SFB 649 Discussion Paper 2011-074

Time-Varying Occupational Contents: An Additional Link between Occupational Task Profiles and Individual Wages

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This research was supported by the Deutsche Forschungsgemeinschaft through the SFB 649 "Economic Risk".

http://sfb649.wiwi.hu-berlin.de
ISSN 1860-5664

SFB 649, Humboldt-Universität zu Berlin
Spandauer Straße 1, D-10178 Berlin

Time-Varying Occupational Contents: An Additional Link between Occupational Task Profiles and Individual Wages

by

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October 31, 2011

Abstract

By analyzing occupational task profiles, an occupational change can be split up into two components: (1) transferability of task portfolios between occupations and (2) change in the value of the occupation-employee match. Extending the task-based approach of Gathmann and Schönberg (2009) by relaxing their assumption of time-invariant occupational contents, I estimate the association of dynamic aspects of occupational task portfolios with individual wages for medium-skilled German workers in 1991 and 1998. Estimated wage returns to the components of an occupational change generally differ in short and long run, as well as in East and West Germany. Wage returns to the changes of task porfolios for the occupational stayers are estimated to be positive.

JEL-Classification: J24, J62, I21, O39.

Keywords: Human capital, wage premium, occupational change, task-based approach.

[†]I gratefully acknowledge financial support by the German Research Foundation through the SFB 649 "Economic Risk", and through the Research Network "Flexibility in Heterogeneous Labor Markets". The data used in this paper have been obtained from the German Zentralarchiv für Empirische Sozialforschung at the University of Cologne (ZA). The data were collected by the Bundesinstitut für Berufsbildung (BIBB) and the Institut für Arbeitsmarkt- und Berufsforschung (IAB) and documented by the ZA. Neither the producers of the data nor the ZA bear any responsibility for the analysis and interpretation of the data in the paper.
I thank Michael Burda, Jan Peter aus dem Moore, Juliane Scheffel, Alexandra Spitz-Oener and Hanna Wielandt for their helpful comments. All mistakes are mine.
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1 Introduction

As the seminal study of Autor et al. (2003) documents, the demand for different skills has shown vivid dynamics both within and between industries since 1960s. Moreover, as Kambourov and Manovskii (2009) and Poletaev and Robinson (2008) show, changes in skill portfolios on an individual level have a stronger effect on wages than a mere change in industry/occupational affiliation. In my paper I address changes in task portfolios that are associated with an occupational change and their association with individual wage. Following the task-based approach as in the study of Gathmann and Schönberg (2009), I disentangle the following components of an occupational change: (1) transferability of human capital across occupational groups based on similarity of skill portfolios and (2) changes in the value of the occupation-employee match. For the calculation of the task portfolios, I rely on the model proposed by Gathmann and Schönberg (2009), extending their approach by relaxing the assumption on time-invariant occupational contents. Thus, I contribute to the existing literature by directly accounting for time-variant occupational contents within a Mincerian-type wage regression for both occupational movers and stayers.

The phenomena of job and occupational mobility are widely studied in the labor market literature using the concepts of human capital, as well as search and matching. Independently from the theoretical approach, most studies on both voluntary and involuntary changes[1] do not account for similarity of the contents of the new and the previous employment due to the lack of the appropriate data. Nevertheless, the general idea of differentiation between job changes of various complexity dates back at least to the overview on the phenomenon of the labor mobility by Parnes (1954). The author distinguishes *simple* job changes when the worker

[1] See, e.g. Addison and Portugal (1989), Carrington (1999), Harhoff and Kane (1993), Werwatz (1997), Acemoglu and Pischke (1998), Franz and Zimmermann (1999), Burda and Mertens (2001), Couch (2001).

only changes the employer without changing the task content of the employment from *complex* shifts that occur when both the employer and the tasks performed in the job are changed. A formal realization of differentiation of job changes by their complexity can be found in McCall (1990) and Neal (1999). Based on the detailed data on occupational contents, the strand of task-based literature has emerged. Employing information on the tasks performed in an occupation, it became possible to quantify the similarity of occupation, like in the studies of Poletaev and Robinson (2008) and Gathmann and Schönberg (2009).

Allowing for time-variant occupational contents for occupational stayers and looking at the remuneration to their adjustment to altering occupational contents sheds additional light on the link between occupational tenure and individual wages. The theoretical link between wages and tenure in a job or occupation was established by Becker (1975), who has postulated that there should be an "effect of the productive process itself on worker productivity". However, the general discussion in the literature on *job* tenure[2] is inconclusive of whether job tenure positively affects wages. Projecting this discussion on the link between wages and occupational tenure, I empirically show one of the channels why *occupational* tenure is positively associated with wages. Namely, the more the task portfolios within an occupation have changed over time, the higher is the wage remuneration of the employees in this occupation.

The analysis presented in this paper is based on the German Qualification and Career Survey (QCS), which contains detailed information on the tasks performed by the respondents in their respective occupations. QCS is one of the most prominent data sets for the research using the task-based approach; just to name a few studies using on the QCS data: DiNardo and Pischke (1996), Spitz-Oener (2006), Antonczyk et al. (2009), Borghans et al. (2009).

My paper analyzes the impact of occupational changes on wages of medium-skilled workers

[2]E.g. as summarized in Altonji and Shakotko (1987), Altonji and Williams (2005).

in Germany taking account of the transferability of human capital across different occupations, as well as values of occupation-employee mathes and permanently changing occupational skill portfolios. An additional facet of the study comes from the comparison of the occupational change components in East and West Germany. The empirical analysis based on the task-based decomposition of the components of an occupational change provides supporting evidence to the standard theoretical models. The regression estimation shows that both the occupational change itself and the extent to which occupational content changes matter to explain individual wages. The occupational change as such is associated with higher wages for the West-German employees both in the short and in the long run. This confirms that by an occupational change a better match between the employee and his occupation can be achieved. For the East-German subsample, the respective coefficient is nearly zero and insignificant. As for the extent to which task contents change when an occupational change occurs, the estimation confirms the hypothesis that the higher the differences in the occupational contents, the higher the fraction of human capital (and, therefore, wages) that is lost. East German sample exhibits similar pattern as West-German counterpart in this case. The adjustment of skills when staying in an occupation creates a positive payoff for the West-German subsample. In East Germany the same association is estimated to be slightly negative, though insignificant, in the short run, and positive in the long run. The positive coefficient of such a skill adjustment is in line with the human capital theory that predicts that accumulation of specific human capital becomes rewarded by increasing wages.

Although the differences in the coefficients for West and East Germany are statistically insignificant, they are very insightful and deserve to be discussed in detail. The differences generally result from the institutional backgrounds of the GDR and the FRG economies. However, in the long-run analysis most of the period of interest falls into the post-reunification

period, i.e. into the time when West-German institutions became dominant in East Germany. Accordingly, the long-term evidence for East Germany (as opposed to the short-term evidence) better fits the predictions of the standard labor market theories concerning returns to an occupational change.

The paper proceeds along the following lines. The next section sketches the underlying economic mechanism, whereas section 3 describes the data structure and the estimation design. Section 4 provides descriptive statistics of the data. Estimation results complemented by a subsection on heterogeneity of outcome for the group of younger employees can be found in section 5. Section 6 concludes.

2 Conceptual Framework

The economic mechanism of an occupational change considered in this section can be traced back mainly to the human capital theory and the search and matching theory.

Following Becker (1975), the human capital theory postulates the dependence of individual productivity on two components – general and specific human capital. With regard to occupational mobility, general human capital can be defined as knowledge/skills that can be transferred between occupations without loss and, hence, do not result in a wage penalty. In contrast, occupation-specific human capital is not fully transferable when an occupational change occurs. The transferability of occupation-specific human capital depends on the similarity between the source and the target occupations.[3] The more similar the occupations are, the higher the fraction of the occupation-specific human capital that will be transferred.

