Polarisation and Segmentation – Do They Coincide? Evidence from an Occupational Classification for Germany

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June, 2007

Abstract

Recent work traces skill-biased technological change by means of tasks. In order to use a less abstract measure, we concentrate on occupations and conduct a two-stage cluster analysis to develop an occupation classification based on three qualification indicators. Our results indicate a labour force stratification alongside the selected qualification variables and an even more pronounced divide in PC usage. We also find that task composition has lost explanatory power as regards employment changes in recent years. Analysis of occupation class employment also allows us to inspect whether technological change and segmentation are interrelated via the education system. In fact, the German apprenticeship system proves to be an impediment for functional flexibility but segmented labour markets are difficult to delineate.

1. Introduction

The literature about skill biased technological change (SBTC) describes the structural change of qualification as linear, i. e. the relative demand increases with qualification. Recent work (Autor, Levy & Murnane, 2003; Spitz-Oener, 2006) shows, however, how the bottom end of the qualification distribution might be less affected due to different degrees of substitutability of certain tasks to information and communication technology (ICT).

While these results encourage further sophisticated analysis, tasks are too abstract a measure for further analysis or policy purposes. On the other hand, in the SBTC literature qualification is too often oversimplified. This opens the field for more research on qualification measures.

From wage structure analysis, polarisation by wages, too, is a well-known phenomenon. Due to restricted upward mobility from low wage professions or occupation classes of low quality in all other respects, segmentation research devotes a lot of empirical work in delineating and describing such segmented labour markets. Therefore, it might help explaining qualification trends in an occupationally segmented labour market like Germany. Additionally, though segmentation research cannot rely upon accepted classifications, it provides theories and methods for dealing with occupational issues. Yet, despite strong ties between job quality and qualification, technological change has not been integrated in segmentation theory.

We conduct a two-stage cluster analysis at the occupational level in order to develop a qualification-related classification of occupations. The advantages are straight forward: Firstly, we

can abstract from the dominating system of apprenticeship education and consider a more diversely qualified labour force. Secondly, if tasks are constitutional for occupations, we can apply the task-based framework by Autor et al. (2003) (ALM) to explain employment trends induced by technological change for a more recent time span. Finally, the occupational classification enables us to investigate whether a growing need for occupational, functional flexibility led to qualification related segmentation.

The results have several facets. First of all, neither by means of tasks nor of occupational workplace computerisation we can find direct SBTC evidence. There is, however, a multiple divide of the labour force in further training participation which may be related to PC use and the German apprenticeship system. Moreover, based on qualification characteristics which might transmit segmentation effects of technological change, there is only no ample evidence for SBTC induced labour market segmentation.

Section 2 will review relevant literature concerning task-related SBTC and segmentation and hypothesise about possible segmentation effects of technological change. In section 3 the occupation classification is outlined upon which in section 4 descriptive statistics and regression analysis for occupational employment change is conducted. Section 5 concludes with a summary of theoretical considerations, reviews the results and derives policy implications.

2. Relevant literature

2.1 SBTC and tasks

Most part of the SBTC literature measures human capital by dividing labour force into formally low and high skilled workers drawing on either school or vocational education. Another distinction is white-collar and blue-collar workers. Here, empirical restrictions, i. e. lacking of an adequate measure, impose theoretical restrictions. However, even using a continuous human capital model often yields a simple division because there are only two technologies available (e. g. Caselli, 1999). Recent literature (Autor et al., 2003; Egger & Grossmann, 2005; Spitz-Oener, 2006) focuses on the relation between qualification and job requirements expressed by more differentiated tasks.

Initially, Autor et al. (2003) (ALM) suggested a task-dependent impact of ICT. They introduced the primary distinction between non-routine and routine tasks, the latter – cognitive and manual tasks – being subject to substitution by ICT. Substitutability is derived from the fact that routine tasks can be expressed by repeating algorithms, thus they are programmable and at least as well performed by machines as by workers. Furthermore, non-routine tasks are divided into analytic and interactive tasks which are complementary to ICT and attributed to the high skilled. Finally, non-routine manual tasks are considered being primarily performed by the low skilled.

Applying this concept to empirical analysis, ALM explain the long-term rise in demand for the high skilled having comparative advantages in non-routine tasks. Spitz-Oener (2006) corroborates the ALM hypothesis for Germany and traces higher and more complex job requirements in Germany. Recent wage structure analysis uses the task concept in order to incorporate technological change explanations (Black & Spitz-Oener, 2007 analyse effects on

the gender wage gap; Dustmann, Ludsteck & Schönberg, 2007 for Germany; Goos & Manning, 2007 for UK). All empirical studies have in common that they draw a picture of polarisation regarding employment changes by tasks.

In addition, Egger & Grossmann (2005) develop an intra-firm framework with three interesting assumptions. Firstly, reallocation to non-routine tasks is productivity enhancing but training for this purpose is costly. Secondly, they attribute analytical and social skill requirements to non-routine tasks. Thirdly, Egger & Grossmann assume organizational activity to be knowledge intensive. In their model, organisational restructuring away from Tayloristic production occurs if supply of high skilled workers increases and technological change arises. They empirically corroborate model results of increased demand for analytic and social skills.

2.2 Segmentation by qualification

Segmentation theory has its theoretical roots in the dual labour market hypothesis by Doeringer & Piore (1971) presuming the existence of primary and secondary jobs which can be delineated along characteristics as employment stability, upward mobility, high income and other working conditions. The characteristics are presumed to be bundled together (Tilly, 1996). Though employment stability is the most important feature of segmentation theory (Piore, 1975, p. 126), most empirical research concentrates on wage distribution and job mobility.

Cain (1976) points out, that segmentation theory neglects mutual influences of job characteristics and simply assumes them to be inherent to the job. Above all human capital and employment stability have strong ties. Cain argues that the supply-side structural and permanent job characteristics affect employment in the long-term. He refers to the job competition model of Thurow (1975) which assumes a limited number of entry jobs for the internal labour market which is characterised by rent-sharing of firm-specific human capital inducing employment stability, above average wages and job advancement. However, a high degree of training is precondition for advancement and requires a certain trainability which might be signalled by formal education certificates. Educated job applicants therefore enjoy an improved position in the job queue and may receive a higher status (Thurow, 1972).

The dual labour market hypothesis was developed to deal with unequal labour market participation in the US by gender or race. Additionally, due to high wage flexibility in the US exclusion is rather meant in terms of low wage employment than unemployment issues.[1] In Germany, potential segmentation caused by the dual system of vocational education – a parallel apprenticeship and vocational school attendance – attracted interest. Basic work was done by Lutz und Sengenberger (1974) who designed three segments:

1. A secondary labour market without qualification requirements, high wage elasticity, no need for training and low employment stability;
2. An internal labour market with high job requirements, predetermined job advancement, intense training and a dominant share of firm-specific human capital;
3. A craft-specific labour market with standardized vocational education, high within-occupation mobility and low training intensity.

[1] See, e. g., Dickens & Lang (1988) or Fichtenbaum et al. (1994).

The new third segment incorporates the dual system. Brauns et al. (1999) showed how the segmenting effect of the dual system proved to be persistent in the course of the time and resistant even against strong long-term changes like the growing female labour force participation or education expansion. Further on, the dual system excludes higher and lower skilled from respective occupations.

Standardized education and segmented labour markets might be linked through stratification effects by the prevailing education system. Following the categories suggested by Allmendinger (1989), stratification results when the special vocational education is linked more closely to labour market success than schooling. This leads to a smooth transition from education to labour market participation. On average occupational status is higher in these systems, too.

In empirical research both primary labour markets of the Lutz und Sengenberger (1974) concept were hard to distinguish (Blien, 1986). Following Blossfeld & Mayer (1988), three quarters of the primary labour markets (together) would consist of dual system graduates, indicating a precondition for primary segment participation. Additionally, mobility is stronger within than between segments (Blossfeld & Mayer, 1988).

