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Patterns of Labour Market Entry of High-Skilled Workers in Germany

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PATTERNS OF LABOUR MARKET ENTRY OF HIGH-SKILLED WORKERS IN GERMANY

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Abstract

Following an increased demand for higher educated workers during the last decades, developed countries face an ever increasing share of young workers with tertiary education. Recent evidence for the U.S. labour market, however, indicates a (permanent) decline in demand and real wages for young college graduates, notably in the aftermath of the Tech Bust in 2000. Since Germany as an industrialised country experienced an increase in the supply of high-skilled labour, we analyse the corresponding patterns of labour market entrants with respect to wages and occupations. The results indicate that job entrants with higher education have faced slightly declining employment shares in analytical jobs. In contrast to the U.S., this is not directly linked to declining wages.

Keywords: labour demand, labour supply, occupational sorting, polarisation, skill-biased technological change

JEL Classification: J21, J23, J24, O33

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1 Introduction

Despite the increasing demand for highly-educated workers and cognitive skills, recent evidence for the US labour market indicate declining wages for college graduates in the aftermath of the Tech Bust in 2000. At the same time, post-college workers face continuously high employment and wage opportunities (Beaudry et al., 2013, 2014). There is also evidence for the UK that wage inequality of graduates increase with the increasing variance of childhood test scores at the age of ten of graduates (Lindley and McIntosh, 2015). Since an expansion of higher education and a technological shift towards highly-educated labour occurred in many developed countries during the last decades – so in Germany – German graduates may have faced a similar decline in wages and employment opportunities.

To analyse whether the trends for graduates in Germany entering the labour market match the experiences from the U.S. – making declining fortunes of the young a global phenomenon – we consider the labour market entries of highly-educated graduates. To take account of the heterogeneity within this group, we distinguish between three groups of highly-educated workers, who all hold the entrance qualification for university: these are persons with a university degree; workers with a degree from a university of applied science (Fachhochschule); and workers in the apprenticeship system despite having a university entrance qualification.

We analyse the development of wages by educational attainment of young workers in Germany using data from the Sample of Integrated Labour Market Biographies (SIAB) from 1975 to 2010. It is a 2 percent random sample drawn from the Integrated Employment Biographies (IEB) of the Institute for Employment Research (IAB). The focus is on young workers since general changes in the labour market are first apparent for them (Kambourov and Manovskii, 2009). We conduct a detailed empirical analysis considering different job market entry cohorts over time to study shifts in the labour market. In order to capture both – supply-side and demand-side changes – we regard different qualifications and different occupational task groups.

Our results indicate that young highly-educated workers continuously face declining employment opportunities in the top-paying jobs, and declining analytical employment shares, as well as declining wages over time for each entry cohort after 2000. However, wage growth in the first five years is unaffected, other than in the U.S. Beaudry et al. (2014). Also, the declining opportunities for highly-educated workers in analytical, or top-paying jobs, does not directly translate into declining wages, as further jobs pay a rising wage premium for high education.

The remainder of the paper is organised as follows. The next section gives a more detailed discussion of the background to the analysis at hand. Section 3 introduces the data used for the empirical analysis. The empirical results on the German labour market with a particular focus on the position of high-skilled job entrants are in section 4. Section 5 concludes.

2 Background

Wage inequality in the U.S. labour market increased in the course of the 1980s notably at the upper tail of the wage distribution (Katz and Murphy, 1992). Technological change, comple-

menting high-skilled workers and substituting low-skilled workers, seems to be the consensual driving force behind this process (Acemoglu, 2002). The hypothesis of the skill-biased technological change (SBTC) emphasises the exceeding growth in the demand for highly-skilled workers with respect to its supply at the expense of less skilled workers (Katz and Autor, 1999). In recent literature, there is more focus on the increasing concentration of employment at both tails of the wage distribution and disappearing middle-skill occupations, namely job polarisation (e.g. Autor et al. (2006, 2008); Autor and Dorn (2013)) or routine-biased technological change (Goos et al., 2014).

Increasing wage inequality has long been thought of a phenomenon solely present in Anglo-Saxon labour markets and thereby notably in the U.S. labour market. Inequality in Anglo-Saxon labour markets and high unemployment rates of low-skilled workers in Continental Europe appeared as ‘two sides of the same coin’ both stemming from the relative fall in the demand for low-skilled labour (Krugman, 1994). Labour market adjustment rather in Germany occurred through an adaption of employment rather than wages (Antonczyk et al., 2010; Naticchioni et al., 2014). Further, in contrast to the U.S., growth in supply and demand for high-skilled workers coincided, resulting in lower upper tail wage inequality (Acemoglu, 2003).

Starting in the 1990s, wage inequality has also been documented for Germany. Institutional factors, such as unions and implicit minimum wages, that have long resulted in a rigidity of wage setting and a compressed wage structure, especially at the lower tail of the wage distribution, have been loosened. Also, a sharp decline in union coverage, especially at the end of the 1990s, can explain a major part of the risen lower tail inequality (Dustmann et al., 2009). Rising unemployment after reunification led to several further labour market reforms. At the same time, an erosion of the wage setting in Germany began, i.e. refrains from collective bargaining between employer associations and unions (Ochel, 2005).

In the course of slow growth and increasing high unemployment after 2000, the ‘sick man of Europe’ (e.g. *The Economist* (1999)) introduced further labour market reforms, notably in the course of the so-called ‘Agenda 2010’ between 2003 and 2005. They created a dynamic segment of marginal and flexible jobs offering only low opportunities of transition to regular jobs (Eichhorst and Kaiser, 2006). In line with that, Fitzenberger et al. (2011) note the process of increasing lower tail wage inequality in Germany as characterised by episodic events rather than the lower tail polarisation hypothesis by Autor and Dorn (2013). Decomposing wage variance into transitory and permanent parts, Myck et al. (2009) found that permanent inequality peaked in 2001 and declined afterwards. However, polarisation of wages has still occurred thereafter but can only be explained by transitory factors.

In contrast, the influence of institutional factors upon upper tail inequality is limited. It slightly increased in the 1980s mainly driven by the changing composition of the workforce (Dustmann et al., 2009). The share of high-skilled workers increased at a roughly linear rate. Similarly to the U.S. in the 1970s (Katz and Murphy, 1992), expansion in the supply of high-skilled workers occurred at the pace of demand for these qualifications (Antonczyk et al., 2010).

A recent strand in the literature of inequality portrays the U.S. demand for high-skilled as a boom-bust cycle ceasing with the Tech Bust in 2000. Beaudry et al. (2013) argue that the

reversal in the demand for high-skilled workers led to a cascade effect in which high-skilled workers perform jobs previously performed by medium-skilled workers who, for their parts, pushed low-skilled workers further down on the occupational ladder, or out of employment. Beaudry et al. (2014) underline the trend of an increasing share of the working-age population with college degree but declining cognitive employment shares, i.e. a declining share of workers in jobs with high intensity of abstract thinking, and declining wages after 2000. In contrast, job entrants with a post-college degree have faced stable cognitive employment shares and wage profiles. The questions hence arises whether a similar reversal of opportunities for young highly-educated labour market entrants occurred in Germany.

3 Data and Methodology

We base our empirical study on data of the Sample of Integrated Labour Market Biographies (SIAB) from 1975 to 2010. It is a 2 percent random sample of the German social security records drawn from the Integrated Employment Biographies Sample (IEB) of the Institute for Employment Research (IAB). The social security system contains the majority of the workforce but exclude certain groups of the working population, e.g. civil servants, soldiers, and self-employed. The social security records represent 79.4% of the working population in 1995 in West Germany (Bender et al., 2000).¹ These data have been used to study the German wage structure, among others, by Dustmann et al. (2009) and Kohn (2006).

We restrict the analysis on workers with workplace and residence in West Germany since wage levels and structure differ substantially between East and West Germany. East German data are only available after 1992. Further, the East German wage structure is characterised by depreciation of human capital and a transformation process in which a highly compressed wage structure shortly after reunification vanishes and wage dispersion increases (Kohn, 2006). Hence, we exclude East Germany from the data and refer to West Germany as Germany in the following.

The data are highly reliability due to the administrative character of the social security records, where misreporting on wages cause severe penalties for the employer. Another main advantage is the large sample size. The main limitation of the data set is the right-censoring for wages above the social security contribution assessment ceiling. However, for our analysis this disadvantage is limited since we mainly focus on median wages. The data do not provide information on exact working hours but contain information on full and part time, where part time is defined as less than 30 hours per week. For this reason, we restrict the sample to full-time employed.

The purpose of the paper is to analyse the opportunities of (young) labour market entrants. Unfortunately, labour market entry is not directly identifiable. A new individual in the data can either enter the labour market or can be randomly drawn for the first time. The same applies for leaving individuals. To approximate labour market entry, we use potential experience. It is computed by the age of an individual minus the age a typical worker of a specific individual enters the labour market. Details on the procedure are explained in appendix A.

¹It can be assumed that annual variation of the representativeness is low.

Wages are defined as the sum of inflation-adjusted gross daily income from employment notification and benefit receipts. For the yearly analyses we use observations with the cutoff date of June 30 of each year. The classification of occupations ascribes jobs to tasks. Dengler et al. (2014) operationalise tasks based on an expert data base that is comparable to the U.S. dictionary of occupational titles for the years 2011 to 2013. We use their operationalisation for the year 2011.² Each occupation is composed of five tasks. Further a main task is determined by the largest task fraction. These task specification has been, among others, applied by Spitz-Oener (2006). The tasks are are:

1. **analytical non-routine**, e.g. research,
2. **interactive non-routine**, e.g. coordination and delegation,
3. **cognitive routine**, e.g. bookkeeping,
4. **manual routine**, e.g. running a machine, and
5. **manual non-routine**, e.g. housekeeping.

In order to comprehend the detailed differences between varying qualities of higher education, we consider three types of higher education, which we all refer to with the term highly-educated or highly-skilled in the following. These high-skilled workers comprise individuals with admittance to university. It distinguishes between graduates from universities, and universities of applied sciences with typically lower duration and lower focus on abstract skills (*Fachhochschule*), a system which is unique in German-speaking countries.³ The third group has admittance to tertiary education (*Abitur*), but however chooses to complete a vocational training in the German apprenticeship system. Finally, we also consider the standard low- and medium-skilled workers for the sake of comparison. In all, we regard five educational attainments with the following denominations:

1. **Low**, for persons who have not completed any vocational training and have not accomplished a university entrance qualification;
2. **Medium**, for persons that have completed secondary school and vocational training (apprenticeship) or that have accomplished a university entrance qualification without vocational training;
3. **High-Abi**, for persons that have accomplished high school admittance (*Abitur*) and a vocational traing; and
4. **High-FH**, for persons that have a degree at a university of applied sciences (*Fachhochschule – FH*);
5. **High-Uni**, for person with a university degree.

²Annual Variation in the task composition is low, however temporal variation may be greater extending the time horizon.

