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 has experienced an increase in the supply of high-skilled labour over the last two decades, we analyse the corresponding patterns of labour market entrants with respect to wages and occupations in a long-run perspective from 1975 to 2010. 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, wages, education groups
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 U.S. labour market indicates declining wages for college graduates in the aftermath of the Tech Bust in 2000. At the same time, post-college workers are facing continuously high employment and wage opportunities (Beaudry et al., 2013, 2014). Since an expansion of higher education and a technological shift towards highly-educated labour has 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" (as called by Beaudry et al. (2014)) a global phenomenon – we consider the labour market entries of highly-educated graduates. To take account of the heterogeneity of this group, we distinguish between three subgroups of highly-educated workers. All of these groups hold the entrance qualification for university but only members of the first group also possess a university degree. The second group are workers with a degree from a university of applied sciences (Fachhochschule) and the third group covers workers that have graduated from the German apprenticeship system despite having a university entrance qualification.

For the empirical analysis of the development of wages by educational attainment of young workers in Germany, we use information of a comprehensive sample of registered employees in the German social security system covering the years 1975 to 2010 with more than 11.78 million observations. We focus on young workers since general changes in the labour market are first apparent for them (Kambourov and Manovskii, 2009) and conduct a detailed empirical analysis considering different job market entry cohorts over time. In order to capture both – supply-side and demand-side changes – we regard different qualifications and different occupational task groups. Our obtained patterns of results indicate that young highly-educated workers have continuously faced declining employment opportunities in the top-paying jobs and declining analytical employment shares. Moreover, starting wages have fallen over time for each entry cohort since the year 2000. However, wage growth in the first five years after job market entry has been unaffected, other than in the U.S. according to Beaudry et al. (2014). Moreover, the declining opportunities for highly-educated workers in analytical or top-paying jobs do not directly translate into declining wages for this group in total.

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 are presented in section 4. The final section provides a short summary.

2 Background

Wage inequality in the U.S. labour market has increased during the 1980s notably at the upper tail of the wage distribution (Katz and Murphy, 1992). There is some consensus that technolog-

ical change complementing high-skilled workers and substituting low-skilled workers has been a major driving force behind this process (Acemoglu, 2002). Related to this, the hypothesis of the skill-biased technological change (SBTC) has emphasised 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). However, despite its convincing character in explaining the development of the labour market during the 1980s until early 2000s, the recent literature has put stronger focus on the increasing concentration of employment at both tails of the wage distribution and the disappearance of medium-skilled occupations. In reference to the resulting u-shaped pattern of the evolution of the wage and job distribution it has been called 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 particularly in the U.S. labour market. From this perception, 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 in Germany occurred through an adaption of employment rather than wages (Antonczyk et al., 2010; Naticchioni et al., 2014). Moreover, in contrast to the U.S., growth in supply and demand for high-skilled workers moved in parallel, resulting in less 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 the wage setting and a compressed wage structure, especially at the lower tail of the wage distribution, have been relaxed. One reason for this was the high and rising unemployment after German reunification that induced several labour market reforms. At the same time, an erosion of the wage setting in Germany began with a diminishing importance of collective bargaining between employer associations and unions (Ochel, 2005). Associated with that was a sharp decline in union coverage, especially at the end of the 1990s; this can explain a major part of the risen lower tail inequality (Dustmann et al., 2009). In the course of slow growth and increasing high unemployment after 2000, the 'sick man of Europe' (The Economist, 1999) introduced further labour market reforms, notably in the course of the so-called 'Agenda 2010' reforms 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). Related to that, Fitzenberger et al. (2011) note that the process of increasing lower tail wage inequality in Germany was characterised by episodic events rather than due to the lower tail polarisation hypothesis suggested 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 seems to be caused by transitory factors only.

In contrast to that, the influence of institutional factors upon upper tail inequality is limited. It slightly increased during the 1980s, mainly driven by the changing composition of the work-

force (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).

Despite these developments characterising the labour market until the early 2000s, a recent strand of 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 hat have been previously performed by medium-skilled workers who, for their parts, pushed low-skilled workers further down on the occupational ladder or even 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 to that, job entrants with a post-college degree have faced stable cognitive employment shares and wage profiles.