Assume an individual who graduated at time $t-1$ from an apprenticeship in occupation

[3] By now, the term "similarity" is used as an intuitively conceivable concept. A precise definition and discussion of similarity measures follows later in this section after the introduction of the general economic mechanism.

A_{t-1} and who at the current time point t is employed in occupation C_t. Henceforth, an occupational change is defined to have occurred when A_{t-1} and C_t do not coincide. Otherwise, no occupational change took place. First consider the case in which the occupation of the apprenticeship A_{t-1} and the current occupation C_t are not the same.

According to the theory, human capital $H(\cdot)$ used in each occupation is divided into general and specific human capital. Denote the fraction of general human capital that can be transfered from A_{t-1} to C_t by δ:

$$H(C_t) = \delta \cdot H(A_{t-1}). \tag{1}$$

The parameter δ should be naturally restricted to the interval of $[0,1]$. Moreover, this parameter increases with the similarity of occupations A_{t-1} and C_t.[4]

$$\delta = \delta(\text{similarity}(A_{t-1} \leftrightarrow C_t)), \quad \delta' > 0. \tag{2}$$

The matching theory allots a special role to the value of the match between the employee and his job. For complex (occupational) changes, one can think of a match between the employee and his/her occupation.[5] Thus, the value of the match with the occupation of apprenticeship at timepoint $t-1$ can be denoted by $M(A_{t-1})$, and the value of the match with the current occupation can be written as $M(C_t)$. It can be further assumed that being employed in more similar occupations provides more equal values of the employee-career matches. However, this last assumption cannot be incorporated in the estimation design presented in this paper.

[4]Note that, for simplicity, symmetry of the concept is assumed, i.e. for the similarity measure it would not matter whether the change has occurred from occupation $A_{(\cdot)}$ to $C_{(\cdot)}$, or from the occupation $C_{(\cdot)}$ to $A_{(\cdot)}$.

[5]For reference see e.g. McCall (1990) and Neal (1999).

Consequently, the individual's productivity (P) in the given occupation can be represented by a function of two main components – human capital (H) and the value of the occupation-employee match (M):[6]

$$P(A_{t-1}) = f(H(A_{t-1}), M(A_{t-1})) \quad \text{and} \quad P(C_t) = f(H(C_t), M(C_t)) \tag{3}$$

The respective partial derivatives $f_{H(.)}$ and $f_{M(.)}$ are assumed to be positive in accordance with economic theory: $f_{H(.)} > 0$ and $f_{M(.)} > 0$.

As the exact expressions for the three productivity components are not defined, the partial derivatives $f_{H(.)}$ and $f_{M(.)}$ can be normalized to one without loss of generality. Assuming $f(H(.), M(.))$ to be linearly homogenous in its arguments, allows the application of the Euler theorem and yields the following simplified form of the productivity functions:

$$P(A_{t-1}) = H(A_{t-1}) + M(A_{t-1}) \quad \text{and} \quad P(C_t) = H(C_t) + M(C_t) \tag{4}$$

From the perspective of time point $t-1$ it is not known what productivity can be achieved by the individual at time point t, since the components of productivity are experience goods. Ex post, the difference in productivities in the two occupations can be written as:

$$P(C_t) - P(A_{t-1}) = \big(H(C_t) - H(A_{t-1})\big) + \big(M(C_t) - M(A_{t-1})\big) \tag{5}$$

Plugging in the definition (1) yields:

$$P(C_t) - P(A_{t-1}) = (\delta - 1) \cdot H(A_{t-1}) + \big(M(C_t) - M(A_{t-1})\big) \tag{6}$$

[6]Setting up productivity as a function of several arguments raises the question of exogeneity of these arguments. The derivation is conducted for a time point after the decision on the occupational choice has been made, therefore occupation and consequently the analyzed productivity components can be treated as exogenous.

Note that the factor $(\delta - 1)$ is negative. This indicates that the specific part of human capital accumulated during an apprenticeship will not be used in the employment in a different occupation. More specifically, the terms in (6) can be intuitively described as follows:

- $P(C_t) - P(A_{t-1})$ denotes the change in individual productivilty and can be approximated by individual wage growth in the occupation C_t.
- $(\delta - 1) \cdot H(A_{t-1})$ is associated with the fraction of human capital that is transferable between A_{t-1} and C_t. Its impact on the productivity differential is the higher, the more similar the source and target occupations are.
- $M(C_t) - M(A_{t-1})$ reflects the changes in the value of the occupation-employee match between $t-1$ and t when an occupational change occurs. Assuming occupational changes to be a strategical tool in career planning, it should normally lead to a better occupation-employee match.

2.1 Similarity Measure

So far, the similarity of the occupations was mentioned without precisely defining it. Intuitively, the definition of similarity should reflect the proximity of the contents of the two occupations. In the task-based approach, the content of any occupation is defined by the composition of tasks performed in this occupation. Henceforth, the approach of Gathmann and Schönberg (2009) is used for the construction of the similarity measures.

In order to formalize the idea, each occupation is assumed to consist of J different tasks:

$$\tau_1, ..., \tau_J.$$

According to Gathmann and Schönberg (2009) the following assumptions about the tasks

are made:

- The tasks themselves are of general nature and are transferable between occupations.
- Different occupations combine tasks in different ways.

Formally, these assumptions imply that any occupation can be represented by a weighted sum of tasks $\tau_1 ... \tau_J$:

$$A_{t-1} \equiv \sum_{j=1}^{J} q_{A,j} \tau_j \quad \text{and} \quad C_t \equiv \sum_{j=1}^{J} q_{C,j} \tau_j \tag{7}$$

There are at least two ways to define how different tasks are combined in occupations. The first way is to look at the distribution of time devoted by an employee to different tasks. Then, in the expressions (7) the coefficients in front of the tasks (i.e. their weights) would sum up to one:

$$\sum_{j=1}^{J} q_{A,j} = 1 \quad \text{and} \quad \sum_{j=1}^{J} q_{C,j} = 1 \tag{8}$$

This is the preferred approach, but it is hardly implementable in applied work due to the lack of detailed data on individual time distributions across different tasks.

The approach used in this study employs dichotomic individual data on whether or not each task $\tau_1, ..., \tau_J$ is performed in order to compute the proportion of workers in each occupation who carry out the particular task. In this case, $q_{A,j}$ would denote the fraction of workers in occupation A_{t-1} performing task j. The resulting task composition constitutes a J-dimensional vector, specified for each occupation. This allows me to use distances between points associated with different occupations to construct a similarity measure.

In the subsequent analysis, similarity of occupations is measured using angular separa-

tion (or uncentered correlation) borrowed from Gathmann and Schönberg (2009), who in turn refer to this measures being most common to the literature on proximity of production technologies:

$$AngSep_{A\leftrightarrow C} = \frac{\sum_{j=1}^{J} q_{A,j} \cdot q_{C,j}}{\left[\left(\sum_{j=1}^{J} q_{A,j}^2\right)\left(\sum_{k=1}^{J} q_{C,k}^2\right)\right]^{1/2}}. \tag{9}$$

The distance measure, is then defined by $Dis_{A\leftrightarrow C} = 1 - AngSep_{A\leftrightarrow C}$. The measure varies between zero and one, taking higher values for less similar occupations.

A possible alternative distance measure can be constructed using Euclidian distances. In the following empirical analysis a measure based on Euclidian distances was employed as a robustness check and has delivered similar results.

2.2 Special Case: No Occupational Change Occurs

Up to now, A_{t-1} and C_t were assumed to represent different occupations. Now consider a special case when no occupational change occurs, i.e. A_{t-1} and C_t represent the same occupation.

Generally, this does not change the underlying economic mechanism a lot. Task content of occupations change over time, i.e. the contents of any occupation at time point $t-1$ and t are different: $C_{t-1} \neq C_t$. Thus, the vectors of task compositions change over time, which predetermines non-zero distances between the same occupations in different time periods. With regard to the previous analysis, A_{t-1} and C_t may refer to the same occupation with changing task contents.