³In contrast to the U.S. and other countries, Germany has only recently implemented a clear distinction between first (graduate) and secondary (postgraduate) tertiary education. However, university has a more theoretical-based education and duration of education is typically longer than at universities of applied sciences. The shorter duration can also be observed for the age of labour market entry in appendix A.

4 Results

We start with an overview on recent trends in the German labour market, i.e. the change in the educational composition and the wage development and variances by performed task. We describe the skill-biased technological change and job polarisation in Germany where we describe how young highly-educated workers are confronted with a decreasing opportunity to work in the top-paying occupations. Eventually, we analyse the wage development for labour market entrants, also identifying workers in and outside analytical occupations, and the opportunity of young workers to perform analytical tasks – and if highly-skilled workers apply their cognitive skills. In a last step, we consider the development of wage premia over time.

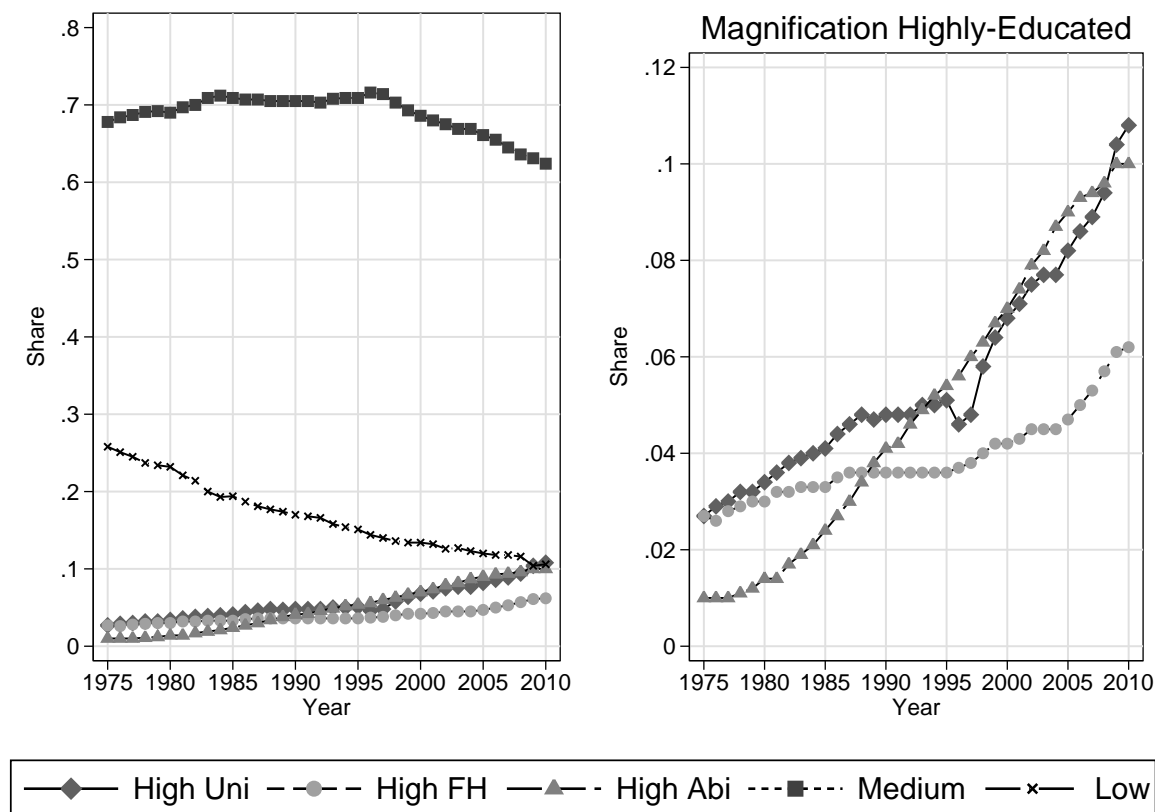
4.1 General Trends

Educational Attainment

Germany faced a constant increase in educational attainment. Figure 1 displays the progress in educational attainment for young workers from 1975 to 2010 in shares. The number of young workers without any vocational qualification decreased considerably from one quarter in 1975 to one tenth in 2010. The proportion of medium-skilled workers remained roughly constant until the mid-1990s, while the share of highly-skilled workers slowly increased, especially workers with university admittance and vocational training. With only 1% share of total young workforce in 1975, its share rose above those who attended university and university of applied sciences in a quasi linear-manner.

The share of medium-skilled workers reached its peak in the mid-1990s and started to shrink by roughly ten percentage points until 2010 thenafter. At the same time the share of workers with university admittance continued to rise. Likewise, also the share of individuals with a degree from a university began to rise sharply and doubled for both subgroups.

Figure 1: Education of young workers in shares (25-35 years) (1975-2010)



Source: 2% IABS Sample for full-time workers between 25 and 35 years of age. N=3,239,242.

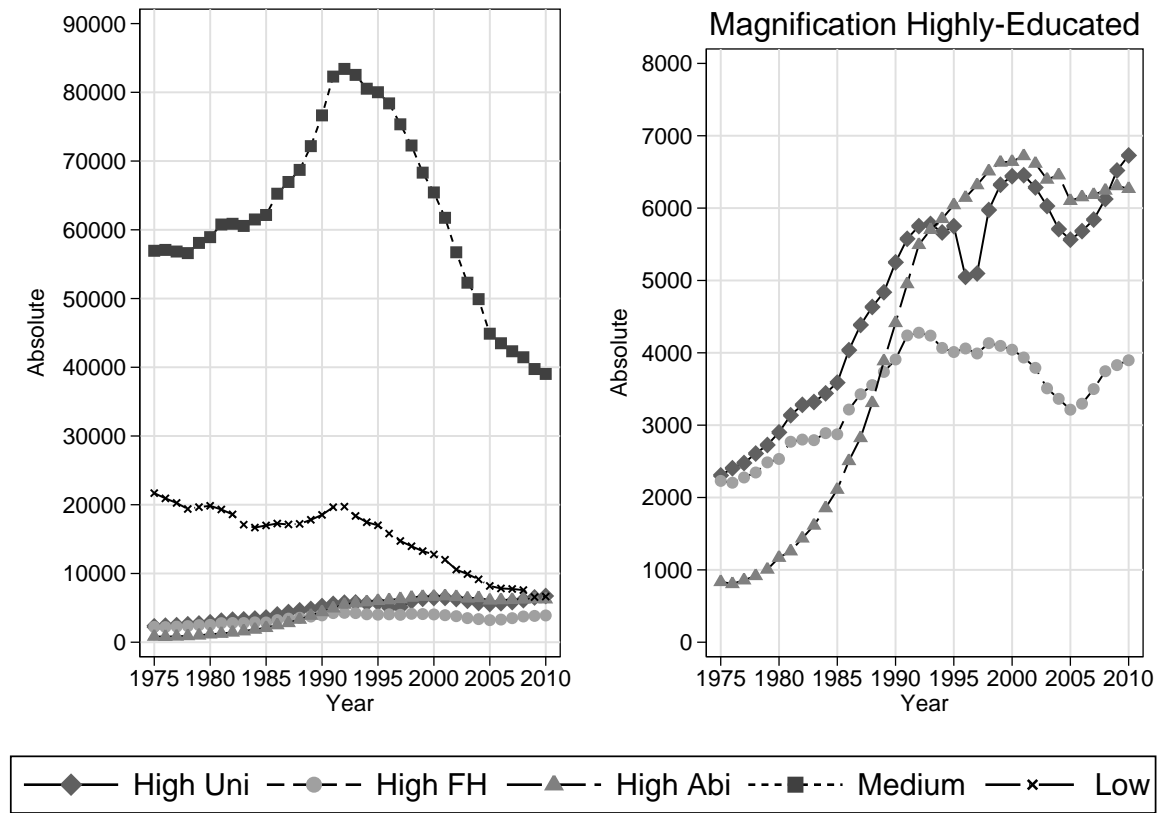
Note: Both graphs represent the absolute number of young workers according to their educational attainment in the sample. The left panel comprises all educational groups, the right panel only those that we classify as highly-educated. The annual number of observation varies between 62,571 in 2010 and 118,660 in 1992. Non-specified observations are omitted when computing the shares.

The proportional shift in educational attainment does not translate into the development in absolute numbers. Although the share of highly-skilled workers increased over time and doubled from 1995 to 2010, the absolute number of highly-skilled workers remained quasi constant (figure 2). The number of young persons decreased dramatically in the 1990s due to a very pronounced baby boom generation in Germany and a lack of subsequent strong birth cohorts.⁴ From 1990 to 1999 the number of persons with 25 years of age decreased by more than one third and remained at that low level (East and West Germany combined).⁵ For that reason the share of highly-skilled workers continually increased, whereas the absolute number did hardly change. Between 2000 and 2005 it shrunk and from 2005, the absolute number of highly-skilled workers increased to its 2000-level for each subgroup of highly-educated workers.

⁴From 1964 to 1974 the number of births shrunk by roughly 41% in Germany.

⁵In comparison, the decrease was roughly 4.5% in metropolitan France, 19.4% in the United Kingdom, and 12.1% in the U.S. (Eurostat, 2015; U.S. Census Bureau, 2012).

Figure 2: Education of young workers in absolute numbers (25-35 years) (1975-2010)



Source: 2% IABS Sample for full-time workers between 25 and 35 years of age. N=3,239,242.

Note: Both graphs represent the absolute number of young workers according to their educational attainment in the sample. The left panel comprises all educational groups, the right panel only those that we classify as highly-educated. The annual number of observation varies between 62,571 in 2010 and 118,660 in 1992. Non-specified observations are omitted.