3 Data

We base our empirical analysis 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) providing information on more than 11.78 million persons. The social security records represent about 80% of the working population in Germany.[1] We restrict the analysis to 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. Furthermore, the East German wage structure has been characterised by a depreciation of human capital and a transformation process in which a highly compressed wage structure has vanished shortly after reunification and a strong increase in the dispersion of wages has begun (Kohn, 2006). The data are highly reliable due to the mandatory and administrative nature of the social security records, where misreporting on wages causes severe penalties for the employer. A further advantage is the large sample size. Limitations of the data occur with respect to right-censoring of wages above the social security contribution assessment ceiling and missing information on working hours while an indication of full-time or part-time employment is available. Whereas our analysis is not affected by right-censoring since we will focus on median wages, we restrict the analysis sample to full-time employed persons to avoid inexact interpretations related to heterogenous levels of part-time employment. The purpose of the paper is to analyse the opportunities of (young) labour market entrants, we assume that persons have finished their education latest at the age of 35 years in Germany. Since labour market entry is not directly identifiable in the data, we approximate it by potential experience.

[1] The social security system contains all employment subject to social security contributions. Excluded are, e.g. civil servants, soldiers, and self-employed. These data have been used to study the German wage structure, among others, by Dustmann et al. (2009) and Kohn (2006).

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 given in appendix A.

Wages are defined as the sum of inflation-adjusted gross daily income from employment and welfare of unemployment benefit receipts. For the yearly analyses we use observations with the cutoff date of June 30 of each year. To distinguish different qualities of jobs we refer to the classification of occupations that ascribes jobs to tasks. Dengler et al. (2014) operationalise tasks based on an expert data base for the years 2011 to 2013.[2] We use their operationalisation for the year 2011 since annual variation of the task composition is low. Each occupation is composed of five tasks. In addition, a main task is determined by the largest task fraction. The set of tasks considered 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. These are all referred to as highly-educated or highly-skilled in the following. They comprise individuals with admittance to university, but we further distinguish between graduates from university (first group) and graduates from university of applied sciences (second group). The latter are characterised by typically shorter duration and lower focus on abstract skills (*Fachhochschule*), a system which is unique in German-speaking countries.[3] The third group we consider has admittance to tertiary education (*Abitur*), but however chooses to complete a vocational training in the German apprenticeship system. In addition to these three groups, we regard low-skilled and medium-skilled workers for the sake of comparison in the analysis. All in all, we have five groups differing in educational attainment 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 training; and

[2]This classification is comparable to the U.S. dictionary of occupational titles

[3]In 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 unversities of applied sciences. The shorter duration can also be observed for the age of labour market entry in appendix A.

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.

4 Empirical Results

Educational Attainment

We will start our empirical analysis with an overview on long-run trends in the German labour market, i.e. the change in the educational composition and the wage development as well as variances by performed task. Figure 1 displays shares of different educational attainment for young workers from 1975 to 2010. The pattern clearly shows that Germany has faced a constant increase in educational attainment over the last three and half decades. Vice versa, the number of young workers without any vocational qualification has decreased considerably from about one quarter in 1975 to about one tenth in 2010. Whereas the proportion of medium-skilled workers has remained roughly constant until the mid-1990s, the share of highly-skilled workers has slowly increased. A particular rise can be observed for the group of workers with university admittance and vocational training. While it represented only about 1% of the total young workforce in 1975, its share rose tremendously to more than 10% in 2010. The share of medium-skilled workers has reached its peak in the mid-1990s. Thereafter, it has started to shrink by roughly ten percentage points until 2010. Over the same time span, the share of workers with university admittance has continued to rise. Likewise, the share of individuals with a degree from a university has begun to rise sharply and has doubled for both subgroups.

< Include Fig. 1 about here >

However, it has to be noted that the proportional shift in educational attainment is not reflected by the development in terms of absolute numbers. Although the share of highly-skilled workers has increased over time and doubled from 1995 to 2010, the absolute number of highly-skilled workers has remained quasi constant (Figure 2). The reason for this was a dramatic decrease of the number of young persons in the 1990s due to a very pronounced baby boom generation 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] Therefore, the share of highly-skilled workers has 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 has recovered to its year 2000-level.

< Include Fig. 2 about here >

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

[5] In 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).

Wage Development

How were these patterns reflected in the wage structure? Figure 3 displays the development of log median daily wages separately for all workers and for 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 for all workers but more considerably for the group of young workers. More importantly, the figure indicates that wages of all workers and young workers have started to diverge over time. Until 1982, young workers tended to gain higher wages than the total workforce with a narrowing difference over time. Starting in 1983, however, young workers have started to earn less than the overall workforce. This wage gap has widened over time, especially after the implementation of the 'Agenda 2010' 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) or Gernandt and Pfeiffer (2007).

