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Abstract

As a new approach we study individual wage compensations due to income risks measured by the variance and skewness of the wage distributions in different occupational groups. Using German administrative panel data and estimating a fixed effects model we confirm the expected positive effect of the variance and the negative effect of the skewness on individual wages.

JEL Classification: J30, J31.
Keywords: Wage compensation, income risk.

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1 Motivation

Portfolio theory predicts that risk averse individual demand higher expected mean incomes for higher income risks. More precisely, risk averse individuals dislike the variance of an income distribution (Arrow, 1965; Pratt, 1964) but like their skewness (Kimball, 1990). When income risk is modeled with measures of dispersion of the wage distribution the variance and the skewness should be considered.

There established a literature which models income risk via the measures of dispersion of wage distributions. One strand of this literature focus on income risk in the context of the decision on investing in education (Hartog and Vijverberg, 2007). These studies compare a certain income now with a stochastic income after finishing education. Empirically, they use a two stage approach to calculate measure of dispersion in an occupational (Hartog *et al.*, 2003) or an educational group (Diaz-Serrano *et al.*, 2008) as risk measures for the stochastic income.

Another strand of literature interprets income risk more generally as an uncertainty in the labor market. These studies measure income risk via the dispersion of the wages in different occupations (King, 1974; Johnson, 1977) or via the dispersion of the individual wage over a certain time period (Feinberg, 1981; Moore, 1995). We contribute to the latter literature and use the second and third moment of the wage distribution in an occupational group as risk measures. An occupational groups is formed by occupations with similar education and field of activity.[1]

Using German administrative panel data (BA-Employment Panel) we assess quarterly wage distributions for 86 occupational groups from 2000 to 2007. As a new approach we study the variation of the second and third moment of the wage distributions over time. Using these risk measures and variety of control variables we estimate individual wages with a fixed effects model for men and women in Eastern and Western Germany. We find, as expected, a positive effect of the second moment but a negative effect of the third moment. Both effects are stronger for men and are mostly stronger in Western

[1] We follow the revised classification of occupations 1988 of the Statistics of the German Federal Employment Agency (2009).

Germany.

2 Theory

To illustrate the effect of income risk on individual wages we show a portfolio model for the labor market.[2] Individuals can choose between two kinds of jobs: one with a certain income Y_c and another one with a stochastic income Y_s. The expected value of the stochastic income $E[Y_s] = \mu_s$ is a mark-up $(1-\delta)^{-1}$ of the certain alternative:

$$E\left[Y_s\right] = \mu_s = (1-\delta)^{-1} Y_c \text{ with } \delta \in]0,1[. \tag{1}$$

Individuals are identical and risk averse. Risk aversion requires a strictly concave utility function of income with positive but decreasing marginal utility. To be indifferent between the two jobs, the expected utility U of both incomes has to be equal:

$$E\left[U(Y_s)\right] = U(Y_c) = U\left[(1-\delta)\,\mu_s\right]. \tag{2}$$

The markup factor δ determines the risk compensation an individual demands to be indifferent. To derive the equilibrium δ as a function of relative risk aversion R and the relative prudence P equation (2) is extended with a third order Taylor series expansion at point μ_s:

$$\delta = \frac{1}{2}\frac{E\left[(Y-\mu_s)^2\right]}{\mu_s^2}R - \frac{1}{6}\frac{E\left[(Y-\mu_s)^3\right]}{\mu_s^3}RP \tag{3}$$

with

$$R = -\frac{U''(\mu_s)}{U'(\mu_s)}\mu_s \text{ and } P = -\frac{U'''(\mu_s)}{U''(\mu_s)}\mu_s.$$

$U'(\mu_s), U''(\mu_s)$ and $U'''(\mu_s)$ represent the first, second and third derivatives of the utility function at point μ_s. Because of the strict concavity of the utility function R and P are positive and constant. To derive an estimation equation we linearize (1) by taking

[2] We simplify the model of Hartog and Vijverberg (2007) and apply it in a more general sense.

