergood, 2009). It is thus plausible to think that they may be more severe for women entrepreneurs. Borjas and Bronars (1989) discuss consumer discrimination in the context of self-employed African-Americans.

A method often applied to study gender differences is the Blinder-Oaxaca decomposition approach with its variations. Georgellis and Wall (2005) used the Blinder-Oaxaca technique for logit models to analyze the lower female transition rate from salaried employment into self-employment. Fairlie (1999) applied the same method to decompose the gap between African-Americans and whites in self-employment in the U.S.A.. In these studies, the potential role of differences in risk preferences is not taken into account, however, and cannot be separated from potential lending or consumer discrimination, as explicitly acknowledged by Fairlie (1999, page 97).[4]

This paper contributes to the explanation of the gender difference in self-employment by explicitly considering the role of risk aversion. The approach is to estimate a structural microeconomeric model of entries into and exits out of self-employment, which includes the Arrow-Pratt coefficient of constant relative risk aversion (CRRA) as a parameter. This allows decomposing the gender differentials in the transition rates into three components: differences in observed endowments; differences in the econometrically estimated level of risk aversion; and differences in the other estimated coefficients, which may be related to creditor or consumer discrimination. This decomposition relies on a novel extension of the Blinder-Oaxaca technique for nonlinear models.

The structural transition models estimated in this paper are related to work by Kanbur (1982) and Kihlstrom and Laffont (1979), who modeled 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 for 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 uncertainty. Recent empirical studies found evidence

[4] Wagner (2007) analyzed the gender difference in nascent entrepreneurs based on a matching approach. He controlled for whether someone mentioned “fear of failure” as a reason for not starting an own business. While this is interesting, “fear of failure” is different from risk aversion, as it depends on the individual expected success probability.

that risk attitudes play a significant role in the decisions to become and remain self-employed (Cramer *et al.*, 2002; Caliendo, Fossen, and Kritikos, 2008 and 2009).

Thus, the microeconometric transition models take account of both the expected value and the variance of earnings in self-employment and dependent employment. In the estimation of the first and second moments of gross earnings, I control for non-random selection into the alternative employment states. Kunze (2005) pointed out the importance of selection in the analysis of gender differentials. As taxation has been shown to influence entrepreneurial choice (e.g. Schuetze, 2000; Bruce, 2002; Cullen and Gordon, 2007; Fossen and Steiner, 2009), net income is calculated from estimated gross income using an estimated tax function. 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 profiles of the future expected value and variance of net earnings over each individual's lifetime conditional on the choice to be self-employed or dependently employed. Annuities of these streams enter the structural transition model.

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 CRRA utility function, but used a simplified model without an explicit risk parameter in the estimation. Pfeiffer and Pohlmeier (1992) specified a similar model and actually estimated its parameters using the first waves of the German Socio-Economic Panel. The model did not allow for individual differences in the level of earnings risk, however. 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.[5]

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[5] Rosen and Willen (2002) used the measured level and variance of income in the two employment states to asses a theoretical model of self-employment choice, but came to the conclusion that the risk premium was too

The results obtained in this paper from estimating the transitions models indicate risk aversion and confirm the theoretical presumptions: Higher expected net earnings in self-employment relative to dependent employment are found to attract people to become and to remain entrepreneurs, whereas higher variance discourages them from choosing this option. Women are found to be more risk averse than men, which is consistent with the literature. The decomposition of the gender differentials in the transition rates yields that women's higher estimated risk aversion explains the largest part of their higher exit rate out of self-employment, but only a small part of their lower entry rate.

Section 2 of this paper develops the structural transition model. It is translated into an empirical discrete time hazard rate model in section 3.1. Section 3.2 briefly introduces the data. The methodology for the estimation of lifetime annuities of the expected value and the variance of net earnings, controlling for selection, is described in section 3.3. Section 4 presents the estimation results of the model, along with a sensitivity analysis, and the decomposition of the gender differential in the estimated transition rates. Section 5 concludes.

2 The Structural Transition Model

To analyze entrepreneurial choice, I model the decision to switch between the two states dependent employment and self-employment in a discrete time hazard rate framework.[6] This allows consistently taking into account duration dependence.[7] Transitions from dependent employment to self-employment (entry model) and transitions from self-employment to

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. A related stream of literature has analyzed the earnings differential between self-employment and dependent employment, without considering the difference in the variance of earnings. These studies include Fraser and Greene (2006) and Taylor (1996), who confirmed that higher expected earnings in self-employment relatively to paid employment significantly increase the probability of becoming self-employed; Hammarstedt (2006), who established the same result for Swedish immigrants; 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.

[6] A similar model is used in Fossen (2009) to study the effect of income taxation on entrepreneurship.

[7] Entrepreneurial exit has been analyzed similarly based on hazard rate models by Evans and Leighton (1989), Audretsch and Mahmood (1995), Taylor (1999), Tervo and Haapanen (2009), and Falck (2007), the latter using German establishment data.

dependent employment (exit model) are specified analogously; in the following, the entry model is described.

In a given period t, a dependently employed individual rationally chooses if he or she wants to remain dependently employed or switch to self-employment in the following period t+1. The agent will enter self-employment if his/her expected utility in self-employment (*se*) is higher than in dependent employment (*e*):

$$E(U_{se}(y_{i,se})) > E(U_e(y_{i,e})), \tag{1}$$

where i is an index over observations in the pooled sample of the dependently employed, $y_{i,se}$ is a person's current lifetime annuity of future net earnings from self-employment, starting from t+1, and $y_{i,e}$ is the lifetime annuity of future net wages from dependent employment. Both $y_{i,se}$ and $y_{i,e}$ are random variables because future income is risky. In this model, it is assumed that people know the probability distribution of their future income in both occupational states. The expected utility with respect to y is approximated by a second order Taylor series expansion around μ_y:

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

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 ($U''(y)<0$).[8]

The following assumes constant relative risk aversion (CRRA).[9] This implies that the utility function must satisfy

$$-\frac{yU''(y)}{U'(y)} = \rho, \tag{3}$$

[8] This general result follows directly from Jensen's inequality.
[9] Alternatively one could assume constant absolute risk aversion (CARA). The advantage of CARA utility is that a closed form representation of expected utility exists if y is normally distributed, and no Taylor approximation is needed. The literature has preferred CRRA as the more realistic specification, however (in the context of entrepreneurship, cf. Kanbur, 1982; Rees and Shah, 1986; and Pfeiffer and Pohlmeier, 1992).

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 in the two alternative employment states $j \in \{se; e\}$ to vary across observations depending on observable characteristics and covariates x_i, the duration in dependent employment d_i, and an error term ε_{ij}:

$$U_j(y_{ij}, x_i, d_i, \varepsilon_{ij}) = \begin{cases} \alpha \dfrac{y_{ij}^{1-\rho}}{1-\rho} & +\beta_j' x_i + \varphi_j(d_i) + \varepsilon_{ij}; \quad \rho \neq 1 \\ \alpha \ln y_{ij} & +\beta_j' x_i + \varphi_j(d_i) + \varepsilon_{ij}; \quad \rho = 1. \end{cases} \tag{4}$$

The parameter α>0 reflects the weight of the risk adjusted income annuity 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. 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 function φ_j describes a possibly nonlinear influence of the spell duration in dependent employment on utility in each of the two states, for instance through habituation.