< Include Fig. 3 about here >

The wage development in the five occupational task groups resembles the wage development of the total young labour force. 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 the highest wages, manual non-routine jobs pay the lowest ones. In addition, the deviations from the median wage for the analytical non-routine and manual non-routine jobs have increased slowly over time which is in line with the SBTC literature. The wage gap for workers performing analytical non-routine jobs has increased notably between 1996 and 2001 from 22% to 27%. Even after the burst of the tech bubble after 2000, 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 has been a slow and minor, but monotonous increase after 1995.

< Include Fig. 4 about here >

Development of the Task Composition

Jobs can be characterised by a variety of tasks, where tasks' composition may change over time. Figure 5 displays the average task share of young workers using the task attribution by Dengler et al. (2014). There has been 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. Moreover, the fraction of routine manual jobs has constantly declined but the share of routine cognitive tasks has remained constant and represents the largest proportion of all tasks. Contrary to the increase in analytical non-routine tasks, the fraction of non-routine manual tasks has decreased from 1997.

< Include Fig. 5 about here >

Since the 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 has remained constant, this may imply an occupational downgrading for highly-skilled workers. This would be likely if the average task share of non-routine analytical tasks shrinks for highly-skilled workers as described for the U.S. in Beaudry et al. (2013, 2014). We therefore decompose the average task performance for each individual educational group to potentially reveal a shift for highly-skilled workers performing jobs that do not require their gained analytical skills (Figure 6).

< Include Fig. 6 about here >

The average analytical task shares are sorted according to the duration of educational attainment (upper left panel). It is highest for employees with a university degree and lowest for persons without vocational training. Overall, the average shares have remained almost constant over time but there was slight decline for highly-skilled workers until 1990. For the high-fh-skilled workers, there was a further slight decrease after 2000. However, the share of non-routine analytical tasks for each educational group has been rather constant over time, which could imply a transition to more non-routine analytical tasks through a shift in educational attainment. The share of non-routine interactive tasks, that has been slightly increasing for the young workforce overall, has decreased for high-uni-skilled until the mid-1990, and has slowly increased after 2000. For high-fh-skilled and high-abi skilled workers the share of non-routine interactive tasks has remained stable. A rise of importance can be established for routine cognitive tasks for highly-skilled workers until 1997. Afterwards however, their fraction in the task composition has begun to fall slowly. For the high-fh-skilled and high-abi-skilled young workers the share has been rising similarly until the mid-1990s, and has remained on that higher level from then onwards. Routine manual and non-routine tasks altogether have played a minor role for highly-skilled workers only in Germany.

To summarise, the figures indicate that the share of highly-skilled workers performing non-routine analytical jobs has not decreased. We can also not observe that highly-skilled workers have performed more routine jobs routine after 2000. Therefore, a clear cascading pattern as described in Beaudry et al. (2014) is not observable of the groups of the highly-skilled workers in Germany. With the slight increase of highly-skilled workers in routine cognitive jobs, there has been a corresponding 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 has constantly increased at the expense of non-routine interactive tasks, whereas the remaining task shares have remained rather constant over time. For the high-fh-skilled the share of routine cognitive tasks has similarly increased, notably at the expense of non-routine analytical tasks before 1985 and after 2003, and at the expense of non-routine interactive tasks between 1987 and 1992. The task composition for high-abi-skilled young workers has remained rather constant after 1990. Only until 1990, the share of non-routine analytical tasks has decreased and the routine cognitive tasks have increased.

Development of the Job Distribution

With regard to the development of jobs over time, 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-paying jobs and bottom-paying jobs grow more profoundly than medium-paying occupations (Figure 7). Hence, our results indicate that some job polarisation has occurred. In general, this could imply that coinciding with the increasing educational attainment of the workforce over time, the number top-paying jobs has increased. However, if there is a pattern in which the growth of highly-skilled workers is larger than the growth in top-paying jobs, there could be a cascading pattern in which highly-skilled workers perform jobs previously performed by medium-skilled workers, who are crowded out of their jobs, and who for their parts will then perform jobs previously done by low-skilled workers. The latter effect could be amplified since medium-paying occupations have grown slower than occupations at both tails of the wage distribution in Germany.

< Include Fig. 7 about here >

To 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-paying jobs as jobs that pay above the 70th wage percentile and bottom-paying jobs that pay below the 30th wage percentile. All other jobs are referred to as medium-paying. We then analyse the development and shares of highly-skilled labour market entrants with five years of potential experience in top-paying jobs over time (Figure 8). The share of labour market entrants in top paying occupations has increased from 14% in 1975 to 21% in 1998 for all workers with a potential experience of five years but has stagnated on that level thereafter. Moreover, the rise has mainly occurred during the 1990s. At the same time, the fraction of workers in the bottom-paying jobs has remained constant during the full observation period. Hence, the shift towards more workers in the top-paying occupations has been made possible by a reduction of workers in medium-paying jobs.