The most radical adjustment of the model predictions for the case when no occupational change arises mainly concerns the transferability of the occupation-specific human capital. As the individual occupational attachment is not changed, changing job requirements would nec-

essarily lead to a permanent skill adjustment, which would produce additional remuneration for the employee. Thus, the term $(\delta - 1) \cdot H(A_{t-1})$ in (6) can be now associated with the skill adjustment within the occupation. To some extent this term absorbs the influence of tenure in the occupation. The term $M(C_t) - M(A_{t-1})$ becomes equal to zero under the assumption that an occupation-employee match is invariant over time. Moreover, in the empirical estimation it would be then impossible to disentangle the adjustment of the skills from the improvement of the match, if the occupation remains unchanged.

3 Data

The analysis is based on the German Qualification and Career Survey (QCS) carried out by the Federal Institute for Vocational Education and Training (BiBB) together with the Institute for Employment Research (IAB). The survey consists of several cross-sections that, amongst others, contain retrospective questions on the labor market history of the respondents.

The unique advantage of the data set for this research is that it contains detailed information on tasks performed by the respondents. This allows me to address the complexity of occupational changes and disentangle its main components, discussed in section 2:

- transferability of human capital across occupational groups based on content similarity of the current occupation and the one the respondent completed an apprenticeship in, given an occupational change occurs,
- change in the value of the occupation-employee match after an occupational change,
- over-time alteration of the average task portfolios of particular occupations, i.e. content developments of an occupation in case there occurs no occupational change after the respondent completes an apprenticeship.

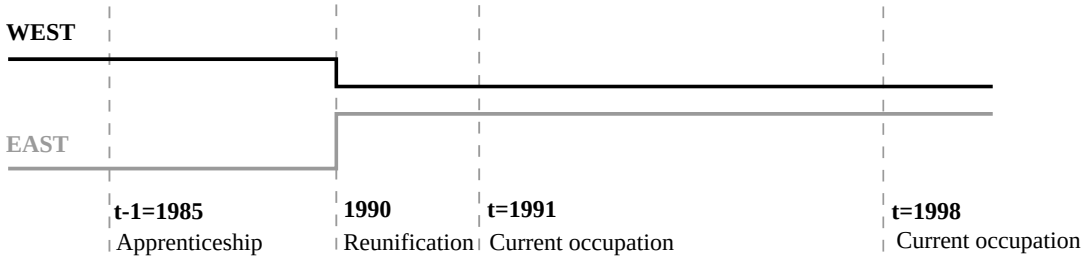


Figure 1: Schematic Representation of the Empirical Setup

For the purposes of the study, the subsequent survey waves of 1991/92 and 1998/99 are employed to assess the task content of the occupations.[7] The main estimation idea can be described as follows (see figure 1). First, the content of the current occupation is described by a vector of tasks performed by the workers of a particular occupational group. More precisely, the entries of the vector represent the fraction of respondents in a particular occupational group (according to the 3-digit occupational classification KldB88) who report to perform a particular task. This vector is constructed separately for the waves of 1991 and 1998. As the main idea is to account for the long- and short-term developments of the skill requirements of the occupations, I will examine only the respondents that have completed their apprenticeship before 1990.[8] This makes it possible to assess the task content of apprenticeships using the survey wave of 1985/86. An occupational change between $t-1$ and t is recorded, if the occupations of apprenticeship and the current employment in terms of the 3-digit KldB88 groups do not coincide.[9] The later econometric estimation of the data of 1991 will reflect

[7]The data for the survey is gathered in December and January. Henceforth, I will refer to the waves by the first year of the survey, i.e. 1991 and 1998.

[8]As it cannot be directly controlled for the occupational tenure and there are indications that some occupational changes took place before reunificaiton, the estimated coefficients cannot be directly associated with post-reunification labor market changes. By 1998, the post-reunification changes become more significant in the development of wages, i.e. the post-reunification effect plays a more significant role for the explanation of coefficient in 1998 compared to 1991.

[9]Additional test of the employed definition of an occupational change was performed using the extension of the questionnaire in the year of 1998 compared to 1991. In 1998 there is a variable on several possible apprenticeships, both completed or not completed by the respondents. Thus, the information on the contents of the occupation of the apprenticeship was constructed using information on all apprenticeships in which the respondent was trained, even if these were not completed. This information was used to run various checks

the adjustments in a short-term period, whereas the estimation of 1998 represent long-term adjustments. In order to minimize the impact of geographic mobility between East and West Germany, I exclude the respondents whose regions of training and the current employment do not coincide.

An important detail concerning the use of the survey wave 1985 from the pre-reunification period is that the sample was collected only in West Germany, which allows me to calculate task intensities of apprenticeships only for the West. The task intensities can be extrapolated on East-German apprenticeships under the assumption that the occupational contents in East and West were similar up to a constant. In the regression specification this constant difference will be captured by the dummy variable for being a resident of East Germany. The assumption of general similarity of the apprenticeship systems in East and West Germany can be supported by at least two facts. First, the analysis is restricted to the so-called accredited occupations that have standardized teaching plans and solid historical background that dates back to the medieval guild system. The phenomenon of the German apprenticeship system has emerged long before the division of Germany after World War II (see e.g. Mitter, 1990; Bundesinstitut für Berufsbildung, 2006). Thus, the institutional design of the apprenticeship systems in East and West Germany was initially the same. Moreover, another supporting argument is the fact that the apprenticeships from East Germany were generally recognized in the educational system of West Germany after reunification (Ertl, 2000).

In closing, I shortly specify the imposed sample restrictions. The sample contains only male employees with apprenticeship as the highest educational level in the so-called accredited occupations completed before reunification of 1990. Furthermore, the sample in both 1991 and

involving the minimum distance between the current occupation and the apprenticeship(s). This more precise measure however did not deliver more significant results compared to the usage of only the first apprenticeship completed by the respondent. Thus, the application of variables involving only the first completed apprenticeship in both 1991 and 1998 is legitimate.

1998 contains prime-aged (20-55) full-time workers.[10] Additionally, the sample is restricted to native Germans who did not change the region of residence (East or West Germany) during life. By doing this, the dimension of employee mobility associated with territorial moves and substantial institutional changes is for the most part switched off and the analysis focuses on the employee turnover due to occupational changes. The final sample contains about 5600 observations for 1991 and almost 3900 observations for 1998.

4 Descriptive Statistics

4.1 Statistics on Distances between Occupations

Section 2 described in detail how the idea of the distances between occupations can be brought to the data. Generally, the construction of the distance measure follows Gathmann and Schönberg (2009) with several modifications. In order to make the distance measures comparable over survey years, the number of considered tasks was reduced. The description of the tasks that enter the final task vector can be found in table 1 below. Following Autor et al. (2003), the tasks can be arranged in three broad groups — manual tasks, analytical tasks and interactive tasks; this classification is widely used in the literature on the task-based approach. However, in the following only tasks themselves will be used, not the broad categories in order to exploit the variation of the task data at maximum.

[10] Generally, such a design may be compared to a cohort study with broadly defined cohorts. As a robustness check, I have restricted the sample in 1991 to the ages between 20 and 48 and the sample in 1998 to the ages between 27 and 55. Thus, I could follow the same broad age group over years. However, the estimation results were very closed to those with the common age restriction 20 to 55 that are presented here.