The vector x_i controls for 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, 2005; Holtz-Eakin and Rosen, 2005). Furthermore, Parker (2008) and Brown *et al.* (2006) found evidence that an individual's household context has an influence on the decision to be self-employed. This is accounted for by including the marital status, the spouse's employment state, if applicable, and the income of other household members in x_i. Section 4.3 includes a sensitivity analysis with respect to the control variables.

The first and second order partial derivations of U with respect to y (suppressing subscripts j and i) are

$$\begin{aligned} U'(y,x,d,\varepsilon) &= \alpha y^{-\rho}, \\ U''(y,x,d,\varepsilon) &= -\alpha\rho y^{-\rho-1}. \end{aligned} \tag{5}$$

Plugging U'' into equation (2) yields expected utility with respect to y:

$$E(U(y,x,d,\varepsilon)) \approx \begin{cases} \alpha\left(\dfrac{\mu_y^{1-\rho}}{1-\rho} - \dfrac{1}{2}\rho\mu_y^{-\rho-1}\sigma_y^2\right) + \beta' x + \varphi(d) + \varepsilon; & \rho \neq 1 \\ \alpha\left(\ln\mu_y - \dfrac{1}{2\mu_y^2}\sigma_y^2\right) + \beta' x + \varphi(d) + \varepsilon; & \rho = 1. \end{cases} \tag{6}$$

For α>0 and $\mu_y > 0$, the equation implies that for risk-averse agents expected utility decreases with greater variance of earnings. Implicitly it is assumed that the market does not provide insurance against income risk, which is plausible given moral hazard and adverse selection. 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 he/she decides to switch to entrepreneurship is

$$\begin{aligned} &\text{Prob}(trans_i = 1 \mid y_{i,se}, y_{i,e}, x_i, d_i) = \text{Prob}(E(U_{se}(y_{i,se}, x_i, d_i, \varepsilon_{i,se})) > E(U_e(y_{i,e}, x_i, d_i, \varepsilon_{i,e}))) \\ &= \text{Prob}(\varepsilon_{i,e} - \varepsilon_{i,se} < \alpha(V(y_{i,se}) - V(y_{i,e})) + (\beta_{se} - \beta_e)' x_i + \varphi_{se}(d_i) - \varphi_e(d_i)) \\ &= F(\alpha(V(y_{i,se}) - V(y_{i,e})) + \beta' x_i + \varphi_{se}(d_i) - \varphi_e(d_i)), \end{aligned} \tag{7}$$

where $trans_i$ is a binary indicator variable that equals 1 if a transition to self-employment is observed between t and t+1, and 0 otherwise; $\beta = \beta_{se} - \beta_e$; F is the cumulative density function of the error term $\varepsilon_i = \varepsilon_{i,e} - \varepsilon_{i,se}$; and

$$V(y_{ij}) = \begin{cases} \dfrac{\mu_y^{1-\rho}}{1-\rho} - \dfrac{1}{2}\rho\mu_y^{-\rho-1}\sigma_y^2; & \rho \neq 1 \\ \ln\mu_y - \dfrac{1}{2\mu_y^2}\sigma_y^2; & \rho = 1 \end{cases} \tag{8}$$

can be interpreted as expected risk adjusted income. The probability of remaining in dependent employment is the complementary probability

$$\text{Prob}(trans_i = 0 \mid y_{i,se}, y_{i,e}, x_i, d_i) = 1 - \text{Prob}(trans_i = 1 \mid y_{i,se}, y_{i,e}, x_i, d_i) = 1 - F(\cdot). \quad (9)$$

3 Empirical Methodology

3.1 Specification of the Empirical Models

In order to estimate the parameters of the structural transition models using the maximum likelihood method, it remains to specify the functions φ_j of the duration in employment state j and the cumulative density function F of the error terms $\varepsilon_i = \varepsilon_{i,e} - \varepsilon_{i,se}$ in equation (7). The functional form of φ_j is specified as a cubic polynomial (higher order polynomials were not significant, see section 4.3):

$$\varphi_j(d_i) = \delta_{1j}\, d_i + \delta_{2j}\, d_i^2 + \delta_{3j}\, d_i^3. \quad (10)$$

It follows that

$$\varphi(d_i) := \varphi_{se}(d_i) - \varphi_e(d_i) = \delta_1 d_i + \delta_2 d_i^2 + \delta_3 d_i^3, \quad (11)$$

where $\delta_k = \delta_{k,se} - \delta_{k,e}$ for $k \in \{1;2;3\}$.

The log likelihood function for the sample of the dependently employed in the entry model can now be written as

$$\begin{aligned} \ln L = & \sum_{i=1}^{N} [trans_i \ln F\left(\alpha\left(V(y_{i,se}) - V(y_{i,e})\right) + \beta' x_i + \delta_1 d_i + \delta_2 d_i^2 + \delta_3 d_i^3\right) \\ & + (1 - trans_i)\ln\left(1 - F\left(\alpha\left(V(y_{i,se}) - V(y_{i,e})\right) + \beta' x_i + \delta_1 d_i + \delta_2 d_i^2 + \delta_3 d_i^3\right)\right)]. \end{aligned} \quad (12)$$

Following McFadden’s (1974) random utility model, the error terms $\varepsilon_{i,e}$ and $\varepsilon_{i,se}$ are assumed to be independently and identically distributed, with the type I extreme value distribution. As McFadden showed, it follows that F is the cumulative logistic probability distribution. Alternatively assuming that F is the cumulative normal distribution yields similar results (see section 4.3).

As mentioned, the exit model based on the sample of the self-employed is specified exactly analogously to the entry model.[10] The entry and exit models are estimated jointly with the same structural risk aversion parameter ρ in both models. The other coefficients are allowed to differ between the two models.

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 *d*, the model can be written as a discrete time hazard rate model where the hazard rate $\lambda_{pk}(d)$ is the probability that spell *k* of person *p* ends in period *d*, i.e. a transition occurs, conditional on survival until the beginning of *d*. The function φ is the baseline hazard in the hazard rate model. The maximum likelihood method allows consistently taking into account not only completed spells, but also both right-censored and left-censored spells in the estimation. Right-censored spells contribute to the likelihood function through equation (9). For left-censored spells retrospective employment history information in the data make it possible to recover the spell duration *d* and to include these spells consistently in the likelihood function, too (cf. Caliendo, Fossen, and Kritikos, 2008).

Before the transition models can be estimated by maximizing the likelihood function, the annuities of the expected value of net 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 section 3.3, after the data basis of this analysis is shortly described in the next section.

[10] 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 both models) is expected to be negative in the exit model. In the estimation of the parameters, α is left unconstrained, so a check if α has the expected sign in all models serves as a test for the models' consistency.

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 with detailed information about the socio-economic situation of 10,000 to 25,000 individuals living in 5,000 to 13,000 households in Germany. This analysis draws on 22 waves, starting with the first one available, from 1984 to 2005.[11] Specific groups have been oversampled in the SOEP, especially migrants (since 1994) and high-income households (since 2002). Sampling weights allow for population representative statistics. Wagner *et al.* (2007) provide a detailed description of the data.

For the purpose of analyzing transitions between employment states, 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 B 1 in Appendix B 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.

[11] The wave of 2005 is used to obtain retrospective income information for 2004 only.

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. Part-time work and non-participation are much more relevant for women than for men in Germany, which is addressed in two ways. First, a two-step procedure controls for non-random selection into the full-time working categories (see section 3.3). Second, in a robustness check, transitions into part-time dependent employment or self-employment are taken into account as well. The results remain largely unchanged (see section 4.3).