the natural logarithm:

$$E(\ln Y_s) = \ln Y_c - \ln(1-\delta) \tag{4}$$

Using the fact that for very small values $-\ln(1-\delta) \approx \delta$ holds (3) and (4) deliver:

$$E(\ln Y_s) = \ln Y_c + \frac{1}{2}\frac{E\left[(Y-\mu_s)^2\right]}{\mu_s^2} \cdot R - \frac{1}{6}\frac{E\left[(Y-\mu_s)^3\right]}{\mu_s^3} \cdot RP \tag{5}$$

Equation (5) shows the effect of the variance $E\left[(Y-\mu_s)^2\right]$ and skewness $E\left[(Y-\mu_s)^3\right]$ on the expected value of the stochastic wage. Individuals want to be compensated for a higher variance but are willing to accept a lower wages as the skewness increases.

3 Empirical strategy

Equation 5 show the risk aversion and skewness affection of people via a simple portfolio approach. Given this context, we argue that individual wages respond to a change of the second and third moment of the wage distribution in the relevant labor market. We follow the literature and see the occupational group as the relevant labor market (Fahr and Sunde, 2009). With a certain vocational training or field of study people work in several occupations but they are all mainly in one occupational group.[3] For example a construction engineer may work as a land surveyor but not as an economist or a chef.

We determine the wage distributions of 86 different occupational groups, separately for men and women in Eastern and Western Germany, at certain points of time and calculate the second and third moment. To identify the effect these income risk measures (standard deviation *sd* and skewness *skew*) on individual wages, we estimate the following model:

$$\ln(wage_{ijt}) = c + \beta_1 \ln(sd_{jt}) + \beta_2 \ln(skew_{jt}) + \beta_k X_{it} + a_i + T_t + \lambda_j + u_{ijt}. \tag{6}$$

[3] Actually, the occupational groups are formed as groups of occupations with similar training or field of study. We use the classification of the Statistics of the German Federal Employment Agency (2009).

The logarithmic value of individual i's wage in the occupational group j at time t is denoted $\ln(wage_{ijt})$ and is estimated through a constant c, the logarithmic value of the standard deviation $\ln(sd_{jt})$, the logarithmic value of the skewness $\ln(skew_{jt})$ as well as with a set of control variables.[4] We control for observable individual heterogeneity X_{it} (age, age^2, employment status and job tenure within a firm), unobservable individual fixed effects a_i, time fixed effects T_t (year and quarter dummies) and fixed effects for every professional group λ_j. The error term is u_{ijt}.

To identify gender and region specific effects we estimate the model (6) separately for men and women in Eastern and Western Germany. All models are estimated with a heteroscedasticity robust fixed effects approach with clustered standard errors at individuals.

4 Data

We use the BA-Employment Panel 1998 - 2007 (Federal Employment Agency of Germany, 2008): an administrative and representative two-percent sample of all employees subject to social insurance contribution (employed and unemployed) in Germany.[5]

The data provides extensive information on individual level: wage, sex, age, employment status, type of employment, occupation, job tenure within a firm. All information is collected at the end of each quarter. Because of missing unemployment information prior to 2000 we build a balanced panel from the first quarter 2000 to the fourth quarter 2007 including all people who were in that period continuously part of the labor force and working full-time when employed. The employees are grouped into 86 different occupational groups (Statistics of the German Federal Employment Agency, 2009).

We calculate real wages using the German Harmonized Index of Consumer Prices (German Federal Statistical Office, 2012). Age increases in years and job duration in quarters. The employment status of an employee is unskilled blue collar worker, skilled

[4] To ensure positive values of $\ln(sd_{jt})$ we add one to every sd_{jt} before calculating the logarithmic values. To ensure positive values of $\ln(skew_{jt})$ we add the absolute value of the minimum $skew_{jt}$ and one before calculating the logarithmic values.

[5] A detailed description of the data is provided by Schmucker and Seth (2009).

blue collar worker, foreman or white collar worker.