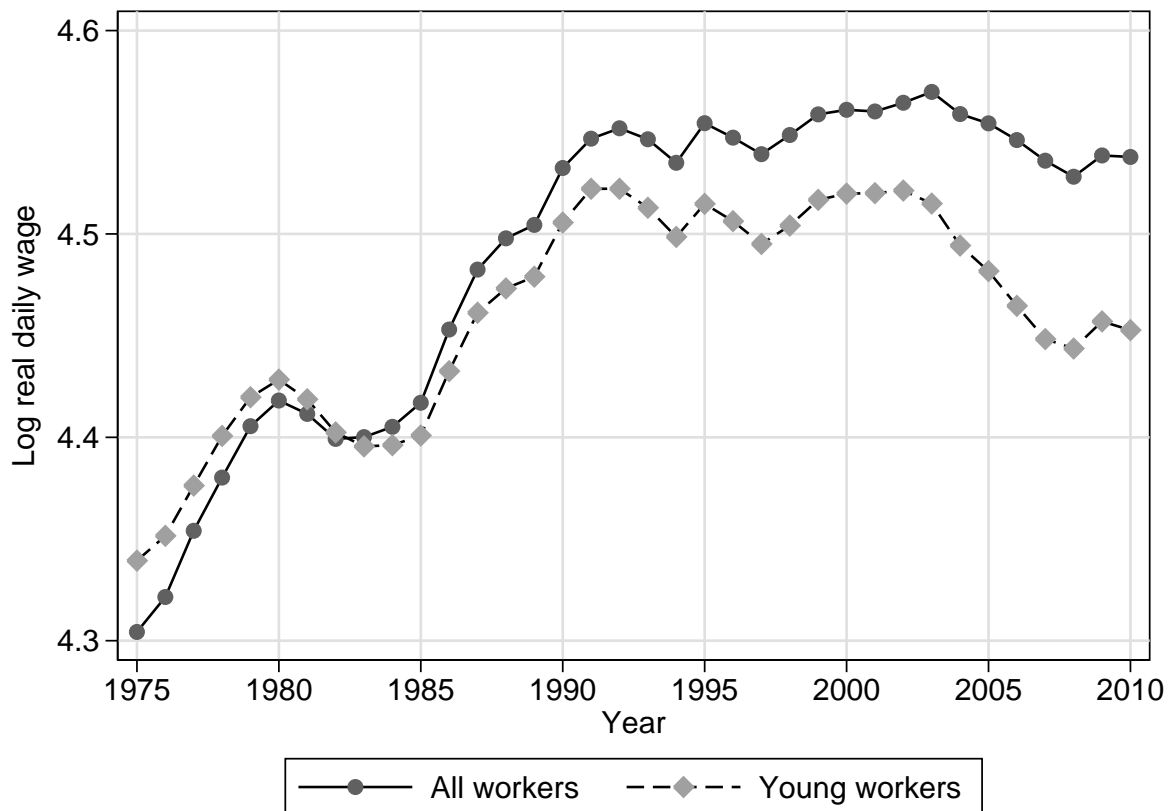
Wage Development

Figure 3 displays the annual development of log median daily wages separated by all workers and young workers. The median real wage has constantly increased from 1975 to 1991 with a short episode of negative growth between 1980 and 1983. This process was followed by a stable wage development during the 1990s. After 2003, real wages started to decrease both for all workers and young workers, but more considerably for the subgroup of young workers.

More importantly for the question at hand, the figure indicates that wages of all workers and young workers have diverged over time. Until 1982, young workers tended to gain higher wages than the total workforce with a narrowing difference over time. Starting in 1983, young workers earned less than the overall workforce. This wage gap has widened over time, especially after the implementation of several labour market reforms in 2003. This hints at the rising inequality

notably for the young (and) labour market entrants that has been discussed in Antonczyk et al. (2010); Eichhorst and Tobsch (2014); Gernandt and Pfeiffer (2007).

Figure 3: Median log real daily wages of all and young workers (between 25 and under 35 years of age) (1975-2010)



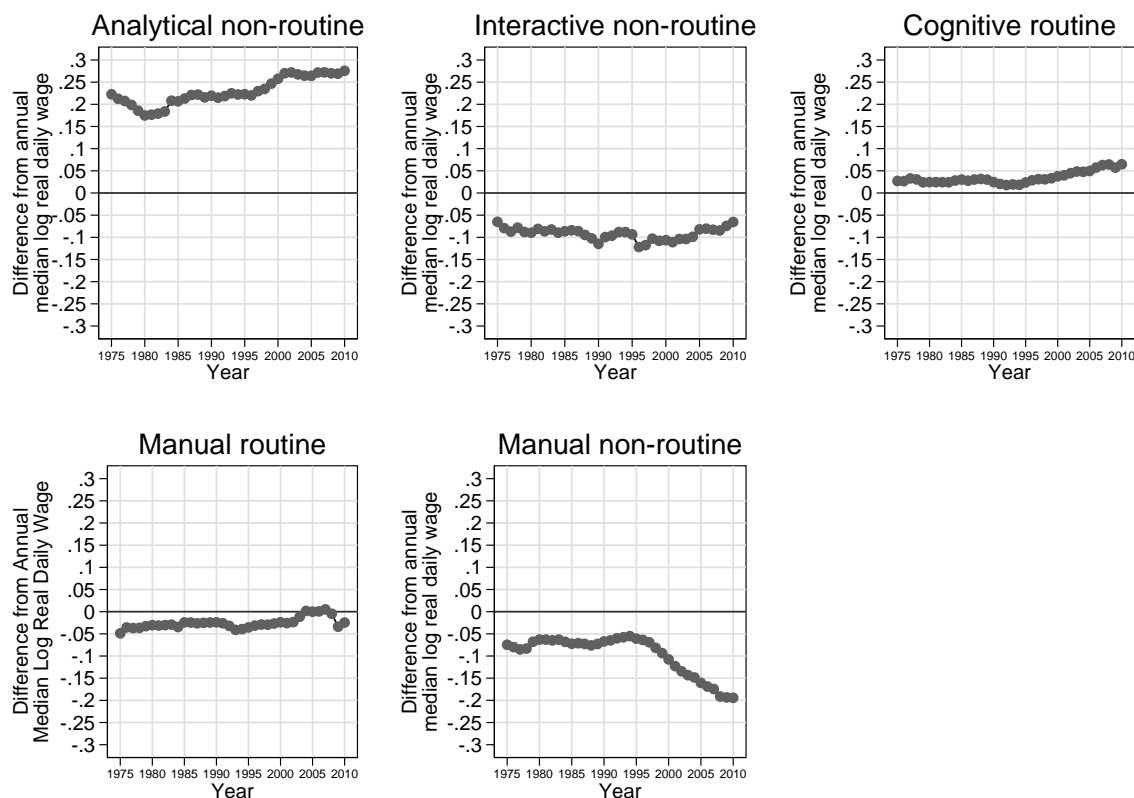
Source: 2% IABS Sample for full-time workers with a positive wage spell. N=11,780,901 for all workers and N=3,522,819 for young workers.

Note: Both lines represent the median log real daily wage. It is computed as the logarithm of the inflation-adjusted daily wage of workers with a non-negative wage spell. The annual number of observation varies between 308,096 in 2005 and 359,644 in 1992 for all workers and 77,393 in 2009 and 124,916 in 1992 for young workers.

The wage development in the five occupational task groups resembles the wage development of the total young labour force. For that reason we describe the wage gaps for each task group. Figure 4 displays the deviation of the median real wage for each task group from the median real wage of all young workers only. Analytical non-routine jobs pay best, manual non-routine jobs pay worst. The deviations from the median wage for the analytical non-routine and manual non-routine jobs slowly increase over time which is in line with the SBTC literature. The wage gap for workers performing analytical non-routine jobs increased notably between 1996 and 2001, with a wage gap increasing from 22% to 27%. Even after the burst of the Tech bubble, relative wages for these jobs remained high. The negative wage differential for manual non-routine jobs started to widen in 1995, overall from 5% to 20%. The deviations from the median

for the remaining task groups are, in comparison, relatively constant over time. For cognitive routine and routine interactive occupations, there is slow and minor, but constant increase after 1995.

Figure 4: Percentage deviation of the median log real daily wage by performed main task of young workers (1975-2010)



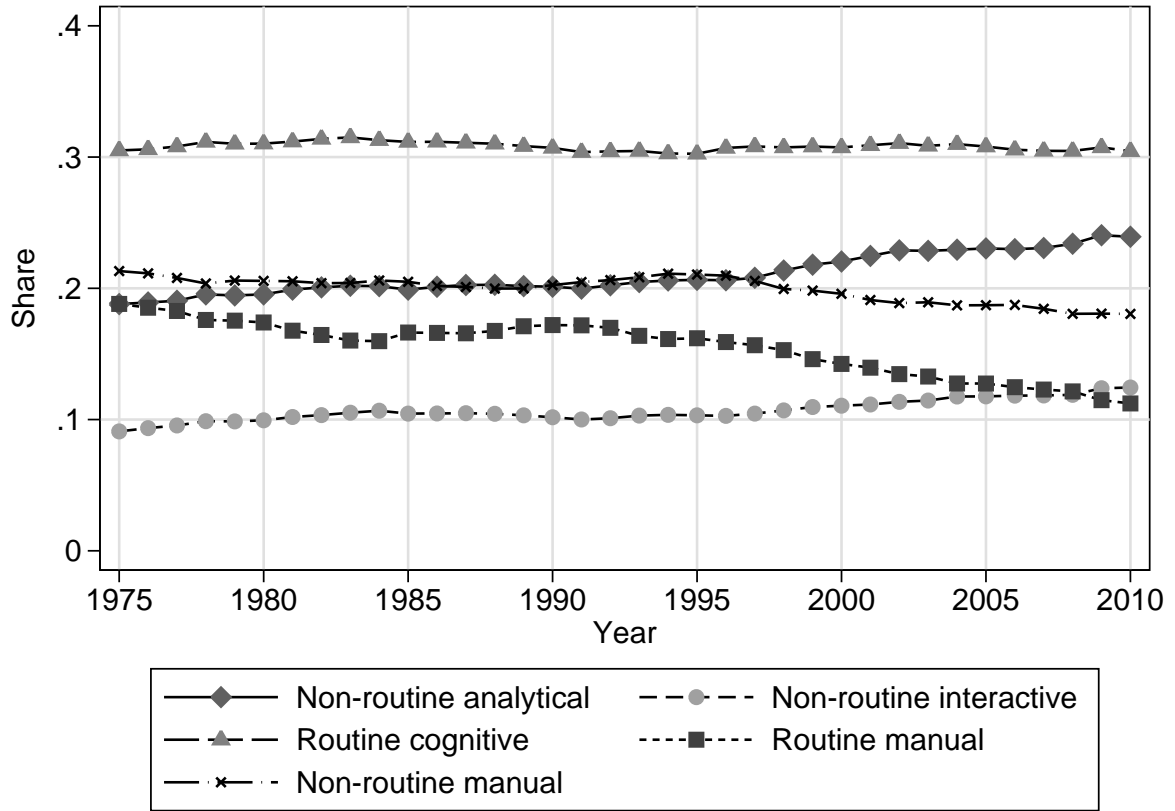
Source: 2% IABS Sample for full-time workers between 25 and 35 years of age with a positive wage spell and whose jobs can be grouped into a task field. $N=3,428,680$.

Note: All lines represent the deviation of the annual development of median log real daily wage in one task from the the median log real daily wage of all workers in this year. A positive gap denotes a median log real daily wage in a task higher than the median log real daily wage in a specific year. The number of observations varies between 6,151 for non-routine interactive workers in 1975 and 41,578 for routine cognitive workers in 1992.

4.2 Skill-biased technological change

Jobs require a variety of tasks. Figure 5 displays the average task share of young workers using the task attribution by Dengler et al. (2014). There was a constant increase in the share of non-routine analytical tasks, especially after 1997, coinciding with increasing wages in non-routine analytical jobs and the increase of highly-educated workers. The fraction of routine manual jobs constantly declined, but the share of routine cognitive task remained constant, and was the largest proportion of all tasks. Coinciding with the increase in analytical non-routine tasks, the fraction of non-routine manual tasks decreased from 1997.