< Include Fig. 8 about here >

Distinguishing between occupational attainments may reveal adverse opportunities for highly-skilled workers. It becomes obvious from the picture that university graduates have faced a decreasing chance of working in top-paying jobs and that the fraction has declined from 80% in 1985 to 70% in 2010. This drop has been especially strong after the year 2000 and notably in support of medium-paying jobs. The shift is similarly profound for high-fh-skilled workers that have 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 has been a similar drop of the share working in top-paying occupations from 48 to 33% between 1975 and 2010. However, this decline has occurred on a comparably slow and constant pace. For highly-skilled workers, the chance of working in a bottom-paying job has been relatively low in all years. Associated with more highly-skilled workers in the top-paying jobs, the fraction of

medium-skilled and low-skilled workers in bottom-paying jobs has increased over time. For low-skilled workers, other than for medium-skilled workers, this correlated with a decreasing chance of working in the medium-paying sector. Hence, the results regarding the job distribution characterised by wage levels indicate that there occurred a cascading down effect of workers displacing one another out of high-paid jobs in Germany.

Labour Market Entrants

Figure 3 above has displayed the increasing wage gap between wages for all workers and young workers that has notably occurred after 2003. To take a closer look at this development, Figure 9 shows how job entrants have performed in their first five years after labour market entry with a distinction by educational attainment and potential experience. Each line represents the development of two consecutive annual entry cohorts. By and large, the picture indicates that both starting wages and wages after 5 years of potential experience have tended to increase until the year 2000 and have tended to fall afterwards. For the low-skilled workers, the fall of wages has already started in the early 1990s. For medium-skilled workers, wage growth has flattened after the 2000-cohort. With the declining share of workers in top-paying positions, wages have decreased similarly for subsequent cohorts between 2000 and 2006. This pattern holds for all groups of highly-skilled workers. For the cohorts after 2006, entry wages have stabilised but still remain on a lower level.

< Include Fig. 9 about here >

Chances 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 higher the obtained educational attainment, the higher is the share of workers performing analytical jobs. The fraction of workers in analytical jobs has been quasi-constant for all skill groups. There has been only small variation for the highly-skilled workers. After 2000, the share of workers in analytical jobs has started to slightly but monotonously decrease for high-uni-skilled and high-fh-skilled. However, this was not accompanied with a drastic decline of the opportunity of performing an analytical job after five years of potential experience.

< Include Fig. 10 about here >

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-specific and task-specific knowledge may reduce the chances of switching with increasing potential experience, it

can be expected that young workers sort themselves into jobs at 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 has decreased for cohorts after the late 1990s, while they have tended to increase for cohorts entering the labour market between the late 1980s and late 1980s. Comparing inter-cohort shares of workers in analytical jobs, an increase for high-fh, medium-skilled and low-skilled workers with increasing potential experience for all cohorts can be observed. For high-uni-skilled workers, there has been a sorting out of analytical jobs for cohorts after 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.

< Include Fig. 11 about here >

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 have tended to decline after 2000 for all workers, independently of educational attainment or working inside or outside analytical jobs. From 2000, starting wages as well as 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 have been higher in analytical occupations. This may explain why high-uni-skilled workers have sorted out of analytical jobs, and the remaining educational attainments with exception of high-abi-skilled have sorted in analytical jobs with increasing potential experience. It should be noted that there has been no distinct fall of wages for highly-skilled workers overall. Moreover, there has been a positive wage growth in the first five years of labour market entry for all cohorts and for workers in and outside analytical jobs. In addition, the relationship between the annual variation of wages between those working in and outside analytical jobs has been strong.

< Include Fig. 12 and Fig. 13 about here >

Wage Premia

As a final step in analysing the labour market chances of young job market entrants, we will consider the development of returns to education (wage premia) over time. Declining opportunities of young highly-skilled workers getting a high-paying job would also be present if wage premia of higher degrees have fallen over time. To analyse this, we estimate an established variant of the Mincer earnings equation. Besides consideration of the effect of potential experience (pexp), we add a dummy variable for gender and take account of qualification by educational dummy variables (with reference category low-skilled workers). This allows us to estimate wage premia of distinct educational attainment levels. We augment the model in a second step by dummy

variables for tasks (reference category: non-routine manual jobs). We analyse wage premia over time by estimating the model for each year separately. Figure 14 plots the estimated coefficients of wage premia over time, both with and without controlling for tasks (left and right panel). Wage premia relative to low skills have increased from the early 1990s for highly-skilled individuals until 2003 and have stagnated afterwards. The wage premium for the medium-skilled, however, has only slightly increased. The wage gap between medium-skilled and highly-skilled workers has thus similarly increased over time. Higher education, independently of having a degree at a university, a university of applied sciences, or of holding a high-school admittance and a completed vocational training has been associated with an increasing wage premium relative to low and medium education. Nevertheless, the gaps in the wage premia for the different variants of higher education have remained constant over time. This could be interpreted as a relative fall of wages and of demand for low-skilled and medium-skilled workers from the early 1990s to the early 2000s.