Table 1: Description of the 13 Dimensions of the Task Space

Task (space dimensions)	Description based on the QCS questionnaires
Analytical tasks	
Task 1: Research, evaluate, measure	Analyze, research, test, evaluate, measure, quality control, evaluate information, develop
Task 2: Design, plan, sketch	Plan, construct, project/design, draw, usage of graphical software
Task 3: Program	Computational tasks, programming, software development, system analysis
Task 4: Execute laws, interpret rules	Execute, interpret rules or laws, legal expertise, knowledge of employment law
Manual tasks	
Task 5: Equip and operate machines	Install, setup, retool, program, control machines, automates or other equipment, usage of manually driven, semiautomatic or computer-controlled machines
Task 6: Repair, renovate, reconstruct	Repair, service machines
Task 7: Manufacture, install, construct	Manufacture, extract, process, mold materials, cook, build
Task 8: Serve and accomodate	Serve, wait, accommodate, nurse
Task 9: Pack, ship, transport	Pack, load, transport, deliver, sort/deposit, ticketing, operate vehicles
Task 10: Secure	Secure, guard
Interactive tasks	
Task 11: Sell, buy, advertise	Sell, buy, encash, communicate, customer service, negotiate, advertise, marketing, acquisitions
Task 12: Teach, train others	Educate/teach/train, mentoring help, consult, inform
Task 13: Employ, organize	Guide/instruct employees, employ, administrate, organize, coordinate, manage personell
Excluded categories compared to Gathmann and Schönberg (2009):	(1) Correct tests or data, (2) Calculate, bookkeeping; (3) Cultivate; (4) Cleaning; (5) Publish, present, entertain.

The basic summary statistics on task intensities measured by the proportion of workers performing the particular task type are reported by survey waves in table 2. On average, task intensities for all three broad task groups increase over time, although the trends for the 13 task dimensions are different and often non-monotonic. The increasing intensity of all tasks might reflect the increasing multi-task nature of occupations.

Table 2: Average Task Intensity of Occupations Measured by the Proportion of Workers Performing the Respective Task

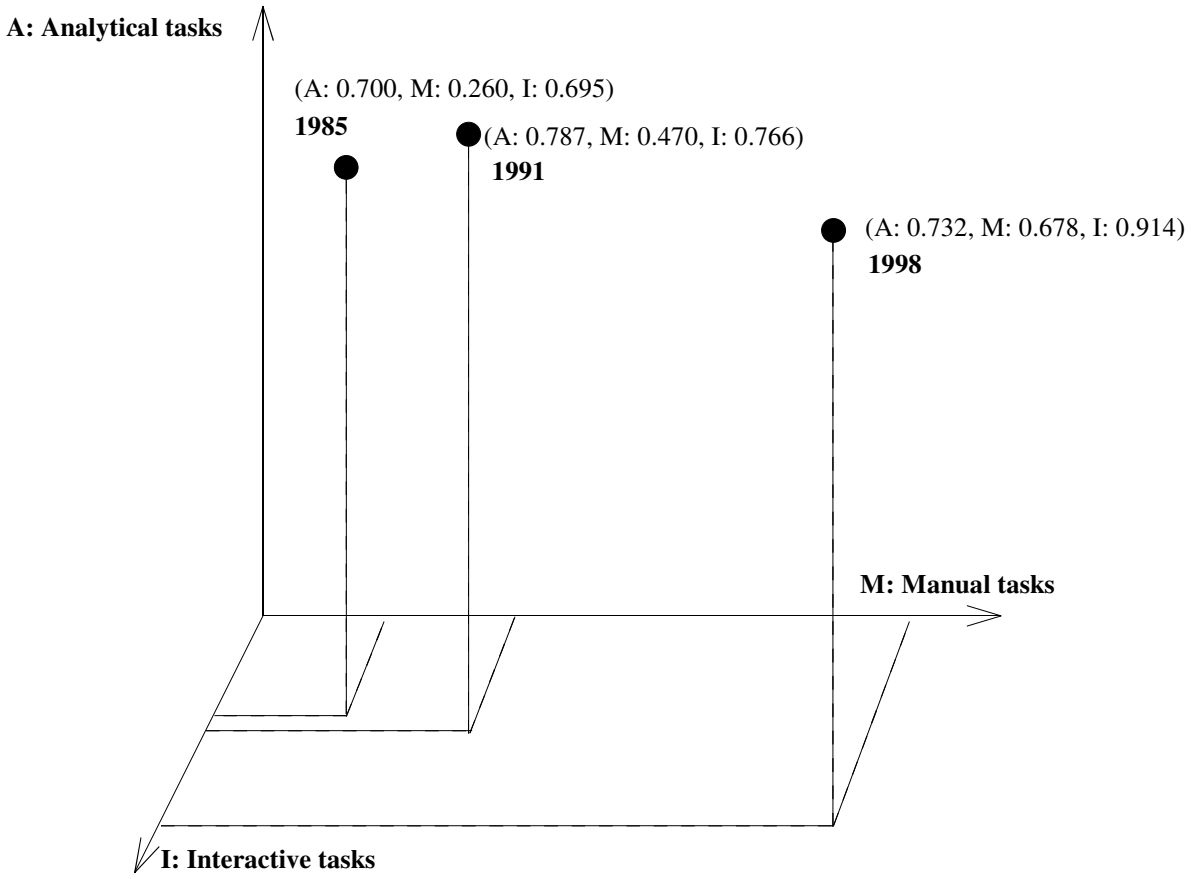
Tasks	1985	1991	1998
	Mean (St.Dev.)	Mean (St.Dev.)	Mean (St.Dev.)
Analytical tasks	0.536 (0.499)	0.633 (0.482)	0.709 (0.454)
Task 1: Research, evaluate and measure	0.366 (0.482)	0.429 (0.495)	0.637 (0.481)
Task 2: Design, plan and sketch	0.128 (0.334)	0.079 (0.269)	0.138 (0.345)
Task 3: Program	0.077 (0.267)	0.136 (0.343)	0.040 (0.195)
Task 4: Execute laws or interpret rules	0.117 (0.321)	0.227 (0.419)	0.172 (0.378)
Manual tasks	0.765 (0.424)	0.850 (0.357)	0.925 (0.263)
Task 5: Equip or operate machines	0.428 (0.495)	0.562 (0.496)	0.637 (0.481)
Task 6: Repair, renovate or reconstruct	0.439 (0.496)	0.378 (0.485)	0.445 (0.497)
Task 7: Manufacture, install or construct	0.327 (0.469)	0.299 (0.458)	0.438 (0.496)
Task 8: Serve and accommodate	0.031 (0.174)	0.015 (0.121)	0.270 (0.444)
Task 9: Pack, ship or transport	0.318 (0.466)	0.483 (0.500)	0.619 (0.486)
Task 10: Secure	0.0474 (0.213)	0.439 (0.496)	0.348 (0.476)
Interactive tasks	0.456 (0.498)	0.416 (0.493)	0.642 (0.480)
Task 11: Sell, buy or advertise	0.313 (0.464)	0.269 (0.444)	0.332 (0.471)
Task 12: Teach or train others	0.104 (0.305)	0.117 (0.321)	0.551 (0.497)
Task 13: Employ, manage personnel, organize	0.267 (0.442)	0.274 (0.446)	0.342 (0.475)
Observations	6429	5612	3895

Table 3: Average Task Intensity of Clerks

Tasks	1985	1991	1998
	Mean (St.Dev.)	Mean (St.Dev.)	Mean (St.Dev.)
Analytical tasks	0.700	0.787	0.732
	(0.458)	(0.410)	(0.443)
Task 1: Research, evaluate and measure	0.160	0.166	0.554
	(0.367)	(0.373)	(0.498)
Task 2: Design, plan and sketch	0.119	0.061	0.224
	(0.324)	(0.239)	(0.417)
Task 3: Program	0.257	0.461	0.066
	(0.437)	(0.499)	(0.249)
Task 4: Execute laws or interpret rules	0.447	0.467	0.356
	(0.497)	(0.499)	(0.479)
Manual tasks	0.260	0.470	0.678
	(0.439)	(0.500)	(0.468)
Task 5: Equip or operate machines	0.105	0.109	0.338
	(0.307)	(0.312)	(0.474)
Task 6: Repair, renovate or reconstruct	0.042	0.045	0.060
	(0.201)	(0.207)	(0.238)
Task 7: Manufacture, install or construct	0.027	0.030	0.048
	(0.162)	(0.172)	(0.214)
Task 8: Serve and accommodate	0.008	0.010	0.370
	(0.087)	(0.098)	(0.483)
Task 9: Pack, ship or transport	0.137	0.307	0.286
	(0.344)	(0.462)	(0.452)
Task 10: Secure	0.0512	0.203	0.178
	(0.221)	(0.403)	(0.383)
Interactive tasks	0.695	0.766	0.914
	(0.461)	(0.423)	(0.281)
Task 11: Sell, buy or advertise	0.453	0.488	0.566
	(0.498)	(0.500)	(0.496)
Task 12: Teach or train others	0.154	0.189	0.790
	(0.361)	(0.392)	(0.408)
Task 13: Employ, manage personnel, organize	0.384	0.522	0.524
	(0.487)	(0.500)	(0.500)
Observations	781	625	500