Theoretical and empirical studies concerning impacts from technological change on labour market segmentation are hard to find, and even recent literature does not relate to technological change (e. g. Hudson, 2007). An earlier overview by Baden et al. (1992) criticizes the missing theoretical basis and contradictory empirical results. Falkinger & Grossmann (2003) present a dual labour market economy where the secondary segment may absorb primary segment layoffs, given there are no minimum wages. Without wage flexibility, technological change will promote unemployment. The number of primary segment jobs depends ex ante on the supply of high skilled management and good skilled production workers. The firm decides about the production technology and will choose the more efficient one if skilled labour supply is guaranteed.

Some part of SBTC literature uses the term segmentation synonymously with segregation in production processes. In these models segmentation is endogenous, i. e. there is no division of workers before there are technological innovations. The models by Caselli (1999) and Duranton (2004) are also good examples for varying human capital measures. The first one, Caselli (1999), assumes workers to differ in learning costs. If a new technology is introduced, workers with lower learning costs will shift from old to new technology because they are more efficient. High learning cost workers remain with the old technology. The second one, Duranton (2004), shows how division develops when high skilled labour supply reaches a critical mass. Before division, all workers enjoyed higher wages due to higher overall productivity. After division low skilled must bare a wage decrease and high skilled remain for themselves.

For one thing it is important to distinguish between given and endogenous segmentation. While Falkinger & Grossmann (2003) think of absorption of primary segment layoffs, this is no question for Caselli (1999) and Duranton (2004) Cain (1976, p. 1238) already criticised the distinction "between a lack of good jobs and a lack of jobs". Former primary segment workers would have more alternatives than a secondary segment layoff. Thus, adequacy of employment would be a more accurate distinction. Furthermore, there is the possibility of

wait unemployment for layoffs seeking for primary sector jobs if they enjoy higher unemployment insurance benefits and accumulated assets (Dickens & Lang, 1988).

2.3 Conclusions from the literature review

Technological change effects relative demand for certain tasks. At the occupational level, where task composition is constitutional, adaptability becomes more important than before. However, in an occupationally segmented labour market with a high degree of standardization most part of human capital investment occurs during vocational education and not on the job. For the individual worker, his trainability, analytical and social skills become more central – altogether rather not observable characteristics. If training is costly or workers are not trainable, human capital as input factor can only be adapted by attracting new workers who enjoyed up-to date curricula or have higher affinity to modern technologies. Else, if there is the possibility of attracting high skilled workers without a narrow vocational education, internal labour markets will induce more functional flexibility because "entrants can flexibly be directed to new and future-oriented occupational fields" (Blossfeld & Stockmann, 1999)

Segmentation theory, on the one hand, tries to take into account the effects of certain vocational education and describes the consequences, especially high occupational exclusion. On the other hand, the distinction between internal and craft-specific labour market is empirically hard to trace. However, while firm-specific training is only considered for the former, adaptability of human capital is not firm-specific but refers to vocational education. Therefore, firstly, we understand occupational adaptability as one of the structural features considered by Cain (1976). Secondly, we recognize that there are difficulties to recover vocational further training in segmentation theory.

One has to ask whether SBTC has displaced segmentation theory because of the clear identification of winners and losers concerning the dominating characteristic of employment stability which is increasingly dependent on qualification. The more differentiated ALM hypothesis which abstracts from formal education, however, could re-open the field for segmentation research. Finally, indications of a skill requirements shift for the low skilled towards social abilities lead to the question whether primary segment layoffs may benefit from their education signal.

To explore conceptual synergies between ALM hypothesis and segmentation research occupational level seems to be best suited. Analysis at the occupational level incorporates task composition and makes allowance for (occupationally) segmented labour markets due to educational system particularities. Empirical analysis here relies on this common ground.

3. An occupational classification of qualification characteristics

3.1 Data

We use Microcensus data from 1998 to 2004 (even years) where 3-digit-occupations ("Klassifikation der Berufe 1992", KldB 92) are reported. Data are restricted to the West German civil labour force population from the age of 15 to 64 excluding working students under the age of 27 and running apprenticeships. Due to low sample size we pooled a few occupations

which were similar in vocational education distribution according to an occupation data base[2], ending up with 288 occupations.

To cluster occupations with similar qualification the following variables were use: years of schooling, occupational status and vocational further training. Years of schooling reflect individual general and vocational education. Table 1 shows the values which were assigned for schooling on the individual level. Occupation data result from yearly means and were averaged over the years. As Table 1 reports, schooling years allows us to include individuals who did not report general or vocational educations.

Occupational status is reported in 2000 and 2004. We assigned values from 1 to 4 (Table 2). Frequencies at the occupational level were weighted with these values and summed up. Again, final value is the average over the years. This variable has multiple meanings. Firstly, as Allmendinger (1989) stated, occupational status may represent the degree of stratification. Secondly, we associate the need for soft skills with occupational status because the higher it is on average the more social competences and responsibility are required.

At last, we include human capital adaption by vocational further training. This variable results from multiplying relative frequency of further training with relative frequency of vocational purpose 2004.

3.2 Two-stage cluster analysis

At first, we standardised (z-transformed) cluster variables for scale comparability. First stage cluster analysis was performed with Ward's minimum variance method using squared Euclidean distance as a measure of similarity. Ward's method is hierarchical, i. e. once two clusters are merged, they will remain together at higher levels of aggregation. it is also agglomerative what characterizes the sequential procedure. As a stopping-rule, one can calculate the pseudo-F by Calinski/Harabasz (Table 3) suggesting 3 clusters. Instead we decided for the fourth best solution with 5 clusters due to cluster characteristics as outlined below. Compared to the following grouping in the agglomeration schedule, especially low-skill occupations which are those of very interest remained separated.

The 5-cluster solution fulfils stability criteria like repeating cluster assignment when dividing the sample in half and carrying out clustering on each half. In addition, comparison with related methods like median linkage and centroid linkage proved stability, too. Results are reported in Table 4 where the Rand index values always exceed the critical value 0.7. At last, within-variance should be smaller than total variance for each cluster variable. This homogeneity criterion can be confirmed by the reported F-values in Table 5.

Finally, using the cluster centroids generated by the hierarchical clustering as starting points, the occupations were reclustered using the iterative k-means algorithm to fine-tune cluster membership. The reasons are twofold. Firstly, a small extent of reclustering indicates cluster stability. Secondly and more important, iterative methods like k-means take into account moving centroids. In other words, if in the course of agglomeration the centroid changes insofar as two early merged clusters have relatively less in common at a later stage, than k-

[2] pallas.iab.de

means revises agglomeration.[3] At last, 20 of 288 occupations have been reclustered confirming the stability of the 5-cluster solution.

Now we can reassure the validity of averaging cluster variables over years due to sample size. To be in accordance, the structure of cluster variables must not have changed or changes have to be proportional. For this purpose, we refer to the bottom panels of Tables 6 to 8. The largest structural changes occur in general schooling often yielding changes of 5 percent points and more. At the same time changes in single cells correspond to total changes indicating proportional movements which are less serious to our proceeding. Vocational education is highly persistent regarding changes of fewer than 3 percent points which are very small with regards of the 7 year time span. Occupational status, too, has largest changes of 3 percent points. Summed up, structural changes are limited and averaging over years shall not arouse serious problems with cluster variables.

4 Empirical analysis

4.1 Descriptive statistics

After cluster analysis produced an occupational classification[4], the cluster solution has to be described regarding cluster variables. Afterwards, the impact of technological change on employment in occupation classes is explored. Finally, segmentation related variables might provide evidence for qualification induced segmentation.

Following analysis is based on individual level rather than occupational level which would treat each occupation with the same weight.