< Include Fig. 14 about here >

The magnitude of the wage premia of high-skilled workers and the relative increase reduce when task groups are considered in the estimation. Despite this level effect, the relative increase of wage premia has followed a similar pattern. For highly-skilled workers wage premia have increased between the early 1990s and 2000s, whereas the wage premia for the subgroups have moved in parallel. The university/abi wage gap has widened from 10 percentage points in 1975 up to 18 percentage points in 2010. The increase in the wage premium of medium-skilled workers relative to low-skilled workers has almost vanished.

Both panels show the increase in wage premia relative to low-skilled and medium-skilled workers. Figures 8 and 9 above have already revealed a declining starting wage 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 have also increased relative to medium-skilled workers. Most importantly, the relative gap in wage premia of the highly-skilled workers has remained constant over time. Moreover, most of the increase of the wage premia has occurred during the early 1990s to early 2000s. From the beginning of the 2000s, all educational groups have faced similar declines in wages.

Similar to the fall of wages for low-skilled workers, our results have shown a fall of relative wages in the non-routine manual sector (see Figure 4 above). Figure 15 adds to this result by displaying wage premia estimates by task groups over the years. The non-routine analytical sector has the highest premium for all years. Routine cognitive tasks yield the second highest wage premia and the gap between task groups has slightly increased over time. This in accordance with findings reported in the RBTC literature (Goos et al., 2014). However, after the the mid-1990s, they have started to remain at a constant level. Similarly in line with the RBTC, there has been a narrowing of the wage gap between non-routine interactive and routine cognitive and manual jobs; this, however, has stayed constant after the mid-1990s, too.

< Include Fig. 15 about here >

Relative wage premia have increased 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 has continually grown, wage premia relative to non-routine manual task have not further widened the gap after the mid-2000s. Wage premia for performing analytical and routine cognitive have moved in parallel from the mid-1990s onwards. The stable relative wage gaps in routine cognitive jobs after 1995 may thus have entailed an academisation in these jobs that is also associated with a wage premium for workers holding a higher degree.

5 Summary

The share of young workers with a higher educational attainment has started to increase in Germany since the mid-1990s. At the same time, demographic change set in with a decline of the size of young cohorts. We have analysed the labour market relevant patterns for those young job market entrants, considering aspects of educational attainment, wages and jobs. The results show that from the mid-1990s, real wages have stagnated, especially for the young. Relative wages of workers performing analytical jobs, mostly performed by highly-skilled workers, have increased until the early 2000s only. Relative wages in routine cognitive tasks have 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-skilled and medium-skilled workers, have decreased, on the other hand. This process has been accompanied by a relative increase of routine cognitive tasks, along with a rising share of highly-skilled workers, and a decrease in routine manual and non-routine manual jobs.

Our results further indicate some kind of job polarisation due to an increase of the number of occupations at the top and bottom of the wage distribution. Correspondingly, the share of young workers in medium-paying occupations has declined, whereas the number of young workers in top-paying occupations has increased. However, the chances of working in top-paying occupations have fallen for highly-skilled individuals. This reduced chance of getting a top-paying job for highly-skilled workers over time, however, does not translate into declining wages itself. The wage gap between different types of highly-skilled workers has not increased over time also, nor has the gap in the opportunity to work in analytical occupations. As an important further result, we have shown that for workers with a university degree performing an analytical jobs does not imply a higher wage than not working in an analytical job. Moreover, highly-skilled workers have tended to perform more routine cognitive tasks over time, and relative wages for these jobs have increased between the mid-1990s and mid-2000s.

Wage premia for highly-skilled workers, relative to low-skilled and medium-skilled workers rose between the mid-1990s and mid-2000s, contemporaneously with increasing returns to 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). However, we do not find evidence for widening wage gaps and adverse opportunities for workers with higher, but not highest education. But we do find evidence for an increasing wage gap for highly-skilled individuals

until the early 2000s. Nevertheless, after that time the wage gap has remained constant and did not increase any further.