For a better understanding of content changes and the growing importance of multitasking, it might be informative to take a closer look at one particular occupation. Table 3 presents task intensities of clerks for 1985, 1991 and 1998. The occupation "clerk" was defined based on the 3-digit occupational classification KldB88 (namely by belonging to the occupational group

Figure 2: Illustration: Within-Occupational Changes in Task Composition for Clerks



781). The intensity of analytical tasks grew slightly from 70 to 73%. However, when looking at the detached task dimensions, the changes in distribution become more illustrative. For instance, the relative proportion of clerks performing the Task 1 "Research, evaluate, measure" has increased from 16% in 1985 and 16.6% in 1991 to 55.4% in 1998. Surprisingly, the proportion of clerks performing manual tasks rose substantially, from 26% in 1985 to 67.8% in 1998. This is mainly due to the increased frequency of the Task 5 "Equip or operate machines", but also of tasks such as Task 8 "Serve and accommodate" and Task 9 "Pack, ship and transport". Interactive tasks also became more important in the task content of a clerk, especially the Task 12 "Teach and train others". This evidence, too, illustrates the growing role of multitasking in the arrangement of office tasks between different departments.

Simplifying the task space to only three broad groups – analytical, manual and interactive

tasks – makes it possible to construct the following three-dimensional space of task categories in order to illustrate the concept of distances between the task content of clerks at different time points (see figure 2). In a similar manner, the 13-dimensional task space is used to construct the vector of tasks associated with different occupational groups and to assess the distances. The example of clerks illustrates that substantial changes regarding task content have occurred over the time span of 15 years.

The observed changes in the task intensities over the years occur mainly because the contents of particular occupations change with time. In case of clerks one can think of permanent changes of the responsibilities of the office workers – they do more multitasking, use various office appliances. Generally, more user-friendly appliances and computer use in modern offices has redistributed particular tasks over departments by changing areas of responsibility of secretaries, accountants, HR- and other office managers. Obviously, the tasks of a clerk became more interactive, which may be associated with increasing communication, both internally and externally. Additionally, the changes in the task content may be affected by measurement errors, which arise from slight inconsistency in the questionnaires over years as well as from employees' perceptions of the relevance of their responsibilities at work. For instance, as multitasking became a phenomenon broadly discussed in media, the respondents in later waves might tend to report all possible tasks they perform, whereas the respondents of earlier waves might focus more on the "main" tasks typical for their occupation.

The percentages of occupational movers and stayers for 1991 and 1998 (compared to the occupation of apprenticeship) on the 3-digit level of KldB are provided in table 4. The numbers show that occupational mobility in the East was on average higher than in the West. About 40% of men in West Germany have changed the occupation in 1991 compared to their apprenticeship; in 1998 the number of movers rose to nearly 44%. In contrast, the percentage

of the occupational movers in East Germany was 53.4% in 1991 and 60% in 1998.

Table 4: Fractions of Occupational Stayers and Movers by Year and Region

	1991		1998	
	West	East	West	East
Stayers	60.8	46.6	56.4	39.9
Movers	39.2	53.4	43.6	60.1
Total	100	100	100	100
N	4284	1328	3041	854

Table 5: Mean Distances and Standard Deviations for Occupational Stayers and Movers

		1991		1998	
		West	East	West	East
Stayers	mean	0.08	0.10	0.14	0.12
	st.dev.	0.04	0.06	0.08	0.06
	N	2603	619	1714	341
Movers	mean	0.36	0.36	0.33	0.30
	st.dev.	0.23	0.22	0.17	0.18
	N	1681	709	1327	513

The sample moments of the distribution of distances for stayers and movers can be found in table 5. As mentioned in section 2, the employed distance measure can theoretically take values between 0 for completely similar occupations in terms of task compositions and 1 for totally different occupations. The top panel of the table contains statistics on the distances for occupational stayers, i.e. the extend to which the task content *within* occupations has changed over time. The differences between East and West seem to be negligible. In both regions the longer time span has brought more changes in the task content for the stayers. The bottom panel of the table shows the statistics for the occupational movers. Again, the statistics reveal no striking differences between the regions. Apparently, the average distance measures for the movers declines over time. It may be explained by the fact that most dramatic changes in occupational structure have taken place around reunification in 1990 (see also

Burda and Hunt, 2001; Hunt, 2001), especially in East Germany. In the later period until 1998, there occurred more changes over the shorter distances, which is reflected by the respective descriptive statistics. In an overall comparison, the group of stayers shows lower average distances with lower variances compared to the group of occupational movers. This implies that the changes of task portfolios experienced "within" occupations are less striking and less dispersed than those arising through an occupational change.

A closer look at the data provides more arguments why it is important to consider distances of changes. An example for a short-distance change from the sample would be e.g. a change from wholesale/retail trader to a florist. An observed long-distance occupational change is the one from being a sewer to an insurance specialist. Note, that according to the broad 2-digit KldB88 categories, both examples above would be treated as an occupational change, although the magnitude of human capital reallocation and the value of the employee-career match in these two examples are not comparable.

In the following econometric estimation, the disentangling of the distances for the stayers and movers will be operationalized by introducing several variables. First of all, the binary variable *Occupational change, KldB88, 3-digit* captures whether the current occupation and the one of the apprenticeship coded according to the 3-digit occupation classification KldB88 coincide (value 0), or not (value 1). The variable *Distance* reflects the content developments that have taken place within an occupation over time. To a certain extent, this variable captures the occupation-specific labor market experience, too. The same variable interacted with the binary variable for an occupational change (*Distance * Occ. change*), refers to the task changes the respondent has experienced when changing from one occupational group to another. The same set of variables is employed for West and East Germany by interacting with the respective binary variable that takes the value 0 for West-German and 1 for East-German respondents.

4.2 Potential Bias of the Variables Associated with an Occupational Change

The interpretation of the coefficients regarding the association between individual wages, occupational change and its distance cannot dispence with the discussion of their potential endogeneity. Thus, the selectivity of the sample of movers should be discussed more thoroughly. From the literature on both job and occupational mobility it is known that the group of movers is positively selected with respect to their average characteristics (Booth and Satchell, 1996; Fitzenberger and Spitz, 2004; Winkelmann, 1996). Especially in cases of voluntary mobility it is argued that workers decide in favor of changes if they (at least in the long run) expect better pecuniary or non-pecuniary career perspectives even after accounting for possible wage losses. Involuntary mobility resulting from a layoff or firm closure normally concerns workers with weaker labor market characteristics, i.e. those with lower productivity, less tenure, young workers etc. (see e.g. Addison and Portugal, 1989; Neal, 1999; Burda and Mertens, 2001). However, in case that the displaced workers find a new job quickly (instead of staying unemployed or entering non-employment), significant wage reductions are not always observed (see e.g. evidence for West Germany in Burda and Mertens, 2001). In the QCS data set employed for the empirical analysis, it is impossible to identify whether an occupational change was made voluntarily or was imposed by external factors.