In the sample of full-time working individuals, the unweighted (weighted) male self-employment rate is 6.9 % (6.8 %), whereas the female rate is only 4.3 % (4.1 %). The yearly transition rate from dependent employment into self-employment as a percentage of the dependently employed is 0.94 % (0.95 %) for men and 0.6 % (0.65 %) for women. The yearly transition rate from self-employment to dependent employment as a percentage of the self-employed is 7.5 % (6.9 %) for men and 7.9 % (8.9 %) for women. Thus, the lower self-employment rate among women is explained both by a lower entry rate and a higher exit rate, where the gender difference in the entry rate is much larger in relative terms. Table B 3 in Appendix B 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 B 2. All monetary variables are deflated by the Consumer Price Index (2001 = 100).

3.3 Estimation of Annuities of the Expected Value and the Variance of Net Earnings

This section outlines the estimation strategy for the annuities of the expected value of net earnings μ_y and the variance of net earnings σ_y^2 in the two alternative states self-employment and dependent employment. The estimations are conducted separately for men and women because of the well documented differences in male and female wage equations.

A two-step procedure is applied to control for selection effects in the earnings and variance regressions. People self-select into 5 possible employment states: 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 based on a multinomial logit model:

$$\mathrm{Prob}(J_i = j | z_i) = \frac{\exp(\gamma_j' z_i)}{\sum_{k=1}^{5} \exp(\gamma_k' z_i)}, \qquad (13)$$

where γ_j are the coefficient vectors[12] and z_i is the vector of regressors. This vector consist of the variables z_i^{earn} used in the earnings regression (see below), excluding spell duration, and for identification, it additionally includes variables indicating a self-employed father,[13] the number of children, and the marital status.[14] The Hausman specification tests do not indicate a violation of the assumption of independence from irrelevant alternatives. After estimation of the selection model an individual sample selection term λ_{ij} is calculated for the two employment states of interest $j \in \{se; e\}$ (full-time), which enters the earnings and the variance equations (cf. Maddala, 1983, pp. 275-278).

For each observation in the sample the expected net income must be estimated for the two alternative states self-employment and wage employment. Hourly gross earnings from dependent employment (using the sample of the full-time dependently employed) and from

[12] γ_j is normalized to 0 for the base category *j*=”unemployment/inactivity”

[13] 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), 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.

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

self-employment (using the full-time self-employed) are regressed on a vector of demographic and human capital and work related variables z_i^{earn}:

$$y_{ij}^{\ g} = \theta_j' z_i^{earn} + \sigma_j \lambda_{ij} + u_{ij}\,, \tag{14}$$

where y_{ij}^{g} are hourly gross earnings[15] of person-year observation i in employment state $j \in \{se;e\}$, θ_j is the coefficient vector, $\sigma_j \lambda_{ij}$ controls for selection (see above), and u_{ij} is the error term. Conceptually, human capital variables clearly determine gross earnings, not net earnings, as the latter depend on the tax legislation. Thus, gross earnings are estimated here, and net earnings are derived subsequently (see below). The variables vector z_i^{earn} 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 income enter the structural transition models, for identification some variables should be included in the earnings, but not in the transition equations. This paper follows Fraser and Greene (2006), Taylor (1996), and Rees and Shah (1986), by including industry dummies, which are well proven determinants of earnings, in z_i^{earn} only.[16]

Additionally to the expected earnings, the variance of earnings is also required to estimate the transition models. The variance is estimated based on a flexible specification of a heteroscedasticity function. The natural logarithms of the squared residuals from the earnings estimation are regressed on the explanatory variables of the earnings model z_i^{earn} and the selection term λ_{ij} to control for selection, separately for the two employment states $j \in \{se;e\}$:

$$\ln(\hat{u}_{ij}^{\ 2}) = \pi_j' z_i^{earn} + \sigma_j^{var} \lambda_{ij} + e_{ij}\,, \tag{15}$$

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[15] 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. 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).

[16] 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.

where e_{ij} is the error term.[17] In contrast to the estimation of a population parameter, this approach allows the predicted second moment of earnings to vary not only between the states self-employment and dependent employment and by gender, but also with individual characteristics and covariates, just like the predicted first moment.

To derive net (after-tax) income from predicted 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, individual and period specific average tax rates τ_i, can be calculated:

$$\tau_i = \frac{grossinc_i - netinc_i}{grossinc_i}, \tag{16}$$

where $grossinc_i$ and $netinc_i$ are gross and net income.[18] These tax rates τ_i, are regressed on a vector z_i^{tax} of variables relevant for the tax code:

$$\tau_i = \kappa' z_i^{tax} + v_i, \tag{17}$$

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.[19] The vector z_i^{tax} includes polynomials of the first, second and third degree of gross yearly income to model the 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 conditional on the predicted gross incomes in both the true and the counter-factual employment states and on

[17] 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}.

[18] Additionally to the retrospective income questions in the SOEP, respondents are asked to state their gross and net income in the month before the interview. It is assumed that this reflects average monthly income. Taxes are levied on yearly income, of course, but a multiplication of gross and net incomes by 12 (or some other factor) is irrelevant as it would cancel out in the tax rate formula (16).

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

individual characteristics.[20] This allows deriving the expected value and variance of net income in both alternatives.

Not only one period's net income, but lifetime net income matters for the significant decision to enter or exit self-employment. This is taken into account by predicting the profiles of the future expected value and variance of net earnings over each individual's lifetime conditional on the choice to be self-employed or dependently employed. Then individual lifetime annuities of net income are computed using the net present value method:

$$\mu_y = \frac{q^{n_i}\left(q-1\right)}{\left(q^{n_i}-1\right)} \sum_{k=1}^{n_i} \frac{y_{ij,k}{}^{net}}{q^k}, \tag{18}$$

where q is the real interest rate plus one,[21] and n_i is the number of remaining years of economic activity for observation i; the individual horizon is assumed to be reached at the age of 64. The difference between net income derived from actual gross income and net income derived from predicted gross income in an individual's actual employment state j_i in the year of observation is added to $y_{ij,k}{}^{net}$ if $j=j_i$, as this difference contains additional information about an individual's productivity in state j_i. An annuity of income variance is calculated analogously.

4 Empirical Results

4.1 Net Earnings and Variance Estimation

After having estimated the gross earnings and variance equations (14) and (15), controlling for selection,[22] the expected value and the variance of gross earnings can be predicted for each

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[20] Predicted $y_{ij}{}^g$ 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.

[21] The real interest rate is assumed to be 5%. The results are not sensitive to the choice of q within a reasonable range, see section 4.3.

[22] Table A 1 in Appendix A shows that the variables used as exclusion restrictions (*fatherse*, *married*, and *nchild*) are significant in the selection equation (13). The coefficient of the selectivity term λ is negative in all earnings regressions (see Table A 2), which indicates that the error terms in the selection equation and the earnings equation (14) are negatively correlated. It is significant in the models of dependent employment only.

individual in the two alternative states self-employment and dependent employment.[23] Using the estimated tax rate function (17), net earnings and their variance can be calculated.[24] The results from these estimations are summarized in Tables A 1 through A 4 in Appendix A. The predicted gross and net hourly income profiles over the duration of a spell in self-employment or dependent employment are plotted for self-employed men and women in Figure 2, and for dependently employed men and women in Figure 3 (at the mean values of the other explanatory variables). The net income profiles run below the corresponding gross income profiles (the gap is the tax paid), and they are also flatter, which reflects the progressive income tax in Germany. In each diagram, the income profiles 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 2 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. 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.