In contrast to the results for the U.S., we do not observe a cascading pattern within the group of highly-skilled individuals, where high-uni-skilled workers push down high-fh-skilled and high-abi-skilled workers. However, we can establish a pattern, where the wage and occupational opportunities for medium-skilled and low-skilled workers decline, although the high-medium wage gap and the high-low wage gap have been constant for recent years. Hence, our results indicate some similarities between the development of the U.S. and Germany during the last decade in terms of displacement effects of lower qualifications in the labour market. However, the obtained patterns differ with regard to skill-groups affected.

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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 the potential labour market 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. 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.

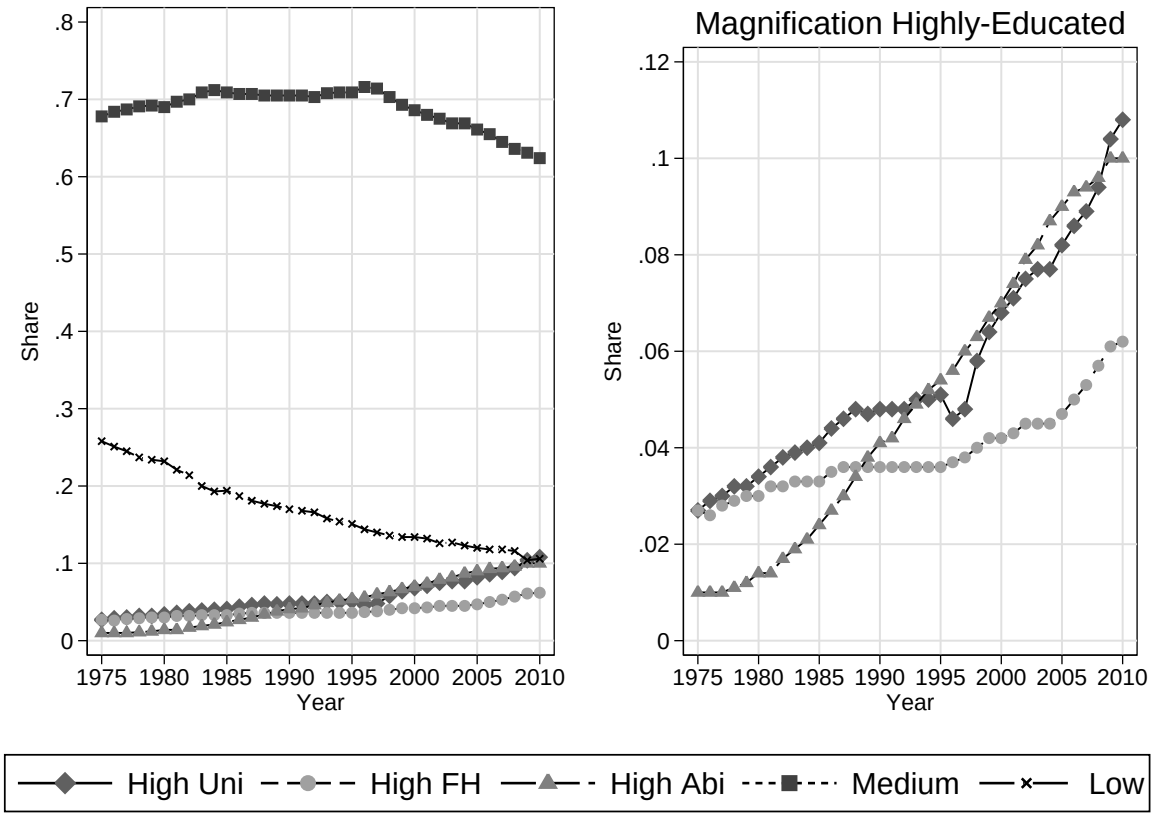
Table A1: Number of observations by educational attainment and age

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. Increasinng 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.

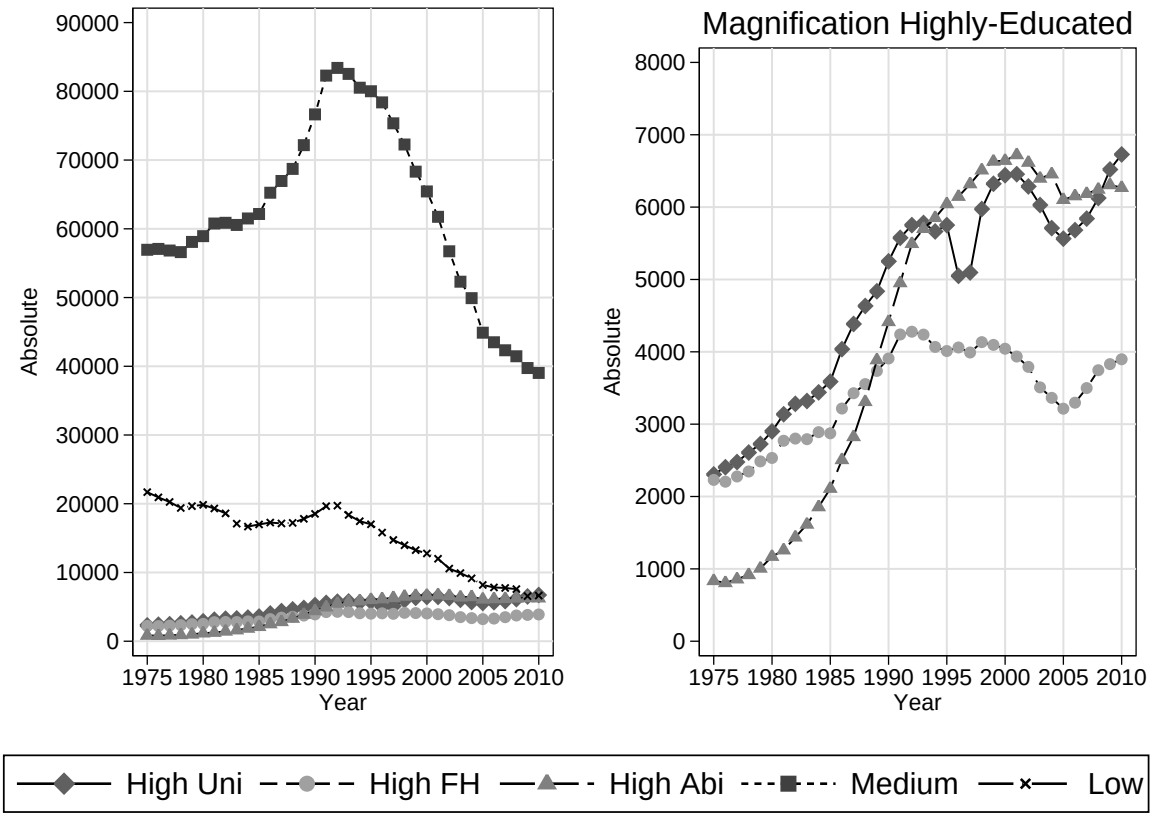
Figures

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



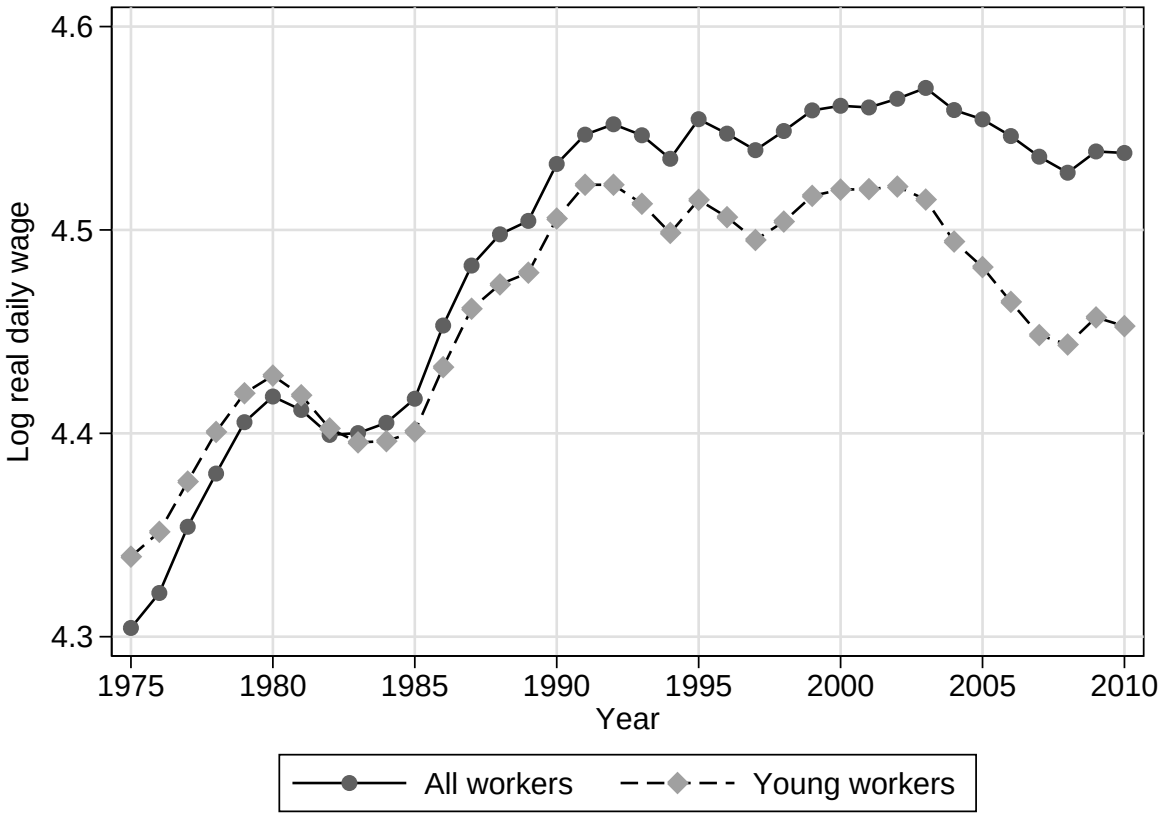
Source: 2% IABS Sample for full-time workers between 25 and 35 years of age. N=3,239,242.
Note: Both graphs represent the absolute number of young workers according to their educational attainment in the sample. The left panel comprises all educational groups, the right panel only those that we classify 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.

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



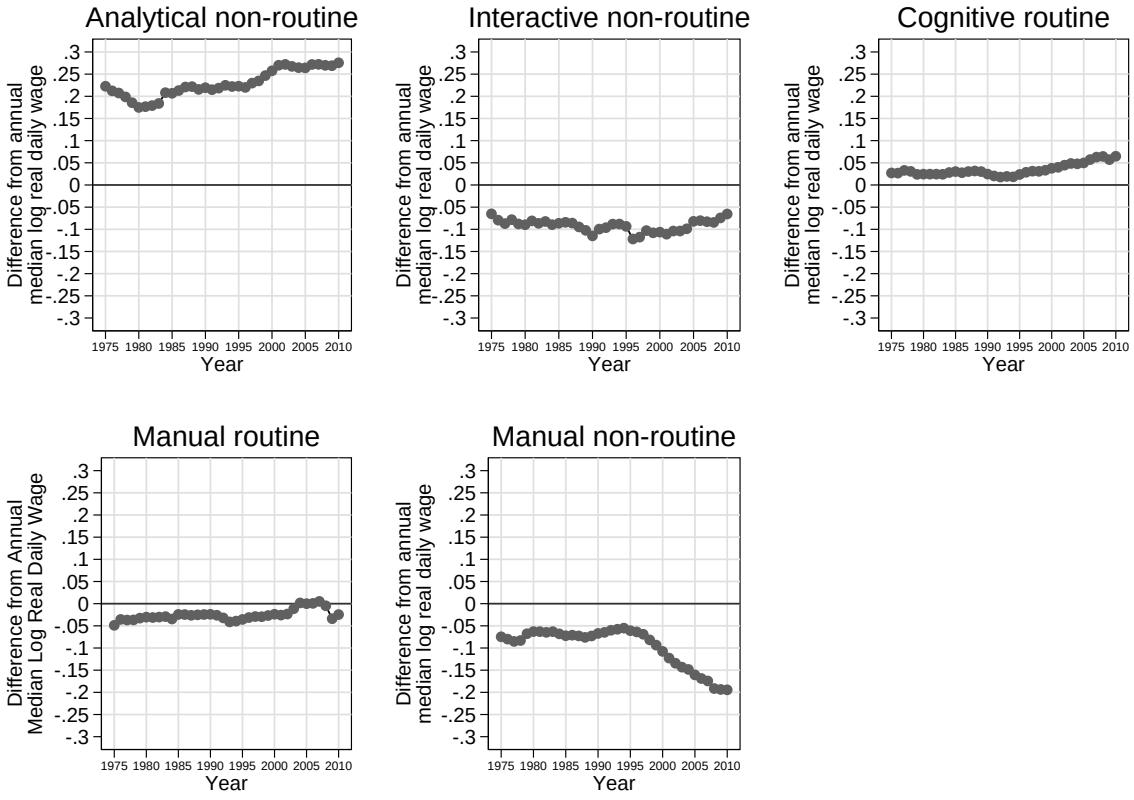
Source: 2% IABS Sample for full-time workers between 25 and 35 years of age. N=3,239,242.
Note: Both graphs represent the absolute number of young workers according to their educational attainment in the sample. The left panel comprises all educational groups, the right panel only those that we classify as highly-educated. The annual number of observation varies between 62,571 in 2010 and 118,660 in 1992. Non-specified observations are omitted.

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