4.1.1 Qualification

As mentioned above, we decided for a 5-cluster solution for reasons of validity which can now be traced. Our first goal was to differentiate the mass of graduates from the dual system that represents two thirds of the labour force (Table 7) and now disperses over several occupation classes. Except for class 1 which has an explicit academic setting, all other classes can be described as combinations of cluster variables.

Qualification class 2 has an exceptionally high individual probability of vocational further training (0.24 compared with a total of 0.15, Table 9) and a relatively high share of upper secondary school graduates (Table 6). Classes 3 and 4 are both highly penetrated by the dual system. Regarding school education, they have different emphasis: Two thirds of Class 3 consists of at least intermediate school graduates, whereas two thirds in class 4 have attended at most lower secondary school. By contrast, the two bottom classes 4 and 5 differ in vocational education although exhibiting similar school education. Furthermore, while vocational further training is for both classes only marginal, occupational status is important to distinguish.

Summed up, the occupational classification can be characterised by following points:

[3] As far as we reviewed existing literature, moving centroids have not taken into account before (e. g. Gittleman & Howell, 1995)

[4] In the following, occupation classes and qualification classes are used synonymously.

- Only the first class is congruent with standard education measures ("academics");
- Despite dual system dominance, its labour force varies a lot in other qualification respects;
- Occupational status and general school attendance are uncorrelated at the bottom end of qualification classes;
- Although the whole classification appears as a continuum, vocational further training distinguishes the classes very clear-cut.

First impressions will conclude with class-related employment growth 1998 to 2004. First of all, one has to keep in mind business cycle dynamics during the time span starting with 1998, which is two years before an upswing, until 2004 when recession ends. In the course of 7 years, the classes developed very differently (Figure 1). Beginning with upper qualification classes, stronger growth in the second class is surprising. From classes 2 to 4 a kind of linear SBTC can be observed. However, the bottom class (5) develops better than its neighbours with higher qualification (3, 4). Reviewing employment growth by vocational education (Figure 2), existing polarisation trends would not have been visible.

So far some results may already indicate labour market segmentation by status or further training participation. But as the first impression will confirm, further analysis is necessary and will be conducted in the following section. Employment stability, derived from employment growth, would suggest the top two classes displaying primary segment characteristics. Occupational status and vocational further training intensity add to this supposition. However, these latter characteristics are doing a bad job in consolidating classes 3 and 5, for example.

The intermediate extent of vocational further training in class 3 is quite distinguished from classes 2 and 4. While the former shows a training intensity which can be expected in internal labour markets, the latter is negligible. Therefore, we rank training intensity in class 3 to reach a level which might equal human capital depreciation rate. This would correspond to a craft-specific labour market with slight human capital adaptability. Thus, bottom classes can be described as excluded from those opportunities provided by vocational further training. At last, class 4 with its distinguishing focus of occupational status might belong to a craft-specific labour market because of its initially higher and probably over the lifetime unchanged status.

4.1.2 PC use and related tasks

Potential impact of technological change can be traced by applying the task-based approach by ALM (2003). For this purpose, we re-construct those 5 categories using the question for the mostly performed task in the Microcensus waves 2000 and 2004 (see Tables 1 and 2).

Intensity of ICT-complementary tasks increases with qualification class (Table 10) while potentially substitutable tasks are concentrated in classes 3 and 4. Non-routine manual tasks have the highest share of all cells with 72.5% in bottom occupations. Discrimination between routine and non-routine tasks yields similar structures in classes 2 and 4, indicating the need for a more differentiated view when aiming for employment growth explanations.

From 2000 to 2004 task structure within occupation classes[5] remains quite constant (Table 11, middle panel). At first, this leads to the conclusion that relative demand changes for tasks result in corresponding demand changes for occupations, suggesting that no adaption within occupations takes place. But looking at growth rates by task-class-cells disputes explanation power of tasks and lays emphasis on the occupation class concept: While the direction of change is row-wise (by occupation class) the same, except for class 5, the directions vary column-wise, i. e. by task category.

These results are not contradictory to former studies (Autor et al., 2003; Spitz-Oener, 2006), which looked at longer and older time spans and proved a lot of explanatory power. Moreover, this simple comparison neglects further influences which can be held constant in regression analysis later on. Nevertheless, we may provide evidence for a halt of substitution processes. Furthermore, the development of PC use is of interest.

At first, PC use rises with qualification class whereas the top three classes altogether exhibit very high shares (Table 10). Concerning changes in shares, there are similar increases of 4.2 to 6.5 percent points. In fact, increased PC use shares not only results from absolute reduction of non-PC user employment, but also from growing PC user employment. Here, class 3 is the exemption with only a small increase of 3.3%. Therefore, there is the possibility of substitution in this class.

4.1.3 Segmentation

Each segmentation oriented analysis has to raise the question to what extent potential segments have to differ in which variables. Employment growth exemplifies this problem: Comparing classes 3 and 5 suggest better opportunities for the latter, while at the same time other working conditions, e. g. occupational status or risk of unemployment, are neglected. Thus, we have to collect evidence from several variables. Furthermore, following that analysis by qualification variables provided evidence for occupational stratification, our primary conclusion from literature review can be tested: In an occupational segmented labour market, technological change will have greater impacts on segmentation where functional flexibility is limited. We suppose flexibility to be smaller when occupations are dominated by dual system education.

One major concern of segmentation research is (upward) mobility between segments. We will explore this issue by calculating shares of employees who changed occupation last year.[6] Therefore it is expected, that open segments have higher shares. And segmentation will persist if primary segments are hard to enter. Comparing openness between classes (Table 3) exhibits comparable low shares in classes 1 to 4 concerning apprenticeship education and in classes 1 to 3 if apprenticeship education is excluded. Vice versa, class 4 is not as open for workers with apprenticeship as it is for those without.

At least, class 4 shows no attributes of a certificate monopoly, in contrast to classes 1 to 3 where mobility is restricted for all other occupations – irrespective of the kind of vocational education. Class 5 might be a secondary labour market but not in respect of mobility be-

[5] ALM (2003) call it the “intensive margin”.

[6] For a complete picture we are lacking of information about the origin occupation.

cause in the course of the business cycle the share remains constant and dismissals in other classes should raised the share in the bottom class.

Job tenure serves as a measure for employment stability, as it was used by Doeringer & Piore (1971). But tenure may have a second meaning which is inversely related to stability which is openness. Table 3 shows at first that average tenure increases with qualification class and additionally, if there is a certified apprenticeship. Again, as occupation changes already showed, classes 4 and 5 are comparable for workers without apprenticeship. Another point is increasing (decreasing) tenure in classes 3 to 5 for workers with (without) apprenticeship when there is a downswing. Then, workers with lower tenure are fired first. Either tenure increases productivity or insider power may explain this personnel policy.

On the other hand, regarding employment growth, average tenure should have declined stronger, especially in class 4. Hence, there is the possibility of increasing retirements, or as Hudson (2007) stated, "there is little reason [...] to make long-term commitments to jobs that pay poorly and provide no benefits". Summed up, in bivariate analysis tenure raises more questions then it answers and we cannot gain explicit evidence for segmentation.

Finally, we calculate unemployment by lastly performed occupation class (Table 2). It is no surprise that unemployment declines with qualification but the distance between classes 3 and 4 is unambiguous. Furthermore, the gap even increases with recession in 2004. Unemployment in class 5 as a secondary segment candidate can be explained by absence of wage flexibility if it cannot absorb primary segment layoffs (Falkinger & Grossmann, 2003).

At low wage levels, in contrast to the US, collectively agreed wages or implicit minimum wages like social welfare impede wage flexibility. Additionally, primary segment layoffs may in fact differ in formal and informal education. Thus, applying the job competition model to class 5, former occupation or certified education may serve as a signal for certain demanded attributes such as social skills (Falkinger & Grossmann, 2003). At last, wait unemployment in primary segment candidates like classes 1 to 3 is less substantial as in the ancient primary segment of class 4.

To conclude, there is ambiguous evidence for qualification related segmentation. First of all, occupational status is not correlated with employment opportunities like class 4 as a traditional craft-specific labour market shows.[7] It is rather training intensity and thus trainability which may be results of a SBTC induced segmentation before 1998. Secondly, there are particularities in the dual system. Classes 2 and 3 prove some kind of insider or monopoly power due to certificates which discriminates existing non-apprenticeship workers and restricts occupational flexibility via the attraction of other workers without standardised vocational education. At last, even class 5 does not show usual secondary segment characteristics. On the one hand, it is typically open to other occupations, but on the other hand, there is high unemployment and possibly crowding-out due to increased requirements of social abilities. Employment stability signalled by its growth rate is therefore a misleading indicator for stability or even other quality characteristics.

[7] Indeed, Piore (1978, p. 74) describes how skilled production workers („Facharbeiter") or white-collar workers with routine tasks are difficult to classify because their work's content is not as complex as their working conditions would suggest. In the end, they still were associated with primary segment labour.

4.2 Structural and technological determinants of occupational employment growth: Results from regression analysis

Descriptive statistics followed two goals. First, occupation class composition regarding qualification and tasks were uncovered. Secondly, in the light of commonly used indicators possible segments were explored. In the following section, we want to determine under which circumstances structural characteristics, especially dominance of a system of vocational education, determine employment growth by occupations.

Growth rates for the time span 1998 to 2004 are estimated using weighted OLS. Weights are employment shares of each occupation on total employment in the middle of the period (2002). Tests for heteroscedasticity suggested the use of robust estimators. Control variables are industry (24 industries) and firm size shares (3 size groups) in the initial year.

Special treatment was necessary for income growth which is calculated by using fitted values of a preceding income regression at the occupational level.[8] In addition, we excluded part-time work but control for its change in percentage points in order to take into account legislative reform which facilitates part-time work for employees, i.e. the introduction of German "Teilzeit- und Befristungsgesetz" in 2001.

To capture the relevance of young employees, we use the ratio of employees under the age of 35 to the 50 years and older group in the base year. The age ratio represents up-to date human capital, technology affinity or employment changes due to retirement. Technology is also explicitly specified by using the difference of 2004 to 2000 shares of PC usage. Moreover, we control for task composition in 2000 at the occupation level. Usually, it would be expected that non-routine (routine) tasks have a positive (negative) impact on employment growth but descriptive evidence was contrary.[9]

In addition, we included a dummy for above average (2/3) penetration of dual system education in the regression analysis. We presume a high correlation with tenure and mobility as depicted above. Following these results, dual system dominance has exclusion effects for external candidates and internal colleagues. The last indicator is fixed-term employment. If vocational education loses its signalling value when complexity increases across occupations (Spitz-Oener, 2006), fixed-term employment may reduce information asymmetries. Hence, it serves as another structural characteristic with long-term effects but static disregard.

Initially, the estimation is conducted for all occupations. Afterwards separated estimations by qualification class were calculated.[10] The basic specification provides significantly negative coefficients for income elasticity and age ratio. Adding change in PC usage shows no net effects, as would be expected if technological change affects qualification classes differently. Although expectations are straightforward for task composition there are no significant coefficients but basically the expected directions. Furthermore, fixed-term employment has sig-

[8] In order to construct income at the occupation level, we took net income without those who reported receipt of public pensions, public assistance benefits or from other sources. Individual level income was assigned by the mean of the reported income class and finally averaged over all employees within the respective occupation.

[9] Non-routine manual tasks were used as a reference category.

[10] Estimation results can be found in tables 17-21.

nificant positive effects, and dual system dominance has a significant negative impact on employment growth.

The latter two effects lose explanatory power when controlled for task composition. Hence, information asymmetry concerning tasks rather than formal education determines the choice of fixed-term employment. Moreover, the required tasks do not seem to be taught in the course of an apprenticeship.

Regression analysis by qualification class has to take into account the smaller sample size, which does not allow OLS for class 1 with only 41 objects. Therefore, only very influential variables will yield significant coefficient estimates.

Demand for class 2 occupations is not income elastic but sensitive to a higher age ratio. Adding PC use yields, surprisingly, a negative but not significant coefficient. The same is true for task composition or fixed-term employment. Controlled for task composition synchronously, PC use becomes significant. Hence, ICT would be labour-saving if complementary tasks did not coexist. The age ratio loses explanatory power if PC use is held constant, implying that high-technology working places are most productive with technology affine, younger workers.

Qualification class 2 exhibits many features of a primary labour market segment: no income elasticity, employment growth and a high intensity of vocational further training. Considering the positive age ratio effect, there is a strong need for human capital adaptability which is achieved by training as well as hiring of young workers.

In contrast to class 2, there is high income elasticity in class 3 but no explanatory power rises from other variables. These results raise more questions. We detect, for example, a relatively high degree of PC use and low unemployment risks. Nevertheless, our results indicate no other structural determinants than income elasticity. Therefore, low quality job attributes are limited and signs for craft-specific labour market characteristics can be observed.

Regression analysis for class 4 occupations produces a significant coefficient for the age ratio which is also robust to alternative specifications. Single specifications for fixed-term employment and dual system dominance show significant estimates, too, but for different directions than expected. Their effects disappear when combined with other variables. At last, there are (sometimes significant) positive effects for routine tasks.

This latter result adds further evidence for a halt of the substitution process in occupation class 4 while basic specifications including all occupation classes produced the expected estimates for task effects. Furthermore, dual system education would be advantageous ceteris paribus, but there is only a small share of younger workers with up-to date human capital or higher productivity in other respects[11]. If the reason is missing up-to date human capital, workers must lack of trainability which can be traced by re-considering their low general education. Finally, because of shrinking employment in class 4, fixed-term employment only serves to compensate short-term demand fluctuations on the goods market while labour demand is reduced in the long run.

[11] Occupations of class 4 partly contain hard physical work, e. g. gardeners, roofer and construction worker.

Regarding occupation class 5, there is no explanatory power by any variable of interest. Therefore, Cain's (1976) argument of segmenting structural effects in the long run has no ground for this occupation class. Furthermore, if the task concept is applied by only using the share of non-routine manual tasks (not reported), our estimations yield positive but not significant coefficient estimates.

Structural effects, embodied by the dual system domination dummy, may be hard to find in class 5 because only half of the employees have an apprenticeship. In addition, in a group with earnings close to an alternative income of social benefits, income elasticity is also difficult to identify. Thus, we have to rely on descriptive evidence to classify group 5 as a secondary labour market segment. Tenure, unemployment as well as low status and exclusion from vocational further training provide some evidence in this regard.

4.3 Summary of the empirical results

At first, descriptive analysis provided evidence for occupational segmentation along the lines of vocational further training and occupational status, both indicators showing low levels on the two bottom classes. Our approach yielded more differentiated results than a single qualification indicator based on vocational education would exhibit. Because training and status are standard segmentation characteristics we conducted further analysis on this ground. We presumed that in times of SBTC, training would be correlated with job quality. Class-wise task composition proved to be consistent with our presumption and employment growth behaved correspondingly, too. While there was mixed evidence for mobility and tenure, which showed to be dependent on dual system graduation, unemployment by former occupation class was clear-cut and confirmed preceding suppositions.

Nevertheless, we found particularities within occupations when we distinguished along the lines of apprenticeship/no apprenticeship. To capture these particularities in multivariate analysis, we introduced a binary variable indicating dual system dominance. In general, results confirm a negative influence of high standardisation of vocational education. Another goal was to trace how technological change, via PC usage and the task concept, determined employment growth during recent years. Surprisingly, neither PC use nor complementary or substitutable tasks showed straightforward influence.

Possible explanations for the unexpected lack of influence of commonly used SBTC indicators can either be related to the lack of variation due to constant task composition over the years or preliminary discontinuity of SBTC. At least, task composition of occupations compensates negative effects from dual system domination. If its negative influence accounts for required tasks, we conclude that lacking occupational adaptability partly explains falling employment. Furthermore, task composition also neutralises employment promoting effects of fixed-term employment indicating that required tasks cannot be certified. Thus employers cannot rely on certificates alone when hiring workers.

Occupational segments are not very distinct with regards to standard measures besides unemployment. Class 2, however, exhibits primary segment characteristics in many respects. It suffers for some part from low age ratios but trainability of employees allows for a high vocational further training intensity. Income elasticity is the only indicator confirming class 3 to

be a secondary segment. Its characteristics rather resemble a craft-specific labour market with almost no need for further training. Other job quality indicators reach sufficient values.

Also class 4, which was probably once a primary segment, is hard to be classified into one of the segments. However, we observed high unemployment and employment losses as well as very low training participation although dependence on young applicants shows a need for human capital adaption. Finally, if future employment prospects and working conditions are highly correlated with usage of ICT, class 4 cannot be labelled as a primary segment. Occupation class 5 resembles a typical secondary segment: downward mobility, low tenure and by definition a low occupational status. Employment prospects are also uncertain if we consider the possible crowding-out by primary segment layoffs who may be equipped with social abilities as well as experience in increasingly important tasks.

5 Conclusions

Technological change affects relative demand for qualification via required tasks. If there are complementary and substitutable tasks regarding ICT adoption, workers have to adapt their human capital in occupations with strong emphasis on substitutable tasks via further training. However, provision of vocational further training might be limited because workers lack trainability due to either limited or outdated vocational education. In this case, younger workers with adequate vocational education could make use of the ICT-induced higher productivity.

In the early years of segmentation theory it was argued that there are occupational segments where workers are excluded from good quality jobs which can be characterised, for example, by training, employment stability and prospects. Moreover, Appelbaum & Schettkat (1990) summarised that Tayloristic production technology induced segmentation and polarisation of qualifications and skills (p. 6) and that "nations may differ […] in their capability to equip workers in labor market segments previously characterized as semi-skilled […] with the full range of requisite skills" (p. 8). In Germany, segments were delineated along vocational education, reflecting the important role of the dual system. Dual system education is associated with exclusion of outsiders (e. g. Brauns et al., 1999) but has ambiguous implications for training.

Therefore, we presume that employment prospects strongly depend on human capital adaptability which in turn might be limited in highly standardised education systems where workers make a once-and-for-all human capital investment. Furthermore, there is reason to believe that dual system education is correlated with further structural characteristics which might exhibit long run effects on employment stability and thus on segmentation (Cain, 1976).

Empirical analysis of qualification related employment changes has to take into account task composition and overcome dual system dominance to create the needed differentiation. We chose an occupational classification based on three qualification variables. Because task composition is constitutional for occupations they sufficiently reflect interrelation with SBTC. In addition, using general education and vocational further training as cluster variables we

achieve a substantial differentiation of vocational education. By means of this occupation classification, qualification-related employment growth shows quite different results than analysis using vocational education only may provide – instead of linear SBTC we observe a small degree of polarisation.

The qualification classes can be characterised as follows. Classes 4 and 5 differ in occupational status but not in general education, whereas class 3 features a noticeably higher general education and a slightly higher probability of further training. Class 2 is distinguished by its high training intensity and large variation in vocational education and Class 1 is dominated by academics. Finally, tasks are concentrated in different occupation classes being a good predisposition for further analysis but proving less explanatory power for employment growth than known from preceding literature. However, descriptive evidence for PC usage shows an unexpected clear divide running between classes 3 and 4.

As in descriptive analysis the multivariate regression analysis of employment growth shows no substantial influence of the task concept. We conclude that employment changes induced by SBTC paused during the observation period. Other determinants, however, like dual system dominance have a significant impact on employment change. Adaption of human capital is an important problem of occupational employment growth as can be observed through dual system and age-related effects. Firstly, younger workers are an important source of up-to date knowledge. Secondly, with a standardised vocational education there are still uncertainties about other abilities which become important to employers who make increasingly use of fixed-term employment.

Labour market segmentation is hardly clear-cut. Class 2 shows features of internal labour markets because of high training, low mobility a wide range of vocational education indicating a dominance of job-related skill acquisition. Class 3 is to a certain degree comparable with craft-specific labour markets but rather due to dual system relevance, intermediate training and a certain occupational status rather than employment growth or missing income elasticity. Furthermore, both classes have in common to exclude external applicants to a relatively high degree.

Occupation class 4, in which the lack of adaptability of human capital worsens the labour market position, is difficult to allocate too. As in class 5, PC usage is not widespread, that is why there are probably only weak employment prospects for future periods. Class 4 seems to be rather a craft-specific labour market consisting of traditional occupations. In Class 5 downward mobility can be identified but high unemployment and missing wage flexibility prevent the valuable absorption capacities of a secondary segment to take effect.

In conclusion, we firstly find evidence for a division in employment prospects which is rather attached to PC usage and qualification characteristics than to segmentation considerations. Our analysis firstly indicates that SBTC may have slowed down but there are also reasons to believe that skill bias related to organisational change is increasingly important shifting demand to higher social abilities.[12] Falkinger & Grossmann (2003), for example, combine task concept and the requirement of social abilities in the context of organisational restructuring which we neglected due to data constraints. There is also evidence provided by Erlinghagen

[12] E. g. Bresnahan et al. (2002), Falk (2002), Lindbeck & Snower (1996), Piva et al. (2003).

(2006) who emphasises opportunities of lower skilled on the labour market which are reduced to work in service occupations where marketable social skills dominate formal education or unemployment.

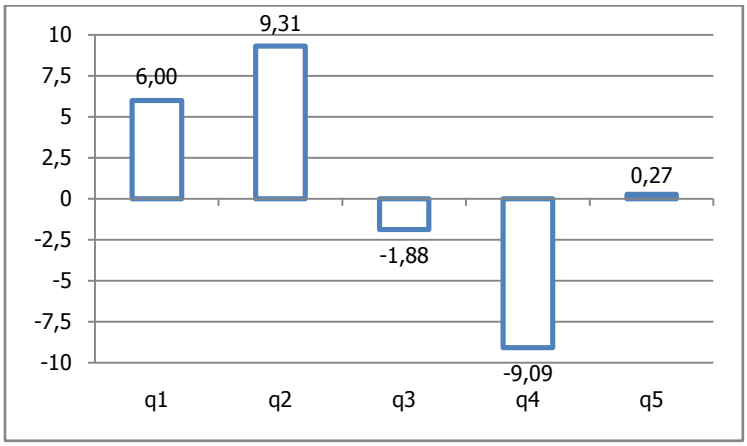
Therefore, unemployment at the bottom end of the qualification classification used here needs further research because there are indications of crowding-out in regard of social abilities. While Pollmann-Schult & Büchel (2004) concluded that crowding-out is only a preliminary phenomenon, there should be further analysis on occupational level.

Secondly, our results indicate that the dual system might impede human capital adaptation. Therefore, we suggest modularisation and related changes of curricula to lower occupational thresholds and deviate from highly standardised vocational education. Furthermore, as the correlation between general education and vocational further training implies, improving general schooling promotes trainability and is especially important for occupations that are strongly exposed to organisational and technological change.

At last, comparisons to other countries with similar apprenticeship systems such as Denmark should improve our understanding of labour market segmentation due to SBTC and low educational flexibility in standardised vocational education systems. They should ideally cover a longer time span which might trace possible halting of SBTC as we detected.

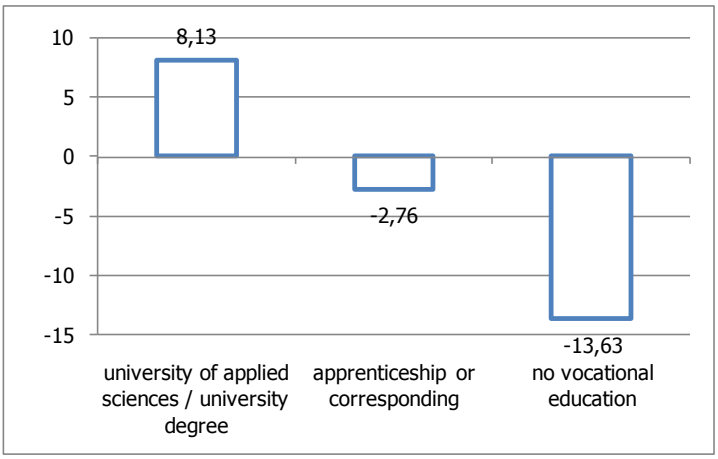
Appendix

Figure 1: Employment growth 1998-2004 by qualification classes (in %)



Microcensus, scientific use files 1998 and 2004, own calculations.

Figure 2: Employment growth 1998-2004 by vocational education (in %)



Microcensus, scientific use files 1998 and 2004, own calculations.

Table 1: Definition: years of schooling

	No school education, no answer	Lower secondary school ("Volksschule", "Hauptschule")	intermediate secondary school ("Realschule")	Certificate of aptitude for university of applied sciences ("Fachhochschulreife")	Upper secondary school ("Abitur")
No vocational education, vocational preparation; no answer	8	9	10	12	13
Semi-skilled vocational education ("Anlernausbildung"), internship	9	10	11	13	14
Apprenticeship	11	12	13	14	15
Master craftsman/Technician	14	15	16	16	17
University of applied sciences	16	16	16	17	17
University	18	18	18	18	18
Ph.D.	20	20	20	20	20

Table 2: Definition: occupational status

low status	Qualified tasks	Intermediate status	High status
Unpaid family workers		Self-employed with 1-4 employees	Self-employed with >4 emloyees
Unskilled and semi-skilled blue collar workers	Skilled labour ("Fachar-beiter") , journeyman ("Geselle"), forman ("Vorarbeiter"), group leader ("Kolonnenführer")	Master craft-sman("Meister"), forman ("Polier")	
White-collar worker with executing tasks	White-collar worker with skilled occupational tasks	White-collar worker with complex occupational tasks, white-collar craftsman	White-collar worker with (widespread) executive functions
low grade civil servant	middle grade civil servant		upper, higher grade civil servant

Table 3: Calinski/Harabasz pseudo-F

# Cluster	Calinski/Harabasz pseudo-F
1	
2	369,14 (3)
3	414,48 (1)
4	381,23 (2)
5	348,59 (4)
6	339,96 (7)
7	346,29 (5)
8	344,00 (6)
9	334,77 (8)
10	323,72 (9)
11	317,40 (10)
12	315,34 (11)
13	315,24 (12)
14	313,68 (14)
15	315,12 (13)
Mean	341,35

Table 4: Rand index, 5-cluster solution

Method	Ward's-Linkage	Median-Linkage	Centroid-Linkage
Ward's-Linkage	1,000		
Median-Linkage	0,7712	1,000	
Centroid-Linkage	0,8065	0,8950	1,000
Mean		0,9121	

Table 5: Homogeneity in cluster variables

cluster variable	Cluster 1	2	3	4	5
			F-Value		
schooling years	0,13	0,27	0,23	0,04	0,03
occupational status	0,19	0,16	0,05	0,08	0,09
probality of further	0,17	0,52	0,64	0,05	0,09

Table 6: School education by qualification class

qualification class	not reported	no school education	lower secondary school	intermediate secondary school	upper secondary school[1]
	2004 shares (in %)				
1	0,9	0,1	2,7	6,4	89,8
2	1,2	0,2	17,9	37,1	43,6
3	1,1	0,5	35,7	40,9	21,8
4	0,9	2,1	63,0	24,9	9,1
5	0,9	6,3	67,9	18,0	6,9
Total	1,0	1,9	39,8	28,2	29,0
	1998 - 2004 change in shares (in %)				
1	0,5	0,0	-2,0	-3,2	4,7
2	0,6	0,0	-6,3	-2,1	7,8
3	0,5	0,0	-6,9	1,6	4,8
4	0,2	0,2	-7,5	5,1	1,9
5	0,2	0,3	-6,4	4,3	1,6
Total	0,4	0,1	-7,3	1,6	5,2

1 "Fachhochschulreife" and "Abitur" together

Microcensus, scientific use files 1998 and 2004, own calculations.

Table 7: Occupational education by qualification class

qualification class	not reported	no vocational education[1]	vocational training[2]	tertiary education
	2004 shares (in %)			
1	0,4	2,1	13,8	83,7
2	0,8	6,5	72,6	20,2
3	0,7	11,2	81,5	6,7
4	0,5	16,5	80,8	2,2
5	0,7	39,6	58,1	1,6
Total	0,6	16,3	67,0	16,1
	1998 - 2004 change in shares (in %)			
1	1,8	-0,5	-0,7	-0,6
2	1,5	-1,3	-2,1	1,9
3	1,4	-2,4	0,0	1,0
4	1,2	-1,4	-0,2	0,3
5	0,8	-2,4	1,3	0,4
Total	1,3	-2,0	-0,9	1,6

1 including vocational preparation, internship, semi-skilled vocational educati

2 including master craftsman, technician

Microcensus, scientific use files 1998 and 2004, own calculations.

Table 8: occupational status by qualification class

qualification class	low status	qualified tasks	intermediate status	high status
	2004 shares (in %)			
1	1,5	4,7	26,9	66,9
2	3,7	10,0	51,7	34,5
3	12,0	27,4	46,4	14,2
4	24,9	54,4	15,9	4,8
5	65,3	27,1	5,7	1,9
Total	22,7	25,9	31,0	20,3
	1998 - 2004 change in shares (in %)			
1	0,1	-0,3	3,6	-3,4
2	0,1	-0,9	3,1	-2,4
3	0,3	-0,4	1,6	-1,5
4	1,0	-2,7	1,6	0,2
5	0,0	-0,9	0,7	0,2
Total	-0,3	-1,7	2,3	-0,3

Microcensus, scientific use files 1998 and 2004, own calculations.

Table 9: vocational further training 2004 by qualification class

qualification class	participation in furtcher training, share (%)	vocational purpose, share (%)	Probability of further vocational training
1	33,4	96,4	0,32
2	25,4	94,5	0,24
3	15,6	91,7	0,14
4	8,0	90,4	0,07
5	4,1	82,8	0,03
Total	16,0	93,2	0,15

Microcensus, scientific use file 2004, own calculations.

Table 10: pc use by qualification class

qualification class	pc use 2004, share (%)	2000-2004 change in shares	2000-2004 change (%) in employment
1	92,2	5,8	13,6
2	84,8	5,8	11,0
3	76,7	5,0	3,3
4	38,0	6,5	10,6
5	19,6	4,2	21,6
Total	61,1	6,3	9,1

Microcensus, scientific use files 2000 and 2004, own calculations

Table 11: tasks by qualification class

qualification class	non-routine analytic	non-routine interactive	routine cognitive	routine manual	non-routine manual
	2004 shares (%)				
1	24,8	48,4	9,9	1,9	15,0
2	11,2	41,1	19,7	4,1	24,0
3	6,2	24,7	38,3	3,7	27,1
4	1,3	22,1	7,4	20,1	49,1
5	0,4	11,1	2,1	13,9	72,5
Total	7,4	27,5	18,0	8,6	38,5
	2000-2004 change in shares				
1	-1,0	0,6	0,5	0,2	-0,3
2	0,1	-0,6	0,2	-0,1	0,4
3	-0,1	0,3	-0,6	-0,1	0,5
4	0,1	1,2	0,2	0,2	-1,7
5	0,0	0,3	0,0	-0,3	0,0
Total	0,2	0,8	0,0	-0,3	-0,7
	2000-2004 percentage change in employment				
1	1,9	7,5	12,2	15,7	4,4
2	4,6	1,8	4,2	0,6	4,9
3	-4,4	-1,7	-4,4	-6,4	-0,9
4	-1,7	-3,5	-6,0	-7,5	-11,5
5	8,3	-1,2	-1,9	-6,0	-3,8
Total	1,0	1,0	-1,7	-5,6	-3,7

Microcensus, scientific use files 2000 and 2004, own calculations.

Table 12: assignment of activities, Spitz (2006)

Table 1
Assignment of Activities

Classification	Tasks
Nonroutine analytic	Researching, analyzing, evaluating and planning, making plans/constructions, designing, sketching, working out rules/prescriptions, and using and interpreting rules
Nonroutine interactive	Negotiating, lobbying, coordinating, organizing, teaching or training, selling, buying, advising customers, advertising, entertaining or presenting, and employing or managing personnel
Routine cognitive	Calculating, bookkeeping, correcting texts/data, and measuring length/weight/temperature
Routine manual	Operating or controlling machines and equipping machines
Nonroutine manual	Repairing or renovating houses/apartments/machines/vehicles, restoring art/monuments, and serving or accommodating

Table 13: assignment of activities, application for Microcensus

non-routine analytic	Büro/Technisches Büro/EDV/Forschen: Forschen, Entwerfen, Konstruieren, Gestalten von Produkten, Plänen, Programmen Persönliche Dienstleistungen: Gesetze/Vorschriften/Verordnungen anwenden, auslegen; Beurkunden
non-routine interactive	Handel/Reparatur: Einkaufen/Verkaufen, Vermitteln, Kassieren Marketing/PR/Management: Werben, Marketing, Öffentlichkeitsarbeit/PR Marketing/PR/Management: Management-, Leitungs- und Führungstätigkeiten Persönliche Dienstleistungen: Erziehen, Ausbilden, Lehren Persönliche Dienstleistungen: Beraten, Informieren Persönliche Dienstleistungen: Künstlerisch, journalistisch, unterhaltend tätig sein
routine cognitive	Büro/Technisches Büro/EDV/Forschen: Ausführen von Schreib-, Rechen- und DV-Arbeiten/Buchen, Erstellen von Zeichnungen Büro/Technisches Büro/EDV/Forschen: Messen, Prüfen; Erproben, Kontrollieren nach vorgegebenen Verfahren
routine manual	Maschinen einrichten/überwachen: Maschinen, technische Anlagen oder Geräte einrichten, steuern, überwachen, warten
non-routine manual	Anbauen/Gewinnen/Herstellen: Fertigen, Be-/Verarbeiten, Bauen/Ausbauen, Installieren, Montieren Handel/Reparatur: Reparieren, Renovieren, Instandsetzen, Ausbessern Persönliche Dienstleistungen: Bewirten, Beherbergen; Speisen vorbereiten Persönliche Dienstleistungen: Gesundheitlich/sozial helfen, pflegen; medizinisch/kosmetisch behandeln Sonstige Dienstleistungen: Fahrzeuge führen, Packen, Beladen, Verladen, Sortieren, Zustellen Sonstige Dienstleistungen: Reinigen, Abfall beseitigen, Recycling Sonstige Dienstleistungen: Sichern, Schützen, Be-/Überwachen Verkehr regeln

Table 14: occupational change by target qualification class

qualification class	Total				apprenticeship[1]				no apprenticeship[2]			
	1998	2000	2002	2004	1998	2000	2002	2004	1998	2000	2002	2004
1	2,9	3,4	3,0	2,4	3,8	4,0	3,5	2,7	2,8	3,3	2,9	2,4
2	3,4	4,2	3,6	2,8	2,9	3,4	3,3	2,5	4,7	5,8	4,5	3,4
3	3,4	4,1	3,7	2,9	3,1	3,7	3,3	2,6	4,2	5,1	4,7	3,7
4	4,7	5,1	4,7	4,1	4,1	4,4	3,9	3,4	6,7	7,0	7,2	6,4
5	7,4	8,4	7,3	6,4	7,5	8,5	7,0	6,2	7,4	8,3	7,8	6,7
total	4,4	5,1	4,6	3,8	4,1	4,7	4,1	3,4	5,0	5,9	5,3	4,3

1 including master craftsman, technician

2 including not reported, no vocational education, tertiary education

Microcensus, scientific use files 1998, 2000, 2002 and 2004, own calculations

Table 15: unemployment by former qualification class

qualification class	1998	2000	2002	2004
1	1,4	1,3	1,0	1,3
2	2,1	1,8	1,7	2,3
3	3,0	2,5	2,6	3,7
4	5,3	4,4	5,1	7,0
5	5,9	5,0	5,4	7,3
total	3,8	3,2	3,4	4,6

Microcensus, scientific use files 1998, 2000, 2002 and 2004, own calculations

Table 16: average tenure by qualification class

	total		apprenticeship[1]		no apprenticeship[2]	
qualification class	1998	2004	1998	2004	1998	2004
1	12,2	12,7	13,8	13,8	11,9	12,5
2	11,6	11,9	12,1	12,5	10,3	10,6
3	11,8	12,1	11,8	12,2	11,7	11,7
4	11,0	11,3	11,2	11,7	10,0	9,9
5	9,4	9,3	9,2	9,4	9,6	9,1

1 including master craftsman, technician

2 including not reported, no vocational education, tertiary education

Microcensus, scientific use files 1998 and 2004, own calculations

Table 17: regression analysis of occupational employment growth 1998-2004, all occupations

	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
income change (%) 1998-2004	-0,89 **	-0,89 **	-0,55	-0,83 **	-0,50	-0,82 **	-0,56	-0,77 *	-0,81 **	-0,83 **	-0,52
change in share pc-use 2000-2004		0,10							0,16	0,10	-0,09
dual system domination, dummy						-0,05 **	-0,02	-0,05 *	-0,05 **		-0,01
fixed-term contracting, share (%)				0,26 *	0,15			0,13		0,26 *	0,12
non-routine analytic tasks, share (%) 2000			0,03		0,03		0,02				0,02
non-routine interactive tasks, share (%) 2000			0,12 **		0,12 **		0,11 **				0,12 **
routine cognitive tasks, share (%) 2000			-0,11		-0,11		-0,10				-0,10
routine manual tasks, share (%) 2000			-0,09		-0,09		-0,09				-0,08
ratio age under 35 to age 50 and above	0,02 **	0,02 **	0,02 ***	0,02 **	0,02 ***	0,02 ***	0,02 ***	0,02 ***	0,02 ***	0,02 **	0,02 ***
constant	-0,01	-0,02	0,02	-0,01	0,02	0,02	0,02	0,02	0,00	-0,03	0,04
n	287	287	287	286	286	287	287	286	287	286	286
F	16,55	16,65	15,4	17,71	16,25	18,67	14,12	19,65	17,12	17,89	15,87
Prob>F	0	0	0	0	0	0	0	0	0	0	0
R^2	0,3471	0,3475	0,3858	0,3452	0,3817	0,3603	0,3868	0,3565	0,3616	0,3457	0,3830

Source: Microcensus scientific use files 1998, 2000, 2002, 2004. Weighted OLS regression, weights are shares of each occupation in 2002. Dependent variable: employment growth 1998-2004. Not reported: 24 industry shares, 3 firm shares. Heteroscedasticity robust estimators. Income change calculation based on fitted values of income regressions for 1998 and 2004. Variables without year indication are 1998 values. */**/*** indicating significance at 10%/5%/1% level.

Table 18: regression analysis of occupational employment growth 1998-2004, qualification class 2

	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
income change (%) 1998-2004	-1,47	-1,41	-0,95	-1,30	-0,95	-1,12	-0,89	-0,94	-1,02	-1,14	-0,46
change in share pc-use 2000-2004		-0,49							-0,57	-0,81	-1,40 *
dual system domination						-0,11	-0,05	-0,11	-0,11		-0,04
fixed-term contracting, share (%)				0,76	0,35			0,77		1,08	0,52
non-routine analytic tasks, share (%) 2000			0,30		0,26		0,23				0,31
non-routine interactive tasks, share (%) 2000			0,20		0,15		0,18				0,29
routine cognitive tasks, share (%) 2000			0,06		0,03		0,06				0,06
routine manual tasks, share (%) 2000			-0,10		-0,16		0,03				-0,09
ratio age under 35 to age 50 and above	0,02 **	0,02 *	0,02 *	0,02 *	0,02 *	0,02 *	0,02	0,01	0,02	0,02	0,01
constant	-3,92	-4,93	-7,03	-1,95	-5,79	-3,87	0,20	-2,03	-7,36	-2,75	-4,19
n	52	52	52	52	52	52	52	52	52	52	52
F	16,7	13,07	19,35	19,54	19,98	16,33	16,44	20,82	11,55	13,73	10,58
Prob>F	0	0	0	0	0	0	0	0	0	0	0
R^2	0,8108	0,8173	0,8341	0,8220	0,8356	0,8250	0,8363	0,8366	0,8337	0,8376	0,8742

Source: Microcensus scientific use files 1998, 2000, 2002, 2004. Weighted OLS regression, weights are shares of each occupation in 2002. Dependent variable: employment growth 1998-2004. Not reported: 24 industry shares, 3 firm shares. Heteroscedasticity robust estimators. Income change calculation based on fitted values of income regressions for 1998 and 2004. Variables without year indication are 1998 values. */**/*** indicating significance at 10%/5%/1% level.

Table 19: regression analysis of occupational employment growth 1998-2004, qualification class 3

	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
income change (%) 1998-2004	-2,08 **	-2,15 **	-1,58 **	-2,10 **	-1,36 *	-2,06 **	-1,58 **	-2,07 **	-2,12 **	-2,15 **	-1,40 *
change in share pc-use 2000-2004		0,28							0,24	0,27	0,21
dual system domination						-0,06	-0,01	-0,05	-0,05		0,01
fixed-term contracting, share (%)				0,12	-0,81			0,08		0,01	-0,91
non-routine analytic tasks, share (%) 2000			0,37		0,31		0,36				0,31
non-routine interactive tasks, share (%) 2000			0,07		0,13		0,07				0,13
routine cognitive tasks, share (%) 2000			-0,24		-0,24		-0,24				-0,23
routine manual tasks, share (%) 2000			-0,53		-0,56		-0,53				-0,58
ratio age under 35 to age 50 and above	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
constant	-0,86	-1,07	-0,99	-1,02	-0,18	-1,15	-0,99	-1,24	-1,28	-1,08	-0,20
n	75	4,13	75	75	75	75	75	75	75	75	75
F	4,12	0	8,01	4,02	9,19	3,79	7,64	3,63	3,75	3,91	7,62
Prob>F	0	0,5071	0	0	0	0	0	0,0001	0	0	0
R^2	0,5047	0,1367	0,5746	0,5049	0,5811	0,5070	0,5746	0,5070	0,5087	0,5071	0,5821

Source: Microcensus scientific use files 1998, 2000, 2002, 2004. Weighted OLS regression, weights are shares of each occupation in 2002. Dependent variable: employment growth 1998-2004. Not reported: 24 industry shares, 3 firm shares. Heteroscedasticity robust estimators. Income change calculation based on fitted values of income regressions for 1998 and 2004. Variables without year indication are 1998 values. */**/*** indicating significance at 10%/5%/1% level.

Table 20: regression analysis of occupational employment growth 1998-2004, qualification class 4

	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
income change (%) 1998-2004	-0,36	-0,35	-1,78	-0,44	-1,99	0,05	-1,14	-0,11	-0,01	-0,41	-2,02
change in share pc-use 2000-2004		1,34							1,10	1,04	1,62
dual system domination						0,18 *	0,19	0,13	0,15		0,08
fixed-term contracting, share (%)				-1,48 *	-1,92			-0,81		-1,02	-1,00
non-routine analytic tasks, share (%) 2000			2,06		4,15		4,20				4,61
non-routine interactive tasks, share (%) 2000			0,19		0,06		0,05				-0,04
routine cognitive tasks, share (%) 2000			0,96		1,14 *		0,96				1,31 *
routine manual tasks, share (%) 2000			0,78 *		0,84 *		0,80 *				0,80 *
ratio age under 35 to age 50 and above	0,07 ***	0,07 ***	0,07 ***	0,08 ***	0,08 ***	0,07 ***	0,08 ***	0,07 ***	0,07 ***	0,07 ***	0,08 ***
constant	-0,29	-0,90	-10,65 *	-0,06	-13,92 **	-0,43	-11,81 *	-0,27	-0,91	-0,61	-15,20 **
n	64	64	64	64	64	64	64	64	64	64	64
F	12,74	9,7	9,94	16,59	10,45	16,79	13,51	26,91	24,53	19,96	12,66
Prob>F	0	0	0	0	0	0	0	0	0	0	0
R^2	0,5983	0,6220	0,6537	0,6175	0,6785	0,6222	0,6720	0,6260	0,6375	0,6298	0,7076

Source: Microcensus scientific use files 1998, 2000, 2002, 2004. Weighted OLS regression, weights are shares of each occupation in 2002. Dependent variable: employment growth 1998-2004. Not reported: 24 industry shares, 3 firm shares. Heteroscedasticity robust estimators. Income change calculation based on fitted values of income regressions for 1998 and 2004. Variables without year indication are 1998 values. */**/*** indicating significance at 10%/5%/1% level.

Table 21: regression analysis of occupational employment growth 1998-2004, qualification class 5

	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
income change (%) 1998-2004	-0,21	-0,42	-0,25	-0,27	-0,16	-0,23	-0,26	-0,28	-0,40	-0,58	-0,44
change in share pc-use 2000-2004		-0,90							-0,91	-0,96	-1,12
dual system domination						0,00	0,00	0,00	0,00		0,01
fixed-term contracting, share (%)				0,78	0,16			0,78		0,90	0,18
non-routine analytic tasks, share (%) 2000			5,21		5,28		5,20				7,68
non-routine interactive tasks, share (%) 2000			-0,21		-0,21		-0,21				-0,06
routine cognitive tasks, share (%) 2000			-0,28		-0,34		-0,28				-0,20
routine manual tasks, share (%) 2000			-0,32		-0,32		-0,32				-0,35
ratio age under 35 to age 50 and above	0,00	0,00	-0,01	-0,03	-0,01	0,00	-0,01	-0,03	0,00	-0,02	-0,02
constant	0,42	0,64 **	0,48	0,38	0,53	0,42	0,48	0,38	0,64 *	0,57 *	0,83
n	55	55	55	54	54	55	55	54	55	54	54
F	55,98	141,81	23,1	51,82	21,08	53,24	21,38	48,7	134,51	92,39	44,49
Prob>F	0	0	0	0	0	0	0	0	0	0	0
R^2	0,7612	0,7780	0,7916	0,7432	0,7738	0,7612	0,7916	0,7432	0,7780	0,7632	0,7963

Source: Microcensus scientific use files 1998, 2000, 2002, 2004. Weighted OLS regression, weights are shares of each occupation in 2002. Dependent variable: employment growth 1998-2004. Not reported: 24 industry shares, 3 firm shares. Heteroscedasticity robust estimators. Income change calculation based on fitted values of income regressions for 1998 and 2004. Variables without year indication are 1998 values. */**/*** indicating significance at 10%/5%/1% level.

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