Insignificant and sometimes negative selection terms in regressions of earnings from self-employment are often reported in the literature (e.g. 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.

[23] In the earnings variance regression (see Table A 3), the explanatory variables are jointly significant for both employment states and genders, 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 and by gender, but also between individuals, depending on their characteristics and covariates.

[24] The results from the tax rate regression (see Table A 4) show that the individual average tax rate increases with gross income at diminishing rates, which reflects the progressive income tax code in Germany.

INSERT FIGURE 2 ABOUT HERE

Dependently employed people would on average earn more if they were self-employed, both in gross and in net terms, as Figure 3 shows. On its own, this finding could be interpreted as a sign indicating that earnings do not play a role in the choice of the employment state, or even of irrational behavior. The structural model developed in this paper offers a different explanation: 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 3 ABOUT HERE

Figure 4 and Figure 5 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 profiles are predicted 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 coefficients of net earnings are smaller than those of gross earnings. This can be explained by the progressive income tax system in Germany. It can also be observed that the variation coefficient is larger in self-employment than in dependent 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 4 ABOUT HERE

INSERT FIGURE 5 ABOUT HERE

4.2 Estimation Results of the Transition Models

After the individual predicted net earnings and net variance profiles over time (till the age of 64) are summarized as annuities (see section 3.3), the structural models of transition rates between the alternative employment states dependent employment and self-employment (7) can be estimated. Table 1 shows the coefficients resulting from the likelihood maximization with their heteroscedasticity robust standard errors in brackets below. 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.

INSERT TABLE 1 ABOUT HERE

The estimated coefficient of CRRA ρ is positive and significant both for men and women, which indicates risk aversion. The estimated degree of risk aversion is low for men and higher, but still moderate, for women. The estimates are consistent with Holt and Laury (2002), who reported a range for the CRRA coefficient around 0.3-0.5. The difference between the estimated degrees of risk aversion for men and women is statistically significant. A Wald test rejects equality of the ρ parameters at the 10 % confidence level (p-value = 0.0681), based on the robust standard errors reported, and at the 5 % level (p-value = 0.0275) based on non-robust standard errors. The finding that women are more risk averse than men is consistent with the literature, as mentioned in the introduction.

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.

4.3 Sensitivity Analysis

This section assesses the sensitivity of the estimation results with respect to potentially critical assumptions made. Table A 5 in Appendix A shows the crucial risk aversion parameter ρ with its robust standard error resulting from different specifications of the transition models, separately for men and women. The baseline estimation results are redisplayed in the first rows for reference. The results indicate that ρ is robust to the exclusion of potentially endogenous variables (row 2), a more flexible specification of the baseline hazard (row 3), a different definition of the dependent variable, where transitions into part-time self-employment, or dependent employment, respectively, are additionally counted as a positive outcome (row 5), and the assumption of a real interest rate of 2 % instead of 5 % (row 6). If a probit instead of logit specification is used, the estimated degree of risk aversion is somewhat higher for men and considerably higher for women (row 4). Higher risk aversion for women also results under the assumption of a real interest rate of 8 % (row 7). The difference in risk aversion between men and women may thus rather be underestimated than overestimated in the main specification, and risk aversion may play a larger role in explaining the gender differential in the self-employment rates. The standard error of women's ρ also increases in these two specifications, however. The lower estimated value in the main specification remains within the 95 % confidence interval of the estimate reported in row (7), but not of that reported in row (4).

When instead of annuities over the individually remaining years of economic activity only the expected value and variance of net income in the next year are used in the transition models (row 8), ρ becomes insignificant for both genders, with a very large standard error for men. As argued in section 3.3, it seems unlikely that agents only look at next year's income prospects when deciding to make a transition between dependent employment and self-employment, and it would be irrational; thus, this specification may not be very informative.

4.4 Decomposition of the Gender Gap in the Transition Rates

The aim of this section is to decompose the differentials between the female and male transition rates into components explained by different endowments, as represented by the variables, by the higher risk aversion estimated for women, and by differences in the other estimated coefficients. The familiar Blinder-Oaxaca decomposition technique (Blinder, 1973; Oaxaca, 1973) is adapted in three ways. First, the variation used here takes account of the nonlinearity of the estimated transition models, similarly to Fairlie (1999, 2007), and Bauer and Sinning (2008). The observed transition rates $\overline{Y}$, i.e. the proportion of those making a transitions in the subsamples, are very close to the average predicted transition probabilities $\overline{\hat{Y}}$: The relative deviation of $\overline{\hat{Y}}$ from $\overline{Y}$ is 0.013 % for the male and 0.755 % for the female entry rate, and 0.001 % for the male and female exit rates. A nonlinear decomposition of the gender differentials in the average transition rates into two components can thus be written as

$$\overline{Y}_M - \overline{Y}_F \approx \overline{\hat{Y}}_M - \overline{\hat{Y}}_F = \left[\frac{1}{N_M} \sum_{i \in M} \hat{Y} \middle| X_i, \hat{\beta}_M, \hat{\rho}_M - \frac{1}{N_M} \sum_{i \in M} \hat{Y} \middle| X_i, \hat{\beta}_F, \hat{\rho}_F \right] + \left[\frac{1}{N_M} \sum_{i \in M} \hat{Y} \middle| X_i, \hat{\beta}_F, \hat{\rho}_F - \frac{1}{N_F} \sum_{j \in F} \hat{Y} \middle| X_j, \hat{\beta}_F, \hat{\rho}_F \right]. \quad (19)$$

N_g is the sample size for gender $g \in \{M;F\}$, X_i is the vector of variables ($\mu_i\ \sigma_i^2\ x_i'\ d_i$), $\hat{\rho}_g$ is the risk parameter, $\hat{\beta}_g$ is the vector of the remaining coefficients ($\hat{\alpha}\ \hat{\beta}'\ \hat{\delta}_1\ \hat{\delta}_2\ \hat{\delta}_3)_g$ estimated on the sub-sample of gender g, including a constant, and $\hat{Y} \big| X_i, \hat{\beta}_g, \hat{\rho}_g$ is the predicted transition probability for an individual with characteristics X_i, using the model with the estimated coefficients $\hat{\rho}_g$ and $\hat{\beta}_g$. The second summand in square brackets in the expression above is the contribution of the variables to the gender gap, and the first is the contribution of the coefficients.

A well-known issue is whether the coefficients for men or women should be used in the second summand to assess the contribution of the variables (index problem). The second adaptation of the decomposition technique is that I follow Oaxaca and Ransom (1994) and use the coefficients $\hat{\rho}_P$ and $\hat{\beta}_P$ from an estimation of the transition models on the pooled sample of men and women instead. The point estimate of the coefficient of CRRA $\hat{\rho}_P$ based on the pooled sample is 0.3779 (robust standard error: 0.0354).[25] As expected, the estimate lies in between those obtained separately for men and women. Now the first summand is split into two by first calculating the difference in the predictions between $\hat{\rho}_M, \hat{\beta}_M$ and $\hat{\rho}_P, \hat{\beta}_P$ and then between $\hat{\rho}_P, \hat{\beta}_P$ and $\hat{\rho}_F, \hat{\beta}_F$.