Generally, the voluntariness of an *occupational* change is not well defined. Based on the formal definition of an involuntary *job* separation, which occurs either through a displacement or plant closure, there could be no such thing as an *involuntary occupational change*. Indeed, an employee cannot be displaced from an occupation and occupations do not usually shut down. One can think of certain health conditions or demand shocks as possible reasons for an employee to be forced to change his occupation. Both reasons cannot be implicitely incor-

porated into this study. It is just important to understand that forced occupational changes are much less frequent than involuntary job changes. However, a numerical comparison with the rate of involuntary job separations might be instructive. Using the numbers from table 1 of Burda and Mertens (2001), a back-of-the-envelope calculation yields 20% as a fraction of involuntary *job* terminations among all separation reasons. Based on this calculation, one can infer that involuntary *occupational* changes in Germany are likely to occur less frequently, than voluntary ones.

A more detailed illustration of the possible direction of the bias for voluntary and involuntary changes based on the combination of QCS and SOEP can be found in Gathmann and Schönberg (2009). On the whole, the respective coefficient associated with wage changes following an occupational change is expected to be upward biased.

4.3 Sample Descriptive Statistics

The mean values of the available observable characteristics for stayers and movers broken down by year and broad region (East/West Germany) are reported in table 6 below.

Residence in East Germany is a dummy variable taking the value 1 for those resident in East Germany, and 0 for West Germany. Both in 1991 and 1998 occupational movers are overrespresented in the East as compared to West Germany. This is in line with the evidence of higher post-reunification mobility observed in East Germany (see Burda and Hunt, 2001). However, the average of the variable "Tenure with the current employer" points at the fact that in the GDR being employed in a different occupation than the occupation of apprenticeship was not an very unfrequent phenomenon. More supporting evidence on occupational mobility after completion of apprenticeship in the GDR can be found in Huinink et al. (1995), chapter 4.2.

Table 6: Descriptive Statistics for the Covariates for 1991 and 1998, Separately for the Subsamples of Occupational Stayers and Movers. p-values Refer to t-tests on the Difference Between the Subsamples

	1991			1998		
	Stayers	Movers	p-value	Stayers	Movers	p-value
Residence in East Germany	0.192	0.297	0.000	0.166	0.279	0.003
	(0.394)	(0.457)		(0.372)	(0.449)	
West Germany						
Log wages	2.298	2.311	0.000	2.356	2.332	0.000
	(0.302)	(0.297)		(0.319)	(0.305)	
Age	36.11	39.21	0.035	39.47	40.62	0.051
	(9.749)	(9.129)		(7.394)	(7.225)	
Tenure with current employer	12.96	12.44	0.386	15.95	13.38	0.942
	(8.998)	(8.950)		(9.420)	(9.043)	
Number of employers	1.921	2.592	0.006	2.112	2.786	0.116
	(1.067)	(1.088)		(1.144)	(1.105)	
Master certificate	0.097	0.090	0.013	0.143	0.124	0.662
	(0.296)	(0.286)		(0.350)	(0.329)	
Observations	2603	1681		1714	1327	
East Germany						
Log wages	1.650	1.608	0.040	1.952	1.920	0.810
	(0.315)	(0.339)		(0.318)	(0.351)	
Age	35.97	37.22	0.027	39.14	39.87	0.385
	(9.520)	(9.236)		(7.518)	(7.809)	
Tenure with current employer	12.11	9.573	0.134	10.91	9.267	0.885
	(10.54)	(9.680)		(8.455)	(7.460)	
Number of employers	1.976	2.401	0.061	2.405	2.871	0.011
	(1.045)	(1.043)		(1.133)	(0.996)	
Master certificate	0.115	0.117	0.253	0.120	0.144	0.005
	(0.319)	(0.322)		(0.326)	(0.352)	
Observations	619	709		341	513	

Log wages captures real hourly wages in the current job, in prices for 1991. In West Germany in 1991, the unconditional average log wages of occupational movers are higher, than of stayers. In the long run in 1998 the unconditional wages of the movers are lower. In contrast, the unconditional average log wages in East Germany is higher for the stayers. However, this difference becomes insignificant in 1998.

Age and *age squared* broadly approximate the overall (potential) labor market experience.

In 1991 in West Germany the average age of the employees who have completed the apprenticeship before 1990 was around 36 years for the stayers and 39 years for the movers. In 1998, the movers are also older on average, although the difference between stayers and movers shrinks to 1 year. In East Germany, the average age of the stayers in 1991 was around 36 years; the movers are over 1 year older on average. By 1998, this difference reduces to less than one year and becomes insignificant. The means indicate that the movers tend to be older on average, thus, they potentially have more labor market experience.

Tenure with the current employer measured by the number of years spent with current employer reflects the firm-specific human capital accumulated by the respondent. Tenure with current employer is longer for the stayers than for the movers, although the difference is insignificant due to the high variance of the variable. This variable also indicates that most occupational changes in East Germany in 1991 are likely to have occurred before reunification; in 1998 most changes can be associated with the post-reunification period. Tenure squared included in the regression did not improve the estimation and hence was excluded from the final specification.

Number of employers captures the number of job changes of the respondent and it controls for the overall mobility of the respondents. The average of the variable for the movers is somewhat higher than for the stayers both in 1991 and 1998.

Master certificate is a dummy variable for a master certificate. Compared to the standard graduation from the apprenticeship, receiving a master certificate requires additional training, schooling, experience and passing special examinations. Movers appear to have a master certificate more frequently, which also points at positive selection of the group.

Additionally, I include sets of dummies for the occupational groups (21 categories), firm size (8 categories) and federal states (Bundesland, 16 categories).

5 Estimation

5.1 Empirical Approach

Based on the underlying economic framework described in section 2, I employ a standard Mincer-type wage regression to estimate the association of wages with different components of an occupational change. In order to incorporate the possible adjustment of skills when changing, wage regressions 10 are estimated for the cross-sections of 1991 and 1998 separately. The estimation for the later cross-section of 1998 is expected to be generally less significant than the earlier one due to the increasing level of unobserved heterogeneity.

$$\ln w_t = \alpha_t + \beta_t X_t + \epsilon_t, \quad t = 1991,\ 1998, \tag{10}$$

where the vector X_t contains the three components related to occupational changes (*Distance*, the binary variable *Occupational change* and their interaction *Distance * Occ. change*) as well as variables capturing individual and employment characteristics (see subsection 4.3 for a detailed description).

5.2 Estimation Results

The correlation between an occupational change and the current wage rate is estimated based on two cross-sections in order to capture short- and long-term developments. The main results are reported in table 7.

The results for 1991 are generally more significant than those for 1998, which may reflect the overall lower marginal returns to occupational changes in the long run as well as the growing impact of factors not included into the regression specification.

Table 7: OLS Estimation of the Wage Equation. Dependent Variable is Log Real Hourly Wages

	Year=1991	Year=1998
Distance	0.330**	0.130
	(0.153)	(0.135)
Occupational change, KldB88, 3-digit	0.055***	0.055**
	(0.019)	(0.025)
Distance * Occ. change	-0.494***	-0.321**
	(0.158)	(0.130)
Residence in East Germany	-0.418***	-0.190***
	(0.045)	(0.062)
Distance * East	-0.371	0.323
	(0.248)	(0.294)
Occ. change * East	-0.054	-0.019
	(0.035)	(0.050)
Distance * Occ. change * East	0.373	-0.205
	(0.253)	(0.308)
Tenure with the current employer	0.003***	0.005***
	(0.001)	(0.001)
Master certificate	0.127***	0.120***
	(0.013)	(0.014)
Age	0.036***	0.019***
	(0.003)	(0.007)
Age squared	-0.000***	-0.000**
	(0.000)	(0.000)
Number of employers	0.019***	0.001
	(0.004)	(0.005)
Constant	1.294***	1.516***
	(0.078)	(0.151)
Occupational groups (dummies)	Yes	Yes
Firm size (dummies)	Yes	Yes
Federal states (dummies)	Yes	Yes
Adjusted R^2	0.570	0.369
Observations	5612	3895

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

To begin with, the first three rows with the variables referring to West Germany are considered. The first variable *Distance* shows that in the short run the distance of changes in tasks performed in an occupation is positively correlated with the wage for those who do not change their occupation. Thus, for a skill adjustment within his occupation an employee receives a

wage premium. Over the longer time period this premium remains positive, although it loses significance. An occupational change according to the KldB88 code has a positive impact on wages in both short and long run. This indicates that in most cases the occupation-employee match becomes more efficient when an occupation is changed. The transferability of human capital across occupations captured by the interaction *Distance * Occ. change* is significantly negative, which is in line with the predictions of the human capital theory. The coefficient of the long-term regression also shows that the negative correlation between the distance of the change and wages is persistent over time.