Figure 5: Average task share performed by young workers (25 to 35 years of age)



Source: 2% IABS Sample for full-time workers between 25 and 35 years of age. $N=3,530,494$. Number of observations vary from 125,295 in 1992 and 77,951 in 2009.

Note: All lines represent the annual average level of each task. Each job is assigned proportions of tasks performed according to Dengler et al. (2014). The means represent the task shares within each job. Annual proportional average task shares do not add up to 1 since some jobs cannot be classified into tasks. The sum varies between 95.9% in 2008 and 98.7% in 1984.

Since educational composition of the workforce and the share of highly-skilled workers has increased over time but the average employment share in non-routine analytical tasks remained constant, this might imply an occupational downgrading for highly-skilled workers in which the average task share for non-routine analytical tasks shrinks for highly skilled workers. This process has been described for the U.S. in (Beaudry et al., 2013, 2014). Decomposing the average task performance for each individual educational group may reveal a shift for highly-skilled workers performing jobs that do not require their gained analytical skills. Figure 6 therefore displays a decomposition for average tasks performed for each educational attainment.

The average analytical task shares are sorted according to the duration of educational attainment (upper left panel). It is highest for workers with a university degree and lowest without vocational training. The average shares are almost constant. There was only a slight decline for highly-skilled workers until 1990. For the high-flh-skilled young workers there was a further slight decrease after 2000. However, the share of non-routine analytical tasks for each

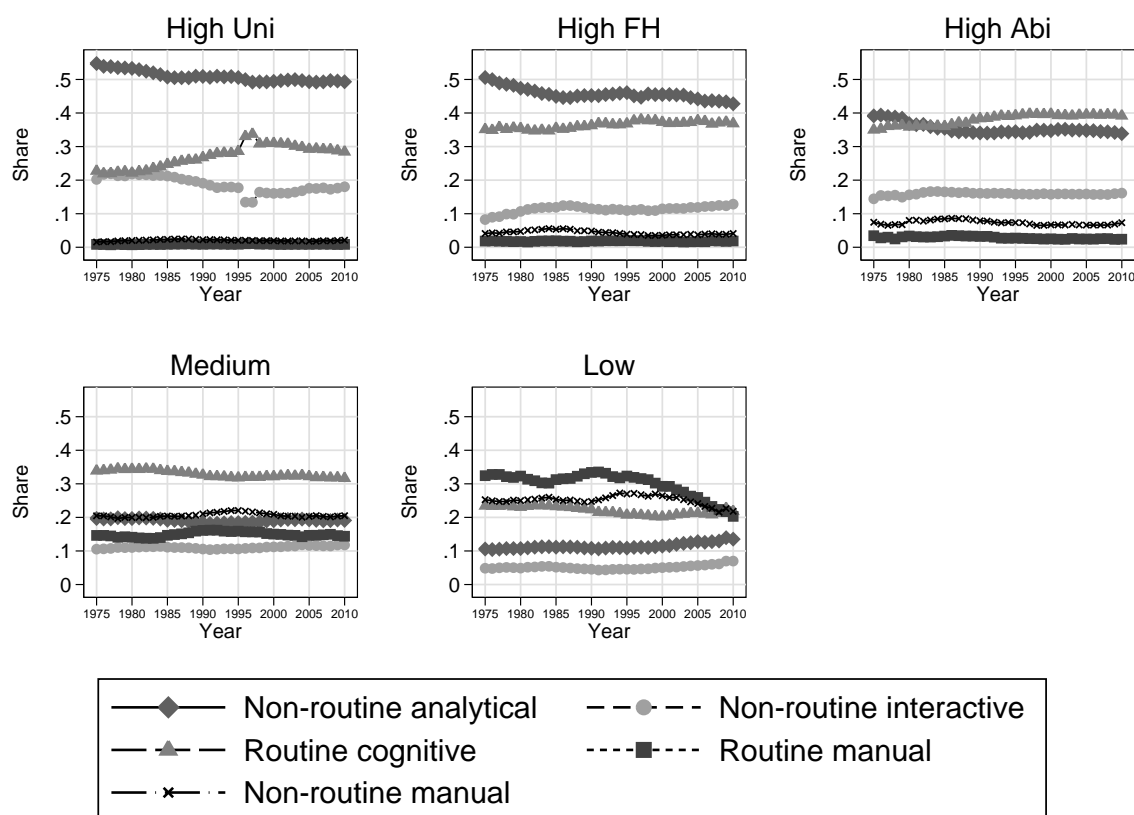
educational group was rather constant in time, which could imply a transition to more non-routine analytical tasks through a shift in the educational attainment. The share of non-routine interactive tasks, that was slightly increasing for the overall young workforce decreased for high-uni-skilled until the mid-1990, and slowly increased after 2000. For high-fh-skilled and high-abi-skilled workers the share of non-routine interactive tasks was constant.

Routine cognitive tasks have become more important for highly-skilled workers until 1997. However their fraction in the task composition fell slowly after 2000. For the high-fh- and high-abi-skilled young workers the share was similarly rising until the mid-1990s and remained on that higher level from then on. The routine manual and non-routine tasks play a minor role for highly-skilled workers.

Overall, the share of highly-skilled workers performing non-routine analytical jobs did not decrease – also, we cannot observe that highly-skilled workers performed more routine jobs routine after 2000. Similarly, we cannot observe a cascading pattern that is described in (Beaudry et al., 2014). With the slight increase of highly-skilled workers in routine cognitive jobs, there was a coinciding trend of an increasing relative wage gap in this task group (see figure 4). This may hint at an academisation of these jobs if wage premia exist.

For the high-skilled, the share of routine cognitive tasks constantly increased at the expense of non-routine interactive tasks whereas the remaining task shares remained rather constant over time. For the high-fh-skilled the share of routine cognitive tasks similarly increased constantly notably at the expense of non-routine analytical tasks before 1985 and after 2003 and non-routine interactive tasks between 1987 and 1992. The task composition for high-abi-skilled young workers remained rather constant after 1990. Until 1990, the share of non-routine analytical task decreased and the routine cognitive tasks increased.

Figure 6: Average task performed by educational group (25 to 35 years of age) – alternative way to display



Source: 2% IABS Sample for full-time workers between 25 and 35 years of age. N=3,530,494.

Note: All lines represent the annual mean of each task performed. Each job is assigned proportions of tasks performed according to Dengler et al. (2014). The means represent the task shares within each job. The number of observations vary from 125,295 in 1992 and 77,951 in 2009. Annual proportional average task shares by educational attainment do not add up to 1 since some jobs cannot be classified into tasks. The sum varies from 84.3% for low-educated workers in 2008 to 1 for observations of high-skilled workers in the 1970s. With exception of low-skilled workers, all annual task shares sum up to at least 97%.

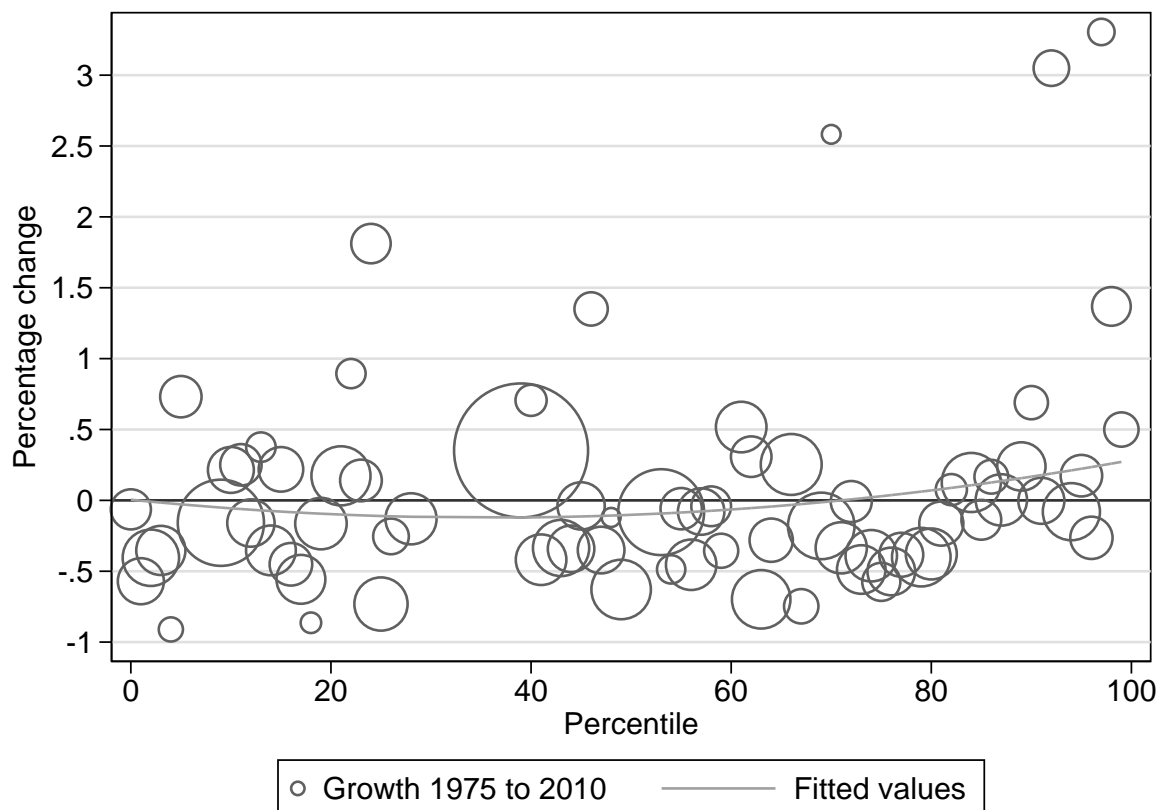
Job polarisation

We find a job polarisation, described among others in (Goos and Manning, 2007), in Germany which is displayed in figure 7. We order jobs in percentiles according to their mean wage in 1990 and observe the growth of jobs between 1975 and 2010. There is a u-shaped pattern in which top- jobs and bottom-paying jobs grow more profoundly than medium-paying occupations.

In general, it could imply that coinciding with advancing educational attainment of time, the number top-paying jobs increases. However, if there is a pattern in which growth of highly-skilled workers is greater than the growth in top-paying jobs, there could be a cascading pattern in which highly-skilled workers perform jobs previously done by medium-skilled workers, who

are crowded out of their jobs, and who for their parts perform jobs previously done by low-skilled workers. The latter effect could be amplified since medium-paying occupations grow slower than occupations at both tails of the wage distribution.

Figure 7: Job polarisation of all workers (average 1990 wages)



Source: 2% IABS Sample for full-time workers with information on job. N=318,186 in 1975, N=310,303 in 2010. Note: Jobs are ordered according to their 1990 mean wage and assigned a percentile in the 1990 wage distribution. One percentile can contain more than one job. The percentage change represent the growth of jobs from 1975 to 2010. The size of the circles represent the number of observations in each percentile in 1975. The fitted values represent the predicted values of a linear regression of the growth onto the percentiles and percentiles squared that is weighted with the number of observations in each percentile in 1975.