Finally, as the third and novel variation I further decompose the contribution of the coefficients into the contribution of the risk attitude ρ and the contribution of the other coefficients β. Using a shorter notation, a complete decomposition can be written as

$$\begin{aligned}\bar{\hat{Y}}_M - \bar{\hat{Y}}_F = & \left[\overline{\hat{Y}\middle| X_{i\in M}, \hat{\beta}_M, \hat{\rho}_M} - \overline{\hat{Y}\middle| X_{i\in M}, \hat{\beta}_P, \hat{\rho}_M}\right] + \left[\overline{\hat{Y}\middle| X_{i\in M}, \hat{\beta}_P, \hat{\rho}_M} - \overline{\hat{Y}\middle| X_{i\in M}, \hat{\beta}_P, \hat{\rho}_P}\right] + \\ & \left[\overline{\hat{Y}\middle| X_{i\in M}, \hat{\beta}_P, \hat{\rho}_P} - \overline{\hat{Y}\middle| X_{j\in F}, \hat{\beta}_P, \hat{\rho}_P}\right] + \left[\overline{\hat{Y}\middle| X_{j\in F}, \hat{\beta}_P, \hat{\rho}_P} - \overline{\hat{Y}\middle| X_{j\in F}, \hat{\beta}_P, \hat{\rho}_F}\right] + \\ & \left[\overline{\hat{Y}\middle| X_{j\in F}, \hat{\beta}_P, \hat{\rho}_F} - \overline{\hat{Y}\middle| X_{j\in F}, \hat{\beta}_F, \hat{\rho}_F}\right].\end{aligned} \qquad (20)$$

The 3rd summand is the contribution of the variables, the sum of the 2nd and 4th summands is the contribution of the risk attitude, and the sum of the 1st and last summands is the contribution of the remaining coefficients.

Table 2 presents the decomposition of the entry rate (left three columns) and the exit rate (right three columns) without weighting. Columns 1 and 4 show the average predicted transition rates in the entry and the exit models. Columns 2 and 5 give the differences which correspond to the five summands in equation (20), and columns 3 and 4 present these differences relative to the total gap in the male and female transition rates. The relative difference reported in row 4 is the contribution of the variables to the gender gap, the sum of rows 3 and 5 is the contribution of the estimated risk aversion parameter, and the sum of rows

[25] The full estimation results are available from the author upon request.

2 and 6 is the contribution of the other coefficients. Especially in the exit model, some of the decomposition steps change the transition rate into the direction opposite to the overall gender difference, which means the contributions of these steps to the gender gap are negative.

INSERT TABLE 2 ABOUT HERE

Table 3 summarizes the decomposition of the gender differentials in the entry and exit rates into the three components mentioned. Additionally to the unweighted decomposition, the two columns to the right present the results obtained by weighting the predicted transition rates using population weights (see section 3.2). In both the unweighted and the weighted analysis, only about 2 % of women's lower entry rate are explained by their higher estimated degree of risk aversion. About 10 % (17 %) are explained by the variables without (with) weighting. The remaining 88 % (82 %) are due to differences in the other coefficients: the same endowments make self-employment less attractive for women than they do for men. This may partly reflect creditor or consumer discrimination.

INSERT TABLE 3 ABOUT HERE

The variables, which together explain between about 10 % and 17 % of the gender gap (without / with weighting), include the estimated annuities of the expected value and the variance of earnings in both employment states. These earnings variables may themselves partly be influenced by discrimination against women. In fact, standard Blinder-Oaxaca decompositions of the gender differentials in estimated earnings (using coefficients from a pooled regression as in Oaxaca and Ransom, 1994; unweighted) yield that only 39.9 % of the gap in earnings from dependent employment and 34.2 % of the gap in earnings from self-employment are explained by observed variables. An analogous decomposition shows that just 26.1 % (22.2 %) of the gender differential in the variance of earnings from dependent employment (self-employment) are explained by the variables. Taking this into account, even less of the gender gap in the entry rate can be attributed to gender differences in endowments. The 17 % obtained from the weighted decomposition thus represent an upper bound.

In contrast to the differential in the entry rate, the higher female average exit rate out of self-employment is explained by women's higher estimated degree of risk aversion, either completely (in the unweighted decomposition) or at least to the largest part (in the weighted case). Given the gender difference in risk aversion alone, the differential in the exit rate would even be larger than the differential actually observed. This is compensated for by the other coefficients, which have the opposite effect and decrease the women's exit rate. While these general results are obtained both from the unweighted and the weighed decompositions, the effect of the risk attitude is much stronger in the unweighted analysis. Here, given the gender difference in risk aversion alone, the differential in the exit rate would be more than three times as large as the differential actually observed.

For the interpretation of this large relative effect it is important to consider that the gender differential in the exit rate is relatively small, however: The unweighted female exit rate is only 4.3 % higher than the male exit rate, whereas the unweighted female entry rate is 36.3 % lower (this is calculated from the figures in the first and last rows of columns 1 and 4 in Table 2). As the gender differential in the entry rate is much larger in relative terms than the differential in the exit rate, the results from the decomposition of the entry rate are more relevant for the explanation of the gender gap in the self-employment rate. The relatively small gender differential in the exit rate may also explain why the estimates from the decomposition of the exit rate are less robust to weighting than the estimates from the decomposition of the entry rate.

5 Conclusion

The self-employment rate among women is much lower than among men in almost all OECD countries. In Germany, women's lower self-employment rate is due both to a lower entry rate and – to a smaller extent – to a higher exit rate. This paper investigated the role played by gender differences in the degree of risk aversion. The gender differentials in the transition rates between dependent employment and self-employment, and vice versa, were decomposed into components explained by 1. differences in observable endowments, 2. differences in the econometrically estimated coefficient of constant relative risk aversion (CRRA), and 3. differences in other estimated coefficients.

To achieve this, a structural microeconometric model of the transition probabilities including the parameter of CRRA was estimated. The estimation results from this model show that not only the expected value, but also the variance of an individual's future after-tax income play a significant role in the choice between self-employment and dependent employment. Higher expected net earnings in self-employment relative to dependent employment attract people to become and to remain self-employed, whereas higher variance discourages them from choosing this option. The estimated coefficient of CRRA indicates that men and women are moderately risk averse, and women are significantly more risk averse than men. The estimated structural transition model was then used as the basis for a non-linear Blinder-Oaxaca decomposition.

The result from the decomposition of the gender differential in the entry rate into self-employment is that only about 2 % of the gap are due to women's higher level of risk aversion. Considering potential discrimination effects on expected earnings, less than 17 % of the differential are explained by gender differences in endowments. The largest part of the lower female entry rate thus remains unexplained and may potentially, at least in part, be attributed to creditor or consumer discrimination against self-employed women.

In contrast to the differential in the entry rate, the largest part of the higher exit rate of women out of self-employment is explained by their higher level of risk aversion. The remaining coefficients even reduce the gender gap. The gender differential in the exit rate is much smaller in relative terms than the differential in the entry rate, however, and thus contributes less to the gender differential in the self-employment rate.

Understanding the causes of the low female self-employment rate is important for the design of appropriate policies. Policymakers may aim to increase female entrepreneurship for efficiency reasons, if discrimination against women leads to a sub-optimal allocation. If not discrimination, but gender differences in risk preferences lead to the unequal self-employment rate, government intervention may not be required for efficiency reasons, but may still be desired to reach equality targets.

As women's higher risk aversion and gender differences in endowments only explain a small part of the lower female entry rate into self-employment, the results from this analysis suggest that creditor and consumer discrimination may hinder female entry. State-subsidized credit schemes for female-led businesses in the start-up phase may thus facilitate the step into self-employment for women. As gender differences in risk aversion are found to be the primary reason for the higher female exit rate, further subsidized credit schemes targeted at already established female-led enterprises do not seem to be required. If policymakers want to reduce the female exit rate, risk-sharing offered by the government, e.g. through taxation, may be a suitable instrument to encourage female entrepreneurs to stay self-employed. Comparing the instruments, subsidized credit schemes for female-led start-up firms are more likely to increase women's self-employment rate, as the gender differential in the entry rate is much larger in relative terms, and are also more likely to increase efficiency. Further research is necessary to investigate how much of the large unexplained part of the gender differential in the entry rate found here is due to creditor and consumer discrimination.