East Germans in both 1991 and 1998 earn on average less than their West-German counterparts. A comparison of the coefficients in 1991 and 1998 roughly documents that the wage gap between the two regions has reduced over time. Other coefficients concerning East Germany indicate deviations from the respective coefficients for West Germany. Thus, skill adjustments while staying in one occupational group in East Germany are negatively associated with wages in 1991 ($0.330 - 0.371 = -0.041$), although the sum is not significantly different from zero. By 1998 the sum of the coefficients becomes positive ($0.130 + 0.323 = 0.453$). The absolute coefficient of an occupational change measured by KldB88 is statistically zero for both short and long run (1991: $0.055 - 0.054 = 0.001$; 1998: $0.055 - 0.019 = 0.036$). Transferability of human capital for those who changed occupation is insignificant in 1991 ($-0.494 + 0.373 = -0.121$), whereas in 1998 it becomes both sizable and significant at the 10%-level ($-0.321 - 0.205 = -0.501$).

Note that the recalculated coefficients for the movers in East Germany change from being less sizable and generally insignificant in 1991 to sizable and of comparable magnitude to West-German counterparts in 1998. This is likely to point at considerable changes in the underlying economic system in East Germany that took place right after reunification. The grow-

ing similarity of the coeffiecients associated with task adjustments and occupational changes together with the lower magnitude of the coefficient of *Residence in East Germany* generally point at a convergence of the regions, mostly due to changes in the East-German economy.

All other variables included in the regression specification are generally significant and are in line with the labor market theory. A low coefficient of tenure with current employer can be explained by the inclusion of the variable for "within-occupation" adjustment of the task contents (*Distance*) in the regression specification that to a great extent captures occupational tenure.

5.3 Outcome Heterogeneity: Estimation Results for Younger Workers

One of the relevant groups frequently analyzed in the studies of job and occupational mobility is the group of young workers. This group can be characterized by its higher mobility, as the young workers face less costs of an occupational change. Indeed, young workers have spent less time on the labor marker to accumulate human capital, therefore they can afford to search for a better employee-career or an employee-employer match. For the reference to the relevant theory see the seminal paper on job shopping by Johnson (1978) and the search model of Neal (1999). The latter paper also contains an empirical analysis of job mobility among young men. Other relevant studies are: Werwatz (1997), Franz and Zimmermann (1999), Von Wachter and Bender (2006).

In order to gain more insights on how potential tenure affects the wage outcome associated with an occupational change, I will now restrict the sample to "young" employees, i.e. those aged between 20 and 35 in 1991. Then I will follow up this cohort in 1998. Table 8 of appendix A presents sample averages of the main variables of these young employees.

Aside from the subgroup of young West-German employees in 1991, unconditional average

wages of the movers are always lower compared to the stayers. This evidence is in line with the full sample. As in the case of the full sample, the movers are on average older. Generally, the differences between the two groups based on observables can be explained by the sample construction.

Another perspective of the analysis stems from a possible extension of the models in Johnson (1978) and Neal (1999). As they predict, complex occupational changes take place in the beginning of the career, i.e. in the young age groups. This statement implies that young employees decide to change the occupation more often than the older ones. Moreover, it might also be hypothesized that the observed distance of change for young employees is on average "longer", as they tend to change the task content more radically when changing the occupation. First, consider the proportion of movers among young workers. The results in table 9 of appendix A reveal that for all subgroups the fraction of movers is lower compared to the full sample (see table 4). The differences with respect to the full sample are less striking in East Germany. In 1991 and especially in 1998 the fraction of movers among the young is just slightly lower than in the full sample. Generally, the naive comparison indicates that occupational mobility for the most part takes place in the young ages.

Looking at the distance of the occupational change (table 10 of appendix A) and comparing it to the full-sample results (table 5), it can be shown that the distance of the change of the young movers is slightly lower than in the full sample. The only exception are young movers in East Germany in 1998. However, the differences between the full sample and the "young" subsample are insignificant and negligible. When restricting the maximum age of the respondents in 1991 to 30 years, the mean distances for the stayers stay same and those for the movers insignificantly increase (by 0.001). Thus, the hypothesis of more radical character of occupational mobility measured by "longer" distances of occupational changes among the

young cannot be supported by a naive comparison of the sample means.[11]

The regression results on wage returns associated with different components of an occupational change are reported in table 11 of appendix A. The regression explains a smaller part of the variance of wages of the young employees, compared to the full sample. However, the differences in the distinct coefficients are more striking.

At the beginning, consider the first three rows of the table 11 in appendix A that refer to the West-German employees. Not changing the occupation (*Distance*) is positively and significantly associated with wages. The magnitude of the association is higher than in the case of the full sample. This might be explained by a steeper development of the wage profile in the beginning of the career according to the standard human capital accumulation theory (Becker, 1975). The same coefficient in 1998 implies that in the longer run the additional return for staying in the initial occupation becomes negligible. It should be mentioned, however, that this coefficient is possibly overestimated.[12] Note, that the wage profile associated with *age* generally shows a similar pattern. In 1991, the association of an *occupational change* with wages is positive and provides a higher return than in the full sample. This evidence can be explained by a relative impatience of the young, i.e. they change occupation only if a short-term growth of the wages is expected. The evidence for 1998 confirms that the association with wages in the long run besomes less sizable. Those who change occupation over a longer distance (*Distance * Occ. change*) experience in a short run a wage reduction that, however, becomes less sizable in the long run.

Compared to the full sample, the magnitude of *residence in East Germany* is much lower for

[11] An OLS estimation did not reveal any sizable and significant association between the distance of the change and age, too. The results of this estimation are not included in the current paper, but are available upon request.

[12] Again, the assumption of positive sample selection on the unobservables is supported by positive Inverse Mill's Ratios computed using a standard Heckman model with the average occupation-specific rate of occupational chages as exclusion restriciton.

the young subsample at least in 1991. The most likely explanation to this fact is a higher degree of flexibility of the young, as they are trained or employed in more "modern" occupations better fitting to the current requirements of the economy.

Now, the terms for the East Germans are considered. The association of staying in the occupation of training (*Distance * East*) with wages is negative in 1991 (0.507-0.957=-0.450) and slightly positive in 1998 (0.144 - 0.050 = 0.094). It is noticeable that only in the long term when the standards of the Western economy start to dominate, the association becomes positive as expected from the theory. Moreover, the sign of the coefficients for occupational changes (*Occ. change * East*) is negative although insignificant both in 1991 (0.063 - 0.089 =-0.026) and 1998 (0.052 - 0.060 = -0.008). These results point at the reunification shock that has imposed a wave of occupational changes for the sake of adjustment to the new demand structure for particular occupational groups. Indeed, when looking at the association of the distance for the movers with wages (*Distance * Occ. change * East*), it becomes apparent that in the short run an occupational change over a longer distance is associated with higher wages (-0.664 + 0.885 = 0.221). In the long run the magnitude of the association even becomes negative (-0.331 + 0.215=-0.116). However, in both cases the recalculated coefficients are insignificant.

Summarizing the evidence for the subsample of the young employees, it could be shown that occupational mobility takes part mostly in the young ages, although there was observed no tendency to a more radical character of mobility among the young. The estimation results for West Germany are generally in line with the prediction of the human capital theory that postulates that the wage profiles in the beginning of the career are steeper. Assuming most occupational changes in West Germany to be voluntary, the prediction of the matching theory about positive payoffs of a voluntary change is also supported by the estimation results. The

results for East Germany start being in line with economic theory only in the long run, when the West-German institutions start to dominate the labor market developments.