We further analyse whether highly-skilled labour market entrants work in the highest paid jobs after labour market entry. We order jobs according to their average wage over all years. We define top jobs as jobs that pay above the 70th wage percentile and bottom jobs that pay below the 30th wage percentile. The remainder is defined as medium. We then analyse whether the share of highly-skilled labour market entrants with five years of potential experience in top-paying jobs over time. Figure 8 displays the results.

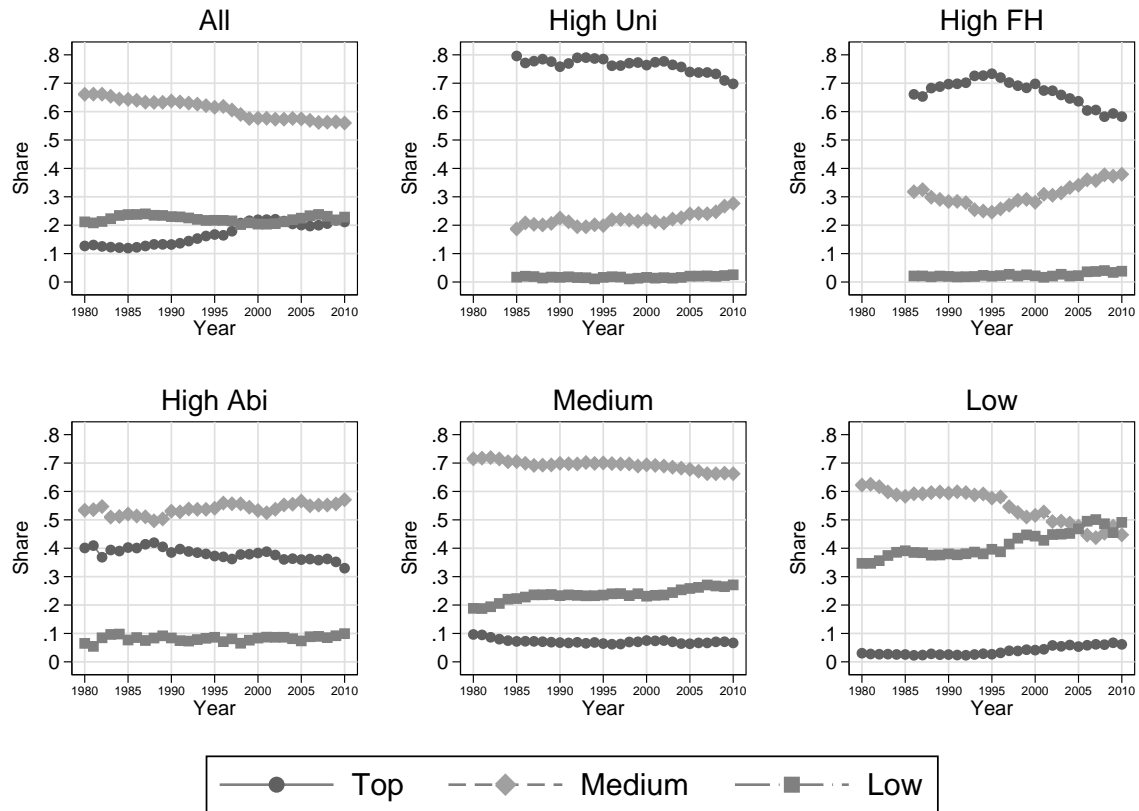
The share of labour market entrants in top paying occupations increases from 14% in 1975 to 21% in 1998 for all workers with a potential experience of five years. It stagnates on that level thereafter. The shift mainly occurs in the 1990s. At the same time the fraction of workers

in the bottom paying jobs remained constant during the full observation period. The shift towards more workers in the top-paying occupations occurred through a reduction of workers in medium-paying jobs.

Distinguishing between occupational attainments may reveal adverse opportunities for highly-skilled workers. University graduates face a decreasing chance of working in top-paying jobs, the fraction declined from 80 in 1985 to 70% in 2010, especially after 2000 and notably in support of medium-paying jobs. The shift is similarly profound for high-fh-skilled workers that faced a drastic drop in the fraction of workers in top-paying jobs from 70 to 58% between 2000 and 2010 in favour of medium-paying jobs. For high-abi-skilled workers there is a similar drop of the share working in top-paying occupations from 48 to 33% between 1975 and 2010 – however, this decline was comparably slow and constant. For highly-skilled workers the chance of working in a bottom-paying job are relatively low and constant.

Coinciding with more highly-skilled workers in the top-paying jobs, the fraction of medium- and low-skilled workers in bottom-paying jobs increased over time. For low-skilled workers, other than for medium-skilled workers, this coincided with a decreasing chance of working in the medium-paying sector. The presented results are in favour of a cascading effect of workers suppressing one another out of high-paid jobs.

Figure 8: Job ordering, five years of potential experience



Source: 2% IABS Sample for full-time workers between 25 and 35 years of age with information on job. N=937,786 for all workers. N=63,549 for high-uni, N=39,380 for high-fh, N=45,498 for high-abi, N= 641,974 for medium, N=147,134 for low.

Note: Jobs are ordered according to their mean wage and assigned to a percentile in the wage distribution. One percentile can contain more than one job. Jobs that have a mean wage above the 70% percentile are denote as top jobs, jobs below the 30% median as bottom jobs, the remainder is denoted as medium jobs. Each line represents the annual share of workers after five years of potential experience in occupations that we denote as top, medium or bottom. Each panel represents a different educational attainment. For some years and educational groups there are missing observations due to data nondisclosure.

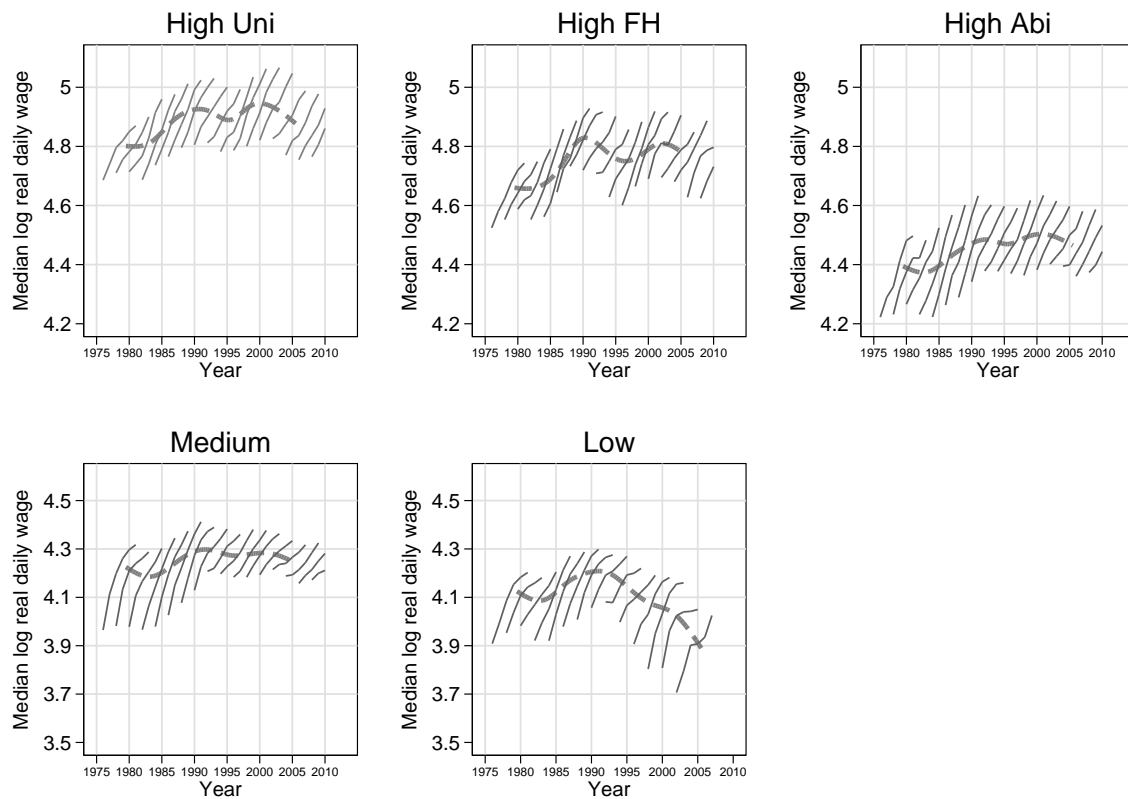
4.3 Labour market entrants

Figure 3 displayed the increasing wage gap between wages for all workers and young workers that notably occurred after 2003. Figure 9 displays how job entrants perform in their first five years of labour market entry by educational attainment and potential and observed experience. Each line represents a different cohort starting with the first year the educational attainment has been reached. To increase the number of observations, two cohorts are pooled to one.

In short, both starting wages and wages after 5 years of potential experience tended to increase until the year 2000 and inclined to fall thenafter. For the low-skilled workers the fall of wages started in the early 1990s. For medium-skilled workers wage growth flattens after the 2000-

cohort. With the declining share of workers in top-paying positions for highly-skilled young workers described above, wages similarly decreased for subsequent cohorts between 2000 and 2006 – however, this holds for all groups of highly-skilled workers. For the cohorts after 2006, entry wages stabilised but remained on a lower level.

Figure 9: Median log real daily wage profiles for labour market entrants – potential experience



Source: 2% IABS Sample for full-time workers with less than five years of potential experience with a positive log real daily wage. N=1,391,358. N= 104,348 for high-uni-skilled, N= 59,623 for high-fh-skilled, N=77,569 for high-abi-skilled, N= 934,052 for medium-skilled, N= 215,766 for low-skilled.