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Tables

Table 1: Maximum Likelihood Estimation Results of Structural Transition Probabilities

Variable / Structural Parameter	Coefficient / Estimated Value (Robust Standard Error)			
	Men		Women	
	Dep. employment to self-employment	Self-employment to dep. employment	Dep. employment to self-employment	Self-employment to dep. employment
CRRA coefficient ρ	0.3215		0.5560	
	(0.0376)***		(0.1229)***	
α	0.2894	-0.1728	0.2646	-0.1040
	(0.0200)***	(0.0173)***	(0.0385)***	(0.0312)***
duration	-0.2756	-0.4455	-0.3490	0.0075
	(0.0555)***	(0.0716)***	(0.1010)***	(0.1216)
dur_sq	0.0139	0.0210	0.0223	-0.0052
	(0.0047)***	(0.0051)***	(0.0089)**	(0.0105)
dur_cu	-0.0002	-0.0003	-0.0004	0.0001
	(0.0001)**	(0.0001)***	(0.0002)**	(0.0002)
highschool	0.1032	-0.2798	0.4444	0.0495
	(0.2137)	(0.2684)	(0.2502)*	(0.3361)
apprenticeship	0.6657	1.0243	-0.0559	0.0689
	(0.1800)***	(0.2986)***	(0.2452)	(0.3495)
highertechncol	1.0809	0.8438	0.2796	-0.6303
	(0.1971)***	(0.3196)***	(0.2826)	(0.4488)
university	0.5989	-0.1926	0.0924	-0.8285
	(0.2201)***	(0.3051)	(0.2873)	(0.4169)**
age_bgn	0.0179	-0.1912	0.0314	-0.0799
	(0.0509)	(0.0695)***	(0.0775)	(0.0896)
age_bgn_sq	-0.0010	0.0018	-0.0007	0.0004
	(0.0007)	(0.0009)**	(0.0010)	(0.0011)
workexp_bgn	0.0123	-0.0115	0.0239	0.0022
	(0.0240)	(0.0317)	(0.0230)	(0.0263)
unemexp	0.0507	-0.0932	0.1650	-0.1180
	(0.0663)	(0.1048)	(0.0928)*	(0.1718)
nchild	0.0802	0.0953	0.0038	-0.3243
	(0.0587)	(0.0963)	(0.1477)	(0.1866)*
east	0.1916	0.1556	0.3899	0.5226
	(0.1571)	(0.2232)	(0.2694)	(0.3406)
north	-0.1321	-0.3483	-0.1246	-0.3544
	(0.1986)	(0.2972)	(0.4320)	(0.5182)
south	-0.3420	-0.1349	0.0698	-0.3054
	(0.1549)**	(0.2230)	(0.3000)	(0.4386)
otherhhinc	-0.0023	0.0015	-0.0141	0.0025
	(0.0036)	(0.0013)	(0.0068)**	(0.0063)
spouse_empl	0.2232	-0.1332	-0.0910	-0.5214
	(0.1515)	(0.2130)	(0.2739)	(0.3939)
spouse_selfempl	0.5500	0.0276	1.4605	1.2113
	(0.4150)	(0.3554)	(0.3186)***	(0.3188)***
constant	-4.6632	2.0283	-5.3738	-0.0682
	(0.9053)***	(1.3404)	(1.3391)***	(1.8956)
Wald χ^2	130.967		47.111	
log likelihood	-2110.833		-845.224	
N	44440		23067	

Stars (* / ** / ***) indicate significance at the 10% / 5% / 1% level, based on heteroscedasticity robust standard errors. Source: Own calculations based on the SOEP 1984-2005, full-time self-employed and dependently employed individuals.

Table 2: Decomposition of Gender Differential in Transition Rates (%, unweighted)

	Dep. employment to self-employment			Self-employment to dep. employment		
	Average predicted entry rate	Difference	Difference in percent of the total difference	Average predicted exit rate	Difference	Difference in percent of the total difference
(1) Men, model: men	0.9379			7.5446		
(2) Men, model: pooled, risk parameter: men	0.8267	0.1112	32.70	7.3052	0.2394	-73.41
(3) Men, model: pooled	0.8312	-0.0045	-1.32	7.6252	-0.3200	98.13
(4) Women, model: pooled	0.7978	0.0334	9.82	7.6207	0.0045	-1.38
(5) Women, model: pooled, risk parameter: women	0.7872	0.0106	3.13	8.4316	-0.8109	248.62
(6) Women, model: women	0.5979	0.1892	55.67	7.8708	0.5608	-171.95
Total		0.3400	100.00		-0.3262	100.00

Source: Own calculations based on the SOEP 1984-2005, full-time self-employed and dependently employed individuals.

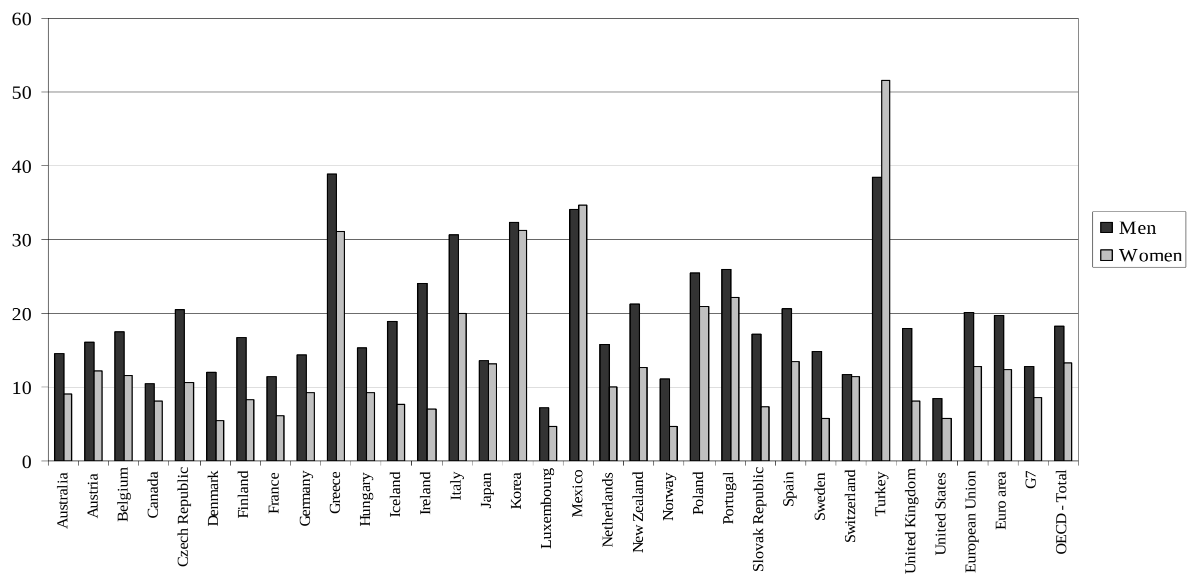
Table 3: Decomposition of Gender Differential in Transition Rates (%) – Summary

	Unweighted		Weighted	
Contribution to the gender gap of…	Dep. empl. to self-employment	Self-employment to dep. empl.	Dep. empl. to self-employment	Self-employment to dep. empl.
Variables	9.82	-1.38	16.63	88.29
Estimated coeff. of risk aversion	1.81	346.74	1.71	126.93
Other coefficients	88.37	-245.36	81.66	-115.22
Total	100.00	100.00	100.00	100.00

Source: Own calculations based on the SOEP 1984-2005, full-time self-employed and dependently employed individuals.