5.4 Biasedness of the Estimates

It should be mentioned that the estimation strategy does not solve the problem of sample selectivity. Generally, one would expect that both the decision to change an occupation and the distance of the change are endogenous with respect to unobservable characteristics of the respondents, such as motivation and talents in particular tasks or occupations. However, the sign of the correlation between the error term and the distance of change is not clear. The most motivated and talented employees might tend to change their task profile very radically, as they are flexible and ready to adjust their skills as soon as possible. Alternatively, they might be strategic in the usage of their accumulated human capital and tend to choose the new occupation such that it requires a similar skill profile to the one they have acquired during the apprenticeship. With respect to the endogeneity of the occupational change itself, the direction of the bias is unambiguous and theoretically substantiated. Based on the discussion in subsection 4.2, one expects an upward bias of the respective estimate. Moreover, the calculation of the Inverse Mills Ratios supports the hypothesis of positive selection bias of the subsample of movers both in East and West Germany in 1991 and 1998 on unobservables.[13] The structure of the data and the resulting research design do not allow me to address the selectivity issue in more detail. However, the OLS estimation itself provides novel descriptive insights in the complex mechanism of an occupational change.

[13]The IMRs were calculated based on the Heckman selection model with the occupation-specific average rate of occupational changes as exclusion restriction. As a robustness check, I calculate the averages for different level of aggregation of the KldB88. The calculated IMRs are positive though insignificant for all year and aggregation levels, besides a 3-digit level in 1998. The details on the calculations are available upon request.

6 Conclusion

The main goal of the present study is to apply the task-based approach to disentangle components of an occupational change. Specifically, I adopt the basic idea of representing occupations by a portfolio of performed tasks and to combine the binomial variable of an occupational change with a measure of distance between occupations from a paper by Gathmann and Schönberg (2009). Relaxing their assumption on the time-invariant content of occupations allows me to additonally analyze the magnitude at which the set of performed tasks alters when a worker does not change his occupation. Thus, a threefold decomposition of the phenomenon of occupational change can be estimated. The analysis was performed both for East and West-German male employees.

All in all, the estimation results using the task-based model design confirm the main predictions of the human capital and search theories. For instance, an occupational change itself is associated with a wage premium, which indicates that occupational changes are often used as a strategic career instrument to achieve higher pecuniary outcomes. At the same time, distant occupational change are negatively correlated with wages, which can be explained by higher human capital losses that emerge due to the changes in the task content of work. In case no occupational change occurs, i.e. the respondent stays in the occupation and gradually adjusts his occupational contents, a wage increase is observed. Adjustment to changing occupational contents can be seen as one of the explanations of why individual wages and occupational tenure are positively correlated. This wage increase captures the part of the effect of job tenure on wages. It is interesting to mention that the estimation for East Germany for the short-time period when most of the occupational changes were made in the pre-unification period are much less in line with the standard theory than the estimation for the long run in

which West-German labor market institutions were dominating. The comparison of East and West Germany in the short and in the long run point at the relative convergence of the two regions in terms of labor market responses. The higher magnitude of convergence is observed for the subgroup of younger employees, who are more flexible and whose skills may better fit the modern labor market requirements. Moreover, the analysis of the "younger" employees exhibits additional task-based evidence that supports standard labor market theories such as the steeper wage profile at the beginning of a career.

In accordance with the predictions of the models of Neal (1999) and Johnson (1978), young employees tend to change the occupation more often than the older ones, just as they tend to change their employers more often according to the theory of job shopping. However, the task changes the the younger employees experience when changing occupation are of same magnitude as those of the older employees, according to the measure of distance between occupations. Thus, in contrast to the evidence concerning *job* mobility, it could not be proved that young employees tend to more radical changes of occupational content than the older employees.

A potential extension of the analysis presented in this paper would be a more thorough study of the East-German evidence in the post-reunificaton period and the link of occupational moblity to the changes in the demand for particular occupational groups.

A Estimation Results for Younger Workers

Table 8: Descriptive Statistics for the Covariates for 1991 and 1998, Separately for the Subsamples of Occupational Stayers and Movers among the Group of "Younger" Employees

	1991		1998	
	Stayers	Movers	Stayers	Movers
Residence in East Germany	19.09	34.14	16.75	28.35
West Germany				
Fraction of stayers/movers	68.45	31.55	58.61	41.39
Log real hourly wage	2.206	2.220	2.326	2.295
	(0.295)	(0.302)	(0.297)	(0.290)
Tenure with current employer	7.771	6.112	12.48	9.849
	(4.468)	(4.210)	(6.655)	(6.101)
Master certificate	0.051	0.072	0.138	0.114
	(0.220)	(0.259)	(0.345)	(0.318)
Age	27.75	29.13	34.69	35.35
	(3.744)	(3.433)	(3.775)	(3.577)
Number of employers	1.644	2.341	2.060	2.721
	(0.945)	(1.066)	(1.126)	(1.094)
Observations	1293	596	1059	748
East Germany				
Fraction of stayers/movers	49.67	50.33	41.85	58.15
Log real hourly wage	1.639	1.584	1.935	1.927
	(0.338)	(0.334)	(0.308)	(0.328)
Tenure with current employer	6.931	5.437	9.531	8.230
	(5.076)	(4.841)	(6.217)	(5.420)
Master certificate	0.056	0.042	0.099	0.132
	(0.223)	(0.201)	(0.299)	(0.339)
Age	27.87	28.63	34.62	34.76
	(3.844)	(3.833)	(4.177)	(4.058)
Number of employers	1.813	2.201	2.399	2.801
	(0.950)	(1.022)	(1.143)	(1.007)
Observations	305	309	213	296

Table 9: Fractions of Occupational Stayers and Movers by Year and Region, Subsample of "Young" Employees

	1991		1998	
	West	East	West	East
Stayers	68.5	49.7	58.6	41.9
Movers	31.5	50.3	41.4	58.1
Total	100	100	100	100
Observations	1889	614	1807	509

Table 10: Mean Distances and Standard Deviations for Occupational Stayers and Movers, Subsample of "Young" Employees

		1991		1998	
		West	East	West	East
Stayers	mean	0.08	0.10	0.14	0.12
	st.dev.	0.04	0.06	0.08	0.06
	Observations	1293	305	1059	213
Movers	mean	0.34	0.34	0.31	0.31
	st.dev.	0.22	0.21	0.17	0.18
	Observations	596	309	748	296

Table 11: OLS Estimation of the Wage Equation. Dependent Variable is Log Real Hourly Wages. Subsample of "Young" Employees

	Year=1991	Year=1998
Distance	0.507**	0.144
	(0.219)	(0.165)
Occupational change, KldB88, 3-digit	0.063**	0.052*
	(0.029)	(0.030)
Distance * Occ. change	-0.664***	-0.331**
	(0.230)	(0.159)
Residence in East Germany	-0.296***	-0.177**
	(0.065)	(0.072)
Distance * East	-0.957***	-0.050
	(0.335)	(0.341)
Occ. change * East	-0.089*	-0.060
	(0.051)	(0.060)
Distance * Occ. change * East	0.885**	0.215
	(0.344)	(0.360)
Tenure with current employer	0.005**	0.006***
	(0.002)	(0.001)
Master certificate	0.127***	0.131***
	(0.025)	(0.018)
Age	0.075***	0.008
	(0.022)	(0.029)
Age squared	-0.001***	-0.000
	(0.000)	(0.000)
Number of employers	0.028***	-0.002
	(0.008)	(0.007)
Constant	0.804**	1.746***
	(0.313)	(0.517)
Occupational groups (dummies)	Yes	Yes
Firm size (dummies)	Yes	Yes
Federal states (dummies)	Yes	Yes
Adjusted R^2	0.521	0.368
Observations	2503	2316

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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