Because of structural differences we split our sample into Eastern and Western Germany. The segmentation is based on the job location. To eliminate implausible outliers and to avoid a high mass of observations at the upper ceiling up to which social security contributions has to be paid we truncate the top and bottom 5-percentile of each wage distribution.[6] As a robustness check we estimate our models with the non-truncated data. The estimation results remain stable.

Under these constraints our data include 136,481 men and 87,065 women in Western Germany and 26,650 men and 27,579 women in Eastern Germany.

5 Results

We confirm a positive effect of the standard deviation and a negative effect of the skewness of a wage distribution of an occupational group on individual wages. This implies risk compensation in individual wages and thus in mean wages. The positive effect of the standard deviation as well as the negative effect of the skewness can be identified for men and women and in Eastern and Western Germany (table 1).

Risk aversion and skewness affection are higher for men in both parts of Germany. Although women are thought to be more risk averse than men (Berkhout *et al.*, 2010; Jianakoplos and Bernasek, 1998) this may be because men may assert their wage claim better. Gender specific occupational choice is still persistent. Men often work in occupations which can be found in very productive industries (automotive industry or financial services) whereas women often work in occupation of the service sector, health care sector or public sector (Beblo *et al.*, 2008; Dolado *et al.*, 2003).

Except for the women's skewness affection all effects are lower in Eastern Germany. This may reflect that it is more difficult for the workers to enforce risk compensations in Eastern Germany. This is due the labor market is much tighter as well as the productivity are lower than in Western Germany (Blien *et al.*, 2010; Gorzig *et al.*, 2010). Both factors weaken the bargaining position of the workers in Eastern Germany.

[6] Wages above that ceiling are reported voluntary and set to the ceiling value when not reported.

Table 1: Estimation results for men and women in Eastern and Western Germany

Dependent variable: ln(wage)	Western Germany		Eastern Germany	
	men	women	men	women
ln(sd)	0.3576***	0.2733***	0.2422***	0.1657***
	(0.0033)	(0.0143)	(0.0080)	(0.0129)
ln($skew$)	-0.2099***	-0.1273***	-0.1715***	-0.1302
	(0.0048)	(0.0104)	(0.0095)	(0.0096)
age	0.0288***	0.0173***	0.0245***	0.0233***
	(0.0003)	(0.0006)	(0.0008)	(0.0010)
age^2	-0.0003	-0.0002***	-0.0003***	-0.0003***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
job tenure	0.0014***	0.0016***	0.0018***	0.0015***
	(0.0000)	(0.0000)	(0.0000)	(0.0001)
unskilled blue collar worker	-0.0460***	0.0441***	-0.0329***	-0.0113*
	(0.0023)	(0.0042)	(0.0053)	(0.0063)
skilled blue collar worker	-0.0389***	0.0341***	-0.0334***	-0.0055
	(0.0021)	(0.0052)	(0.0047)	(0.0054)
foreman	0.0114***	0.0342*	0.0183**	0.0638***
	(0.0033)	(0.0183)	(0.0086)	(0.0195)
constant	2.2500***	2.2955***	2.3623***	2.3085***
	(0.0293)	(0.0789)	(0.0441)	(0.0545)
R^2 (within)	0.1105	0.0309	0.0706	0.0431
R^2 (overall)	0.2462	0.0783	0.2392	0.1182
observations	4,045,937	2,526,791	748,849	772,485
individuals	136,481	87,065	26,650	27,579

*** p<0.01, ** p<0.05, * p<0.1, robust standard errors in parentheses. All models are estimated with fixed effects for individuals, time and professional groups. White collar worker are the reference groups.

Source: author's calculations

6 Conclusion

Using German administrative data we find evidence for a compensation of income risks in individual wages. As a new approach we study the impact of income risk on individual wages via the variation of the standard deviation and skewness of the wage distributions of 86 different occupational groups over time.

Estimating a fixed effects model we confirm the positive effect of the standard deviation and the negative effect of the skewness on individual wages for men and women in Eastern and Western Germany. The effects are stronger for men and mostly stronger in Western Germany.

The general insight of this study is that people respond to changes in the wage distribution of their professional group.

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