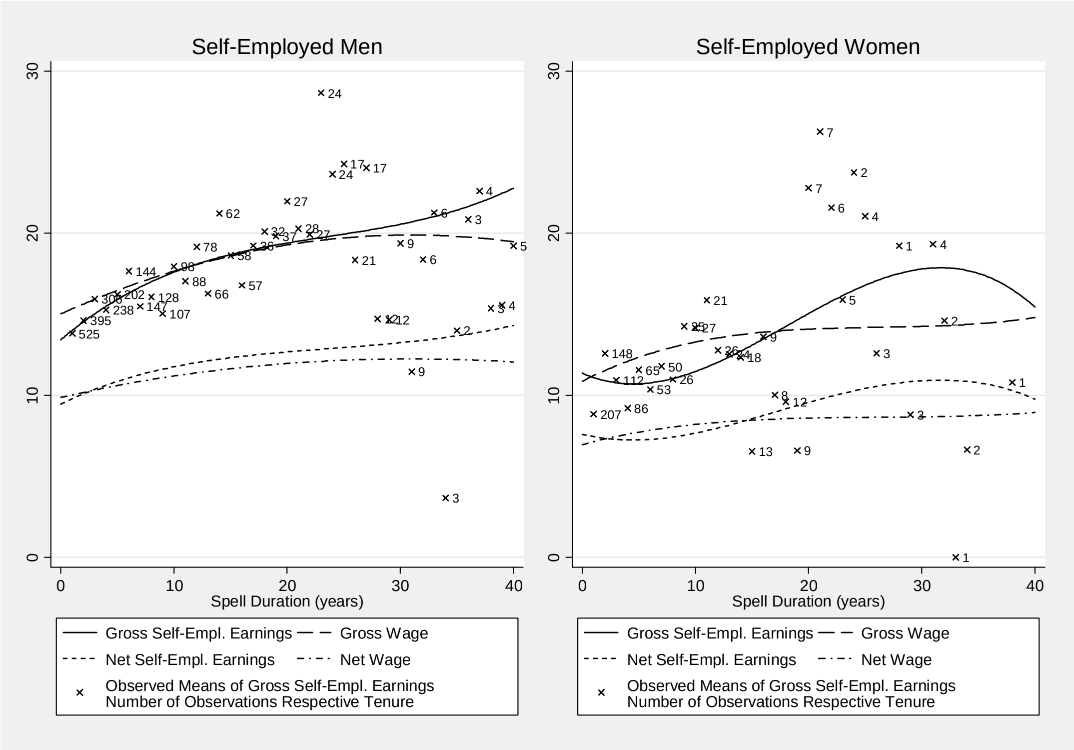
Figures

Figure 1: Share of the Self-Employed in Employed Men and Women in OECD countries (%)



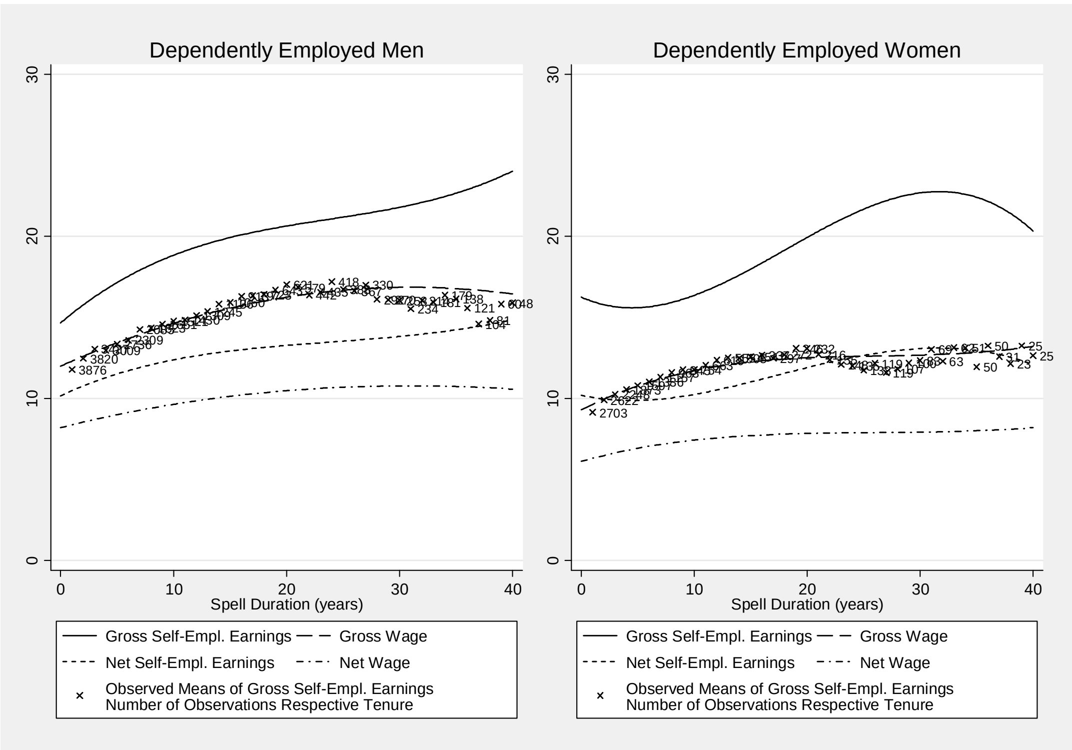
Source: Annual Labour Force Statistics, OECD (2009).

Figure 2: Predicted Hourly Earnings of the Self-employed (Euros)



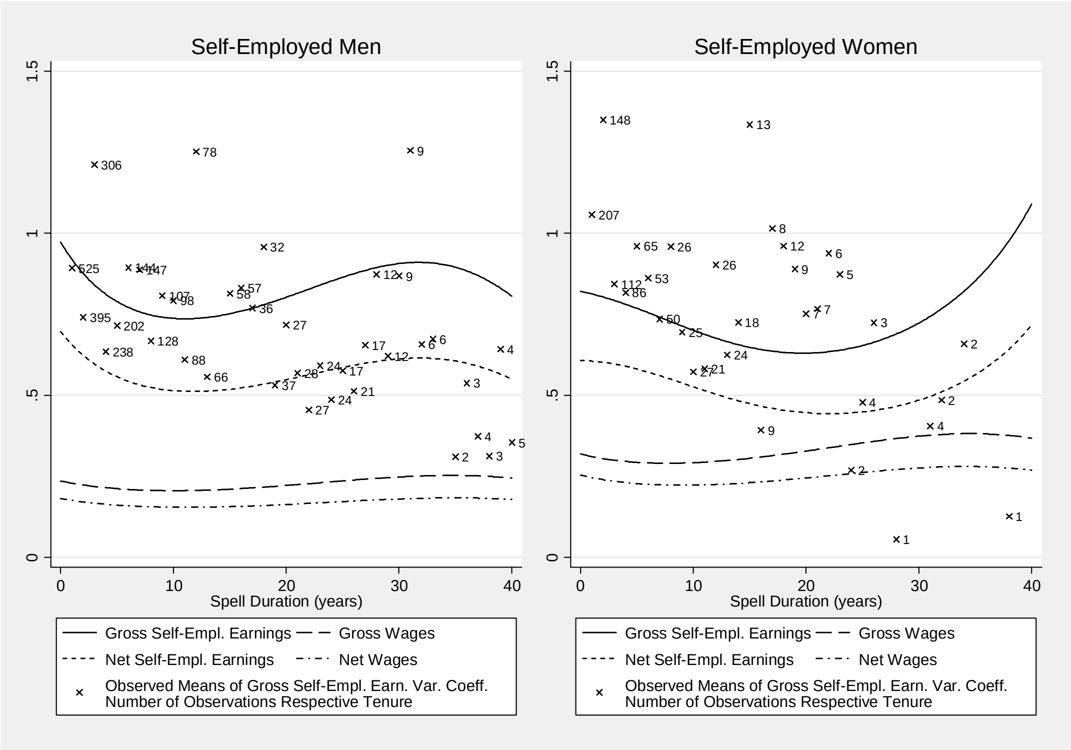
Source: Own calculations based on the SOEP 1984-2005, full-time self-employed individuals.