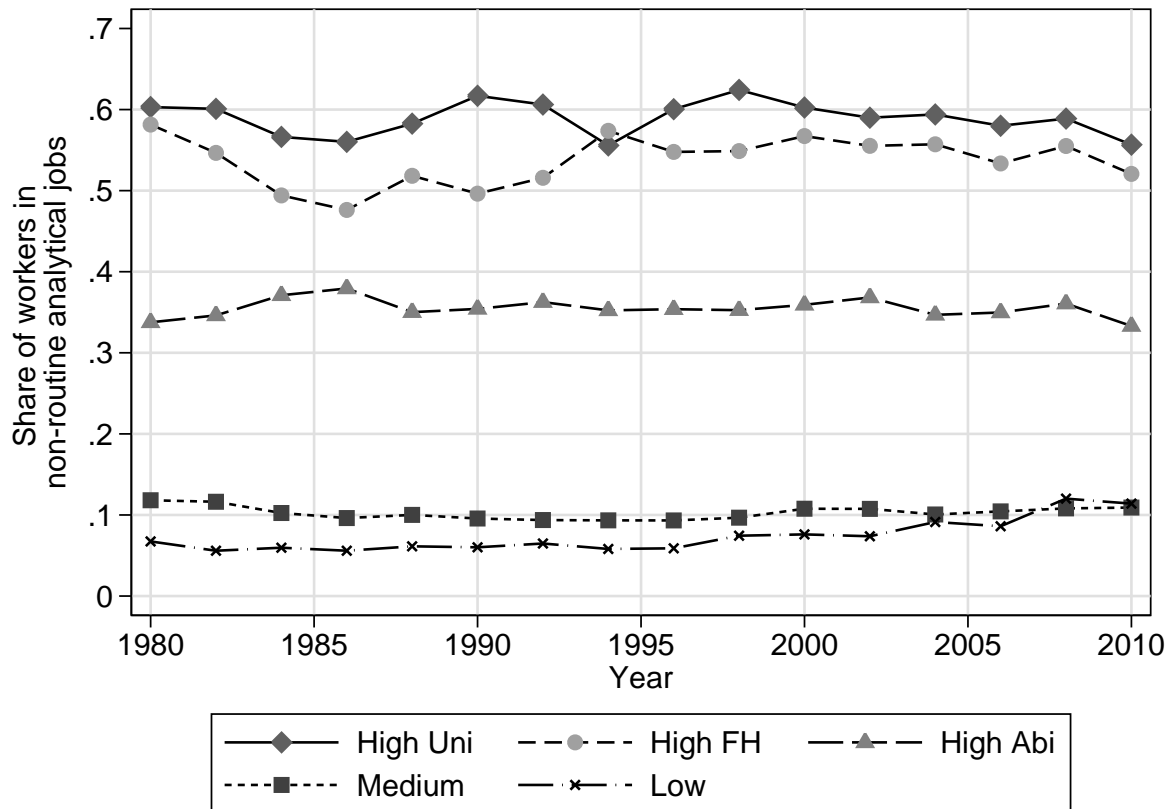
Note: Median wage profiles display the log real median wage by potential experience and cohort. Each solid line represents one cohort where two years are pooled to one cohort to increase number of observations. The dashed line represents the splines for the median of the 1976 to 2008 cohort – where information for 0 to 5 years of potential experience is available. It uses the function `twoway mspline` in STATA that makes use of the cross medians as knots to fit a cubic spline. Each panel represents a varying educational attainment. Cohorts after 2004 are omitted for low-skilled workers due to very low wages.

4.4 Opportunity of performing an analytical job

Performing an analytical job promises not only higher wages but also the application of skills that highly-skilled workers have gained during their qualification. Figure 10 displays the analytical employment shares by educational attainment over time for workers with 5 years of potential experience. The share of workers performing analytical jobs is higher the higher their

educational attainment. The fraction of workers in analytical jobs is quasi-constant for all skill groups - there is only low variation for the highly-skilled workers. After 2000, for high-uni-skilled and high-fh-skilled the share of workers in analytical jobs slightly but constantly decreased. However, there was no drastic decline of the opportunity of performing an analytical job after five years of potential experience.

Figure 10: Share of workers in non-routine analytical jobs by educational attainment (5 years of potential experience)



Source: 2% IABS Sample for full-time workers with less than five years of observed experience with a positive (or real) daily wage. N= 305,904. N= 21,251 for high-skilled, N= 13,161 for high-fh-skilled, N=15,070 for high-abi-skilled, N= 211,603 for medium-skilled, N= 44,819 for low-skilled.

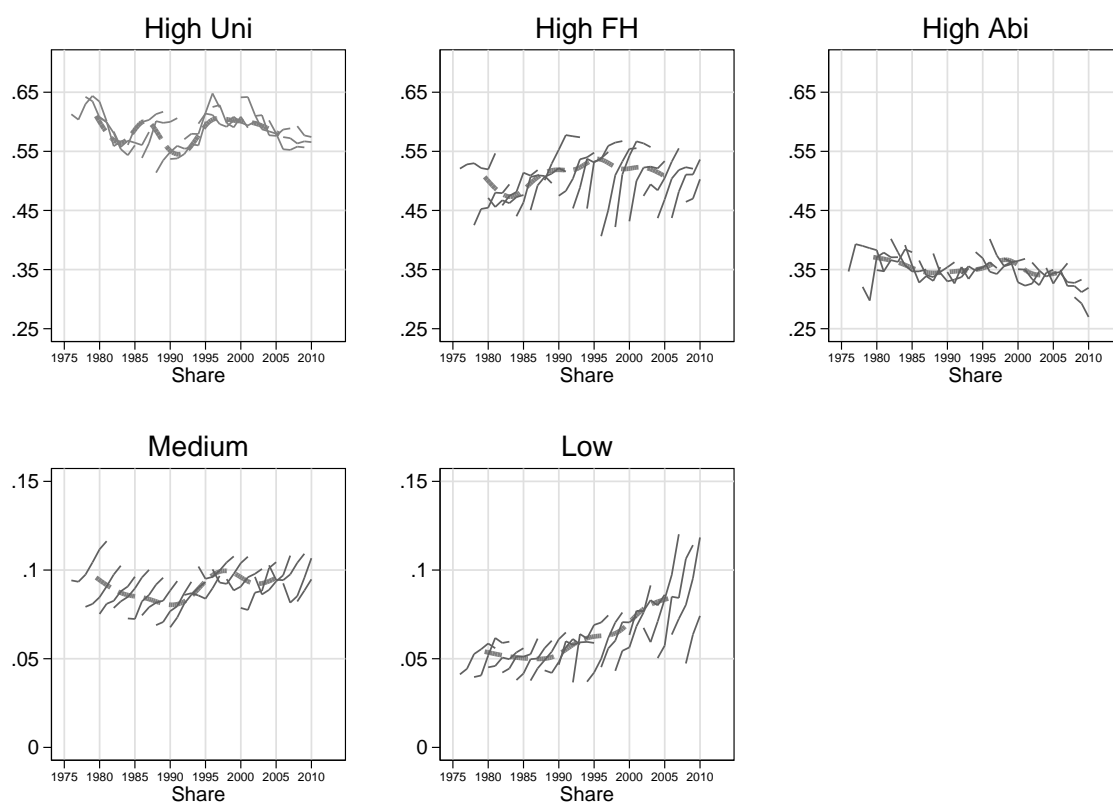
Note: The share of workers in the non-routine analytical sector by educational attainment displays the fraction of workers after 5 years of potential experience that perform a non-routine analytical job. Each line represents a varying educational attainment. Two years are pooled to increase the number of observations.

Figure 11 plots the employment share profiles in analytical jobs after labour market entry for different educational attainments. A simple Roy model would predict that workers sort in the occupation where they expect the highest wages. Given that occupation- and task-specific knowledge decrease the chances of switching with increasing potential experience, one can expect that young workers sort themselves into jobs in the beginning of their career where they expect the highest lifetime earnings.

For most cohorts and educational attainments, the share of workers performing analytical jobs increases with potential experience. These occupations are favoured by the workers due to higher wages and the opportunity to apply gained skills. However, there are variances between and within cohorts. Regarding the opportunities between cohorts, the share of highly-uni-skilled workers in analytical jobs decreases for cohorts after the late 1990s, while they have tended to increase for cohorts entering the labour market between the late 1980s and late 1990s. Observing inter-cohort shares of workers in analytical jobs one observes an increase for high-fh, medium- and low-skilled workers with increasing potential experience for all cohorts.

For high-uni skilled workers, there is a sorting out of analytical jobs for cohorts after the 1996. This similarly holds for high-abi-skilled workers. The decrease of analytical employment within cohorts with increasing potential experience hints at decreasing wages in analytical jobs.

Figure 11: Share profiles of workers in the analytical non-routine sector by educational attainment (potential experience)



Source: 2% IABS Sample for full-time workers with less than five years of observed experience with a positive log real daily wage. N= 1,475,672, N= 110,802 for high-skilled, N= 63,385 for high-fh-skilled, N= 80,499 for high-abi-skilled, N= 1,002,687 for medium-skilled, N= 218,299 for low-skilled.

Note: Share profiles display the share of workers performing a non-routine analytical job by potential experience and cohort. Each solid line represents one cohort where two years are pooled to one cohort to increase number of observations. The dashed line represents the splines for the median of the 1976 to 2008 cohort – where information for 0 to 5 years of potential experience is available. It uses the function `twoway mspline` in STATA that makes use of the cross medians as knots to fit a cubic spline. Each panel represents a varying educational attainment.

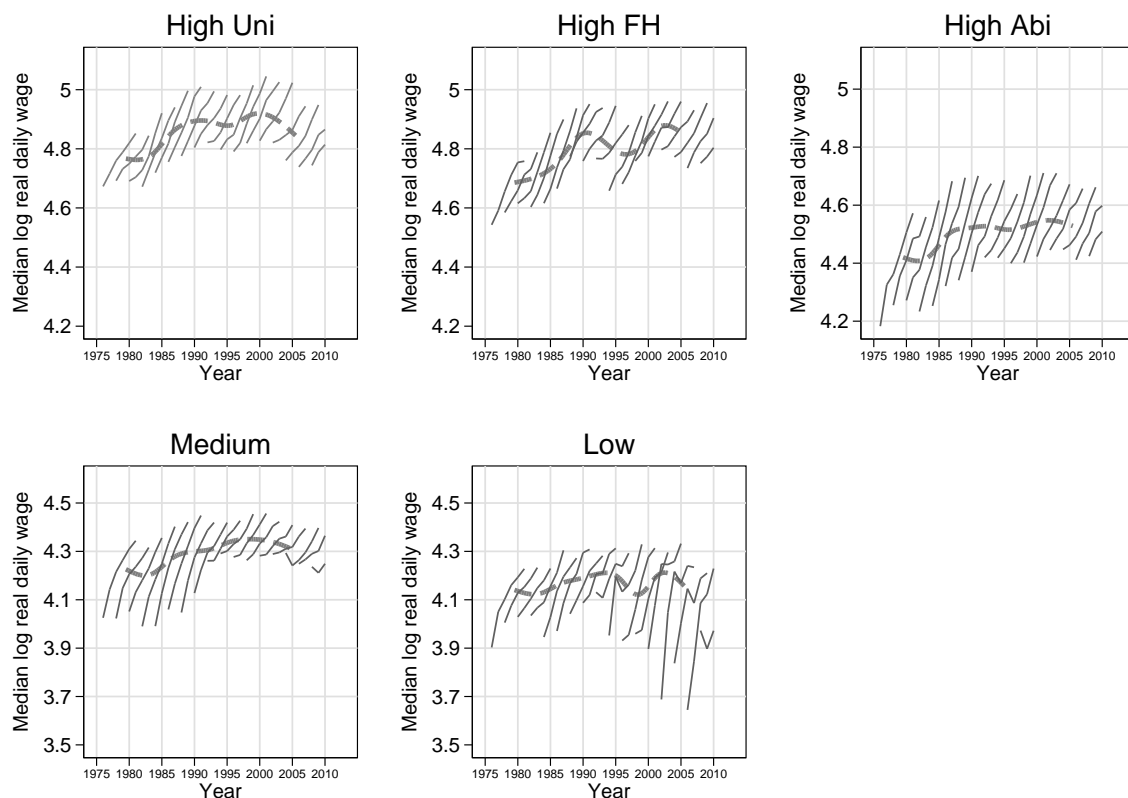
Separating workers in and outside analytical jobs, the decreasing wage opportunities of analytical jobs may be revealed. Figure 12 displays the wage profiles for workers in analytical jobs and figure 13 for those who do not work in analytical occupations.