Figure 3: Predicted Hourly Earnings of Employees (Euros)



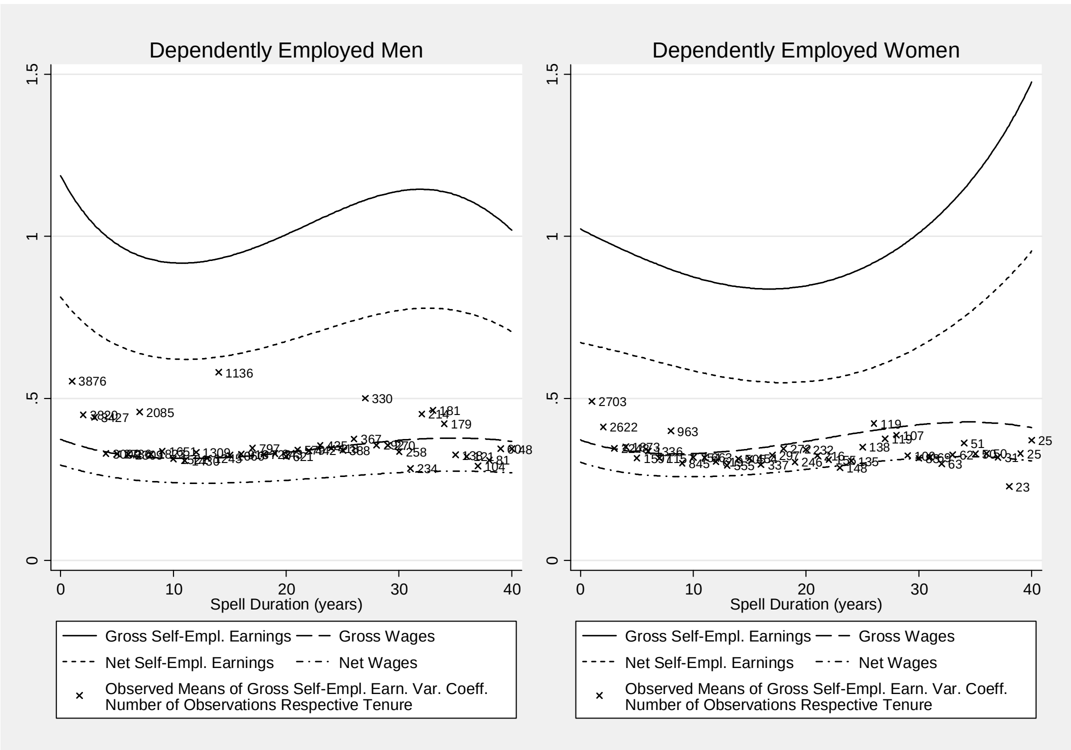
Source: Own calculations based on the SOEP 1984-2005, full-time depend. empl. individuals.

Figure 4: Predicted Variation Coefficient of Hourly Earnings of the Self-Employed



Source: Own calculations based on the SOEP 1984-2005, full-time self-employed individuals.

Figure 5: Predicted Variation Coefficient of Hourly Earnings of Employees



Source: Own calculations based on the SOEP 1984-2005, full-time depend. empl. individuals.

Appendix A: Supplementary Estimation Results

Table A 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 and available upon request. The base category is "unemployment / inactivity". Stars (* / ** / ***) indicate significance at the 5% / 1% / 0.1% level. Source: Own calculations based on the SOEP 1984-2004.

Table A 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: Own calculations based on the SOEP 1984-2005, full-time self-employed and dependently employed individuals.

Table A 3: Regression of Hourly Gross Earnings Variance

Variable	Coefficient (Robust Standard Error)			
	Men		Women	
	Self-employed	Dependently employed	Self-employed	Dependently employed
duration	-0.033	-0.019	-0.073	0.011
	(0.033)	(0.009)*	(0.071)	(0.013)
dur_sq	0.004	0.003	0.005	0.002
	(0.002)	(0.001)***	(0.006)	(0.001)
dur_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: Own calculations based on the SOEP 1984-2005, full-time self-employed and dependently employed individuals.

Table A 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: Own calculations based on the SOEP 1984-2004.

Table A 5: Robustness of the Risk Aversion Parameter in the Transition Model

	Specification	Men CRRA coeff. ρ	Std Error	Women CRRA coeff. ρ	Std Error
(1)	Main estimation	0.3215	(0.0376)***	0.556	(0.1229)***
(2)	Exclusion of number of children, other household income and spouse's employment state	0.321	(0.0378)***	0.4965	(0.0810)***
(3)	Baseline hazard is a polynomial of forth degree	0.3209	(0.0375)***	0.5571	(0.1245)***
(4)	Probit specification of the hazard rate	0.4098	(0.0403)***	1.1169	(0.2077)***
(5)	Transitions to part-time self-employment / dependent empl. counted as positive outcome	0.3266	(0.0368)***	0.5309	(0.0877)***
(6)	Real interest rate 2 %	0.3072	(0.0368)***	0.5254	(0.0886)***
(7)	Real interest rate 8 %	0.3376	(0.0398)***	1.1305	(0.3346)***
(8)	Consideration of next year's expected income only instead of lifetime annuity	-0.2505	(0.4041)	-0.0042	(0.0071)

Stars (* / ** / ***) indicate significance at the 90% / 95% / 99% level. Source: Full-time self-employed and dependently employed individuals in the SOEP 1984-2005.

Appendix B: Descriptive Statistics and Variable Definitions

Table B 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: Own calculations based on the SOEP 1984-2004.

Table B 2: Definition of Variables

Variable	Definition
duration	Duration of current spell (self-employment or employment) in years. 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
highschool	Dummy indicating a high school degree ("Fachhochschulreife" or "Abitur")
apprenticeship	Dummy for having finished an apprenticeship
highertechnical	Dummy for having finished a higher technical college or similar
university	Dummy indicating 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 unemployment experience
nchild	Number of children under 17 in the household
east	Dummy indicating residence in one of the 5 new eastern federal states or East Berlin
north	Dummy indicating residence in one of the northern federal states (Schleswig Holstein, Lower Saxony, Hamburg, or Bremen)
south	Dummy indicating residence 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 indicating 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 (in € 10 000)
self-employed	Dummy indicating self-employment

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 B 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: Own calculations based on the SOEP 1984-2004, full-time self-employed and dependently employed individuals.