Real wages tended to decline after 2000 for all workers – this is present for all educational attainments, and both for workers in and outside analytical jobs. From 2000, both starting wages and wages after a potential experience of 5 years have declined – however wage growth seemed not to be affected. For all educational groups, except for high-uni-skilled workers, wages after a potential experience of 5 years were higher in analytical occupations. This may explain why

high-uni-skilled workers sorted out of analytical jobs and the remaining educational attainments, with exception of high-abi-skilled, sorted in analytical jobs with increasing potential experience.

There was no distinct fall of wages for highly-skilled workers. There was a positive wage growth in the first five years of labour market entry for all cohorts, and both for workers in and outside analytical jobs. Also, there was a strong relationship between the annual variation of wages between those working in and outside analytical jobs.

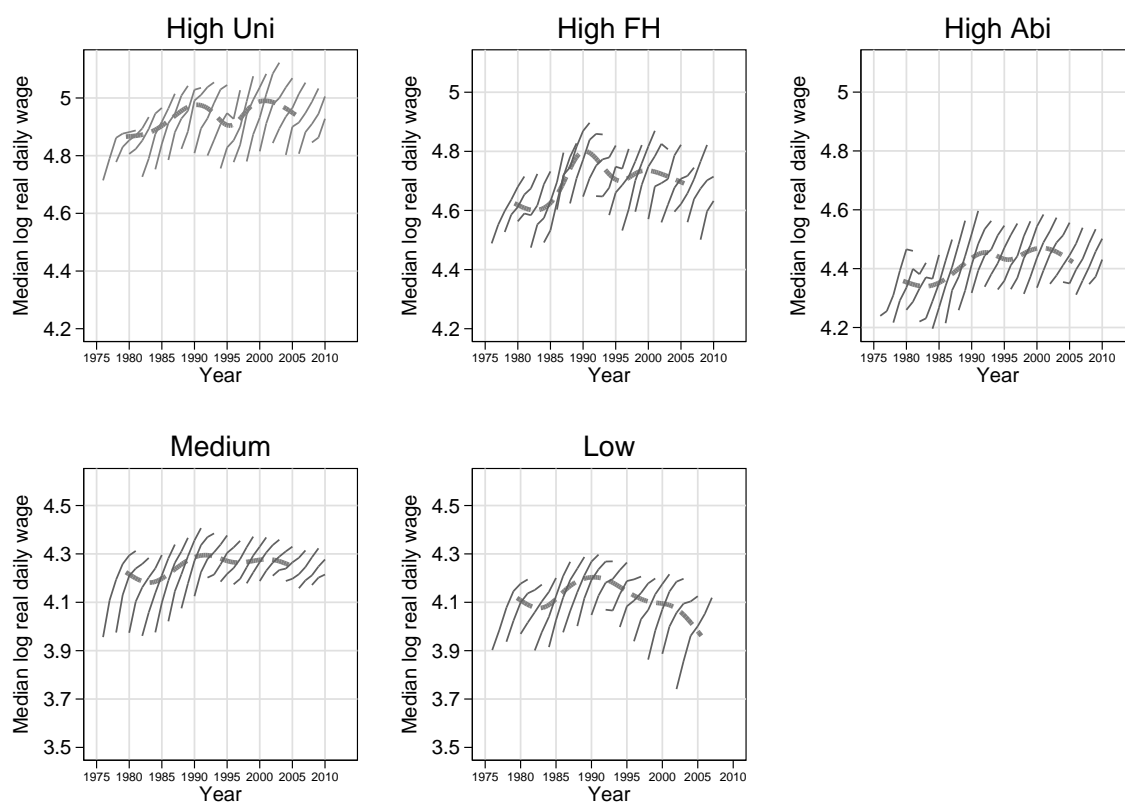
Figure 12: Median log real daily wage profiles for labour market entrants in the non-routine analytical sector (potential experience)



Source: 2% IABS Sample for full-time workers with less than five years of observed experience with a positive log real daily wage. N= 216,695. N= 63,073 for high-skilled, N= 31178 for high-fh-skilled, N= 27,477 for high-abi-skilled, N= 83,822 for medium-skilled, N= 11,175 for low-skilled.

Note: Median wage profiles display the log real median wage by potential experience and cohort. Each solid line represents one cohort where two years are pooled to one cohort to increase number of observations. The dashed line represents the splines for the median of the 1976 to 2004 cohort – where information for 0 to 5 years of potential experience is available. It uses the function `twoway mspline` in STATA that makes use of the cross medians as knots to fit a cubic spline. Each panel represents a varying educational attainment.

Figure 13: Median log real daily wage profiles for labour market outside the non-routine analytical sector (potential experience)



Source: 2% IABS Sample for full-time workers with less than five years of observed experience with a positive log real daily wage. $N = 1,154,402$. $N = 44,311$ for high-skilled, $N = 29,533$ for high-fh-skilled, $N = 51,591$ for high-abi-skilled, $N = 843,577$ for medium-skilled, $N = 185,390$ for low-skilled.

Note: Median wage profiles display the log real median wage by potential experience and cohort. Each solid line represents one cohort where two years are pooled to one cohort to increase number of observations. The dashed line represents the splines for the median of the 1976 to 2004 cohort – where information for 0 to 5 years of potential experience is available. It uses the function `twoway mspline` in STATA that makes use of the cross medians as knots to fit a cubic spline. Each panel represents a varying educational attainment.

4.5 Wage premia

Declining opportunities of young highly-skilled workers getting a high-paying job can also be analysed by observing the wage premia of higher degrees over time. We do so applying a variant of the Mincer earnings equation (Mincer, 1974) displayed in equation 1. Besides the usage of potential experience (`pexp`), we add a female dummy variable and replace the years of schooling by educational dummy variables to estimate wage premia of educational attainment. The reference category are low-skilled workers. We further add dummy variables for tasks where the reference category is non-routine manual jobs.

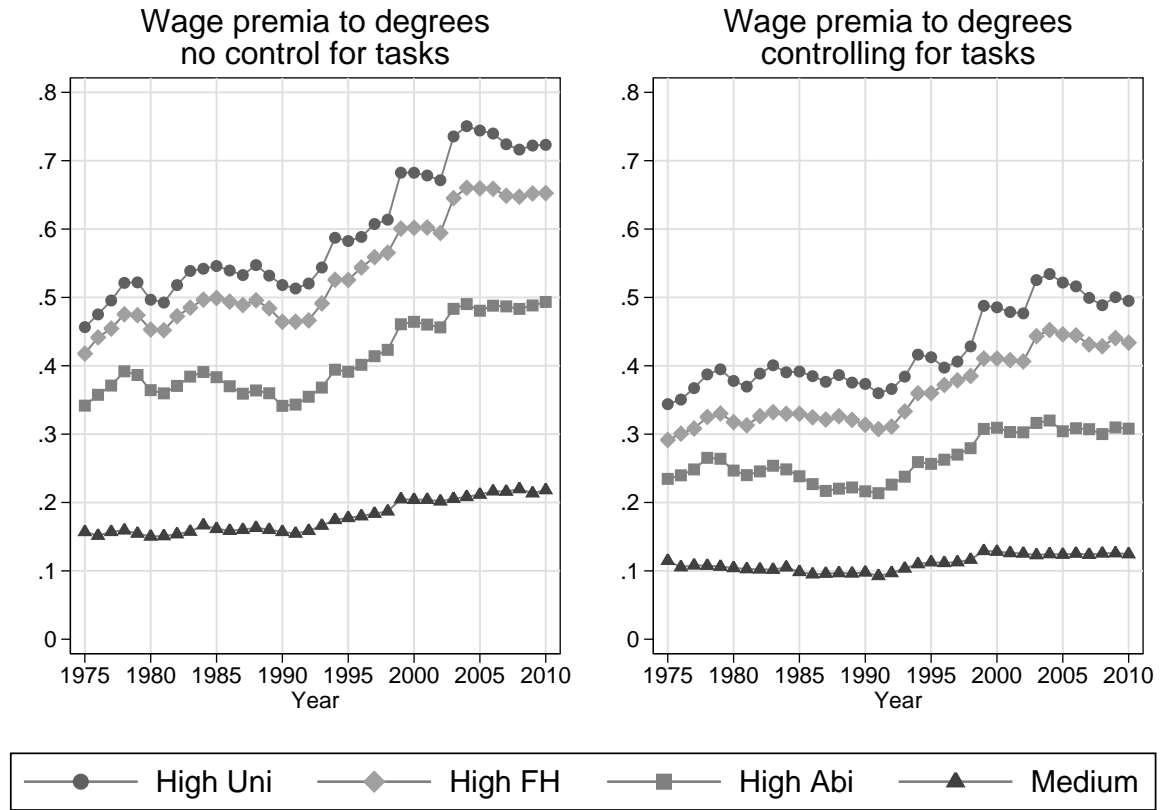
$$\begin{aligned}
E(\log(wage)) = & \alpha + \beta_1 pexp + \beta_2 pexp^2 + \beta_3 female + \\
& \beta_4 high + \beta_5 highfh + \beta_6 highabi + \beta_7 medium + \\
& \beta_8 analytical + \beta_9 interactive + \beta_{10} cognitive + \beta_{11} routinemanual
\end{aligned} \tag{1}$$

We analyse wage premia over time by estimating the equation for each year separately. Figure 14 displays wage premia over time, both with and without controlling for tasks. Wage premia relative to low skills increased from the early 1990s for highly-skilled individuals until 2003 and stagnated thereafter. The wage premium for being medium-skilled however only slightly increased – the wage gap between medium- and highly-skilled workers thus similarly increased over time. Higher education, independent of having a degree at a university, university of applied sciences or holding a high-school admittance and completing vocational training, was associated with an increasing wage premium relative to low and medium education. Still, the gaps in the wage premia between the different variants of higher education were constant over time. This could be also be interpreted as a relative fall of wages and demand for low- and medium-skilled workers from the early 1990s to the early 2000s.

The magnitude of the wage premia of high-skilled and the relative increase reduce when controlling for task groups. The relative increase of wage premia is similar. For highly-skilled workers wage premia increased between the early 1990s and 2000s, whereas the wage premia for the subgroups moved in parallel. The university/abi wage gap widened from 10 percentage in 1975 to 18 percentage points in 2010. The increase in the wage premium of medium-skilled workers relative to low-skilled workers almost vanishes controlling for task groups.

Both panels show the increase in wage premia relative to low- and medium-skilled workers. Figures 8 and 9 revealed a declining for low-skilled workers. The increase in wage premia of highly-skilled workers can thus also be interpreted as a relative fall of demand and wages for low-skilled workers. However, the wage premia also raised relative to medium-skilled workers. Most importantly for the analysis at hand, the relative gap in wage premia of the highly-skilled workers remained constant over time. Also, the increase of wage premia was limited to a time span between the early 1990s and early 2000s. From the beginning of the 2000s, all educational groups faced a similar decline in wages, but the difference between educational groups vanished.

Figure 14: Wage premia for educational groups (25 to 35 years of age)



Source: 2% IABS Sample for full-time workers between the age of 25 and 35 years with a positive log real daily wage. Left panel: N= 6,562,891. Number of observations vary for each regression between 166,579 in 1975 and 195,293 in 2001. Right panel: N= 6,401,423. Number of observations vary for each regression between 161,084 in 1975 and 190,230 in 2001.

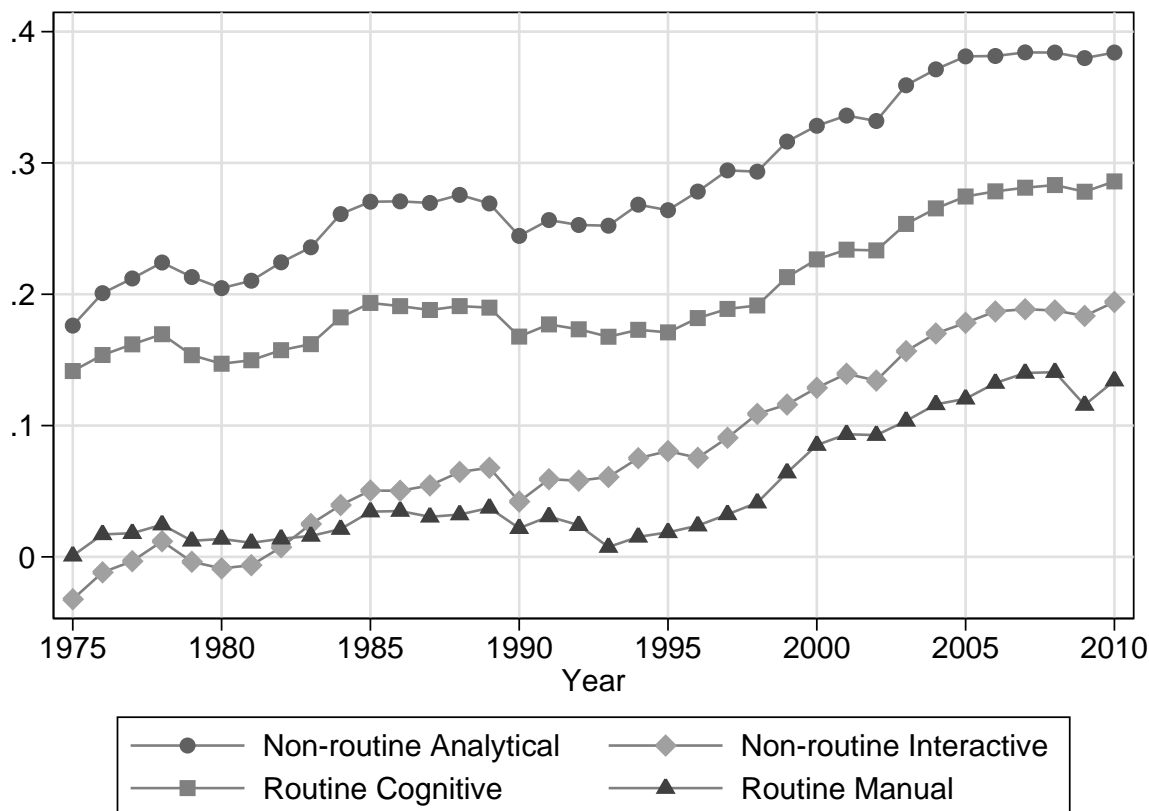
Note: Wage premia represent the dummy variables for each year and each educational attainment applying a Mincer earnings equation with potential experience, potential experience squared and a female dummy variable. The left panel does not control for jobs, the right panel controls for task performed according to their main task. Base category is low educational attainment. All dummy variables regarding educational attainment are statistically significant at the 1% confidence level.

Similar to the fall in wages for low-skilled workers, we have shown a fall of relative wages in the non-routine manual sector in figure 4. Figure 15 shows the results for the task dummy variables over time. The non-routine analytical sector has the highest premium for all years. Routine cognitive tasks yield the second highest wage premia – the gap between task groups slightly increase over time in accord with the RBTC literature (Goos et al., 2014), but are constant from the mid-1990s. Similarly in line with the RBTC is the narrowing of the wage gap between non-routine interactive and routine cognitive and manual jobs, which is however constant after the mid-1990s.

Relative wage premia increase with the fall of wages in non-routine manual jobs from the mid-1990s until the mid-2000s. Whereas the negative wage gap in non-routine manual jobs

continually grew, wage premia relative to non-routine manual task did not further widen after the mid-2000s. Wage premia for performing analytical and routine cognitive moved in parallel from the mid-1990s. The stable relative wage gaps in routine cognitive jobs after 1995 may thus entail an academisation in these jobs – that is also associated with a wage premium for workers holding a higher degree.

Figure 15: Task groups (25 to 35 years of age)



Source: 2% IABS Sample for full-time workers between the age of 25 and 35 years with a positive log real daily wage. N= 6,401,423. Number of observations vary for each regression between 161,084 in 1975 and 190,230 in 2001.

Note: Each line represents the dummy variables for each main task by year applying a Mincer earnings equation with potential experience, potential experience squared, a female dummy variable and educational dummy variables. The base category is non-routine manual tasks. All dummy variables regarding performed main tasks are statistically significant at the 1% confidence level, except for routine manual in 1975, and non-routine interactive in 1977, 1979, 1981, and 1982.

5 Conclusion

The share of young workers with a higher educational attainment started to increase in Germany from the mid-1990s and coincided with a decline of the number of young subsequent persons due to demographic change. From the mid-1990s, real wages did stagnate, especially

for the young. Relative wages of workers performing analytical jobs, mostly performed by highly-skilled workers, increased until the early 2000s. Relative wages in routine cognitive tasks similarly increased, coinciding with an increasing share of highly-skilled workers in these occupations. Relative wages of non-routine manual jobs, mainly performed by low- and medium-skilled workers, decreased. This process is accompanied with a relative increase of routine cognitive tasks, along with an rising share of highly-skilled workers, and a decrease in routine manual and non-routine manual jobs.

We find a job polarisation in which the number of occupations at the top and bottom of the wage distribution increased. Also, the share of young workers in medium-paying occupations declined, whereas the number of young workers in top-paying occupations increased. However, the chances of working in top-paying occupations fell for highly-skilled individuals. The declining opportunity of getting a top-paying job for highly-skilled workers over time does not translate into declining wages itself. Also, the wage gap between the different types of highly-skilled workers did not increase over time, nor did the gap in the opportunity to work in analytical occupations widen. Quite counterintuitively, for workers with a university degree, those who perform analytical jobs do not earn more than those outside analytical jobs. Highly-skilled workers tended to perform more routine cognitive tasks over time, while relative wages for these jobs increased between the mid-1990s and mid-2000s.

Wage premia for highly-skilled workers, relative to low- and medium-skilled workers rose between the mid-1990s and mid-2000s, contemporaneously with increasing returns in analytical jobs but also an increasing share of highly-skilled workers in routine cognitive jobs. This result is in line with findings from the U.S. (Beaudry et al., 2014). At the same time we do not find evidence for widening wage gaps and adverse opportunities for workers with higher, but not highest, education. However, we do find evidence for an increasing wage gap for highly-skilled individuals supporting the literature of the skill-biased technological change – though this wage gap stabilises after 2003.

Within the group of highly-skilled workers, we do not observe a cascading pattern in which high-uni-skilled workers push down high-fh- and high-abi-skilled workers – however, we find a pattern in which the wage and occupational opportunities for medium- and low-skilled workers decline – although the high-medium wage gap and the high-low wage gap was constant for recent years.

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Appendix

A Age of labour market entry

The design of the data does not allow conclusions on the labour market entry of an individual. A spell with a new individual in the data set could either be a person that has not worked

previously or a person that has been randomly drawn from the data set. For that reason, one cannot draw inferences on the labour market entry of an individual. As a proxy, we use two definitions of labour market entry denoted 'potential' and 'observed' experience. Potential experience is computed by the difference between the age of an individual and the age of labour market entry given a certain educational attainment. Observed experience individual-specific. An individual that changes the highest occupational attainment is defined as labour market entrant. Also, all new individuals to the data set that are below the age of typical labour market entry are defined as labour market entrants.

The age of labour market entry is drawn from the data at hand. We observe the number of observations for each educational attainment and age (table A1). We assume that at the age of 35 years the final educational attainment has been reached. We compute the fraction of observations for each educational attainment and age by the number of observations for each educational attainment at the age of 35 years and set the typical age of labour market entry as the age where the share exceeds the 50% margin. This method promises an approach to the age of labour market entry.

Table A1: Number of observations by educational attainment and age

Age	No vocational training	Vocational training	Abitur, no vocational training	Abitur, vocational training	University of applied science	University
16	3463	926				
17	10489	5189				
18	20215	25896				
19	31351	71953	1024	255		
20	36678	113359	2005	695	191	50
21	40860	152105	2800	2371	428	79
22	43881	184126	2739	5898	800	160
23	45398	202557	3037	9935	1507	412
24	45933	212027	3170	12653	2731	1039
25	46035	214967	3218	14136	4547	2566
26	46144	214980	3380	15012	6924	5598
27	46397	212912	3391	15276	9233	9692
28	46217	210043	3289	15182	11148	14060
29	46005	205859	3215	15070	12418	17379
30	46115	201137	3109	14689	13015	19585
31	46162	198000	2937	14145	13218	20938
32	46589	196447	2797	13737	13290	21484
33	47174	195093	2694	13058	13168	21323
34	48076	195195	2560	12411	13221	20820
35	49457	195697	2409	11854	13108	20237

Source: 2% IABS Sample for full-time workers between under 35 years of age. N=4,539,627.

Note: The table displays a contingency table with the number of observations of individuals by age and educational attainment. It is an approach to labour market entry. Increasing number of observations by age hint at increasing number of individuals that enter the labour market with a certain age. Constant observations with increasing age for a certain educational attainment hint at no further labour market entry by increasing age. As an example, one can observe that the number of observations for individuals with vocational training does hardly change above of 23 implying that there are hardly labour market entrants with vocational training older than 23 years of age. Assuming final educational attainment has been reached at the age of 35 years, we set the age of labour market entry the age where the fraction of observations exceeds the 50% of the observations at the age of 35 years for each educational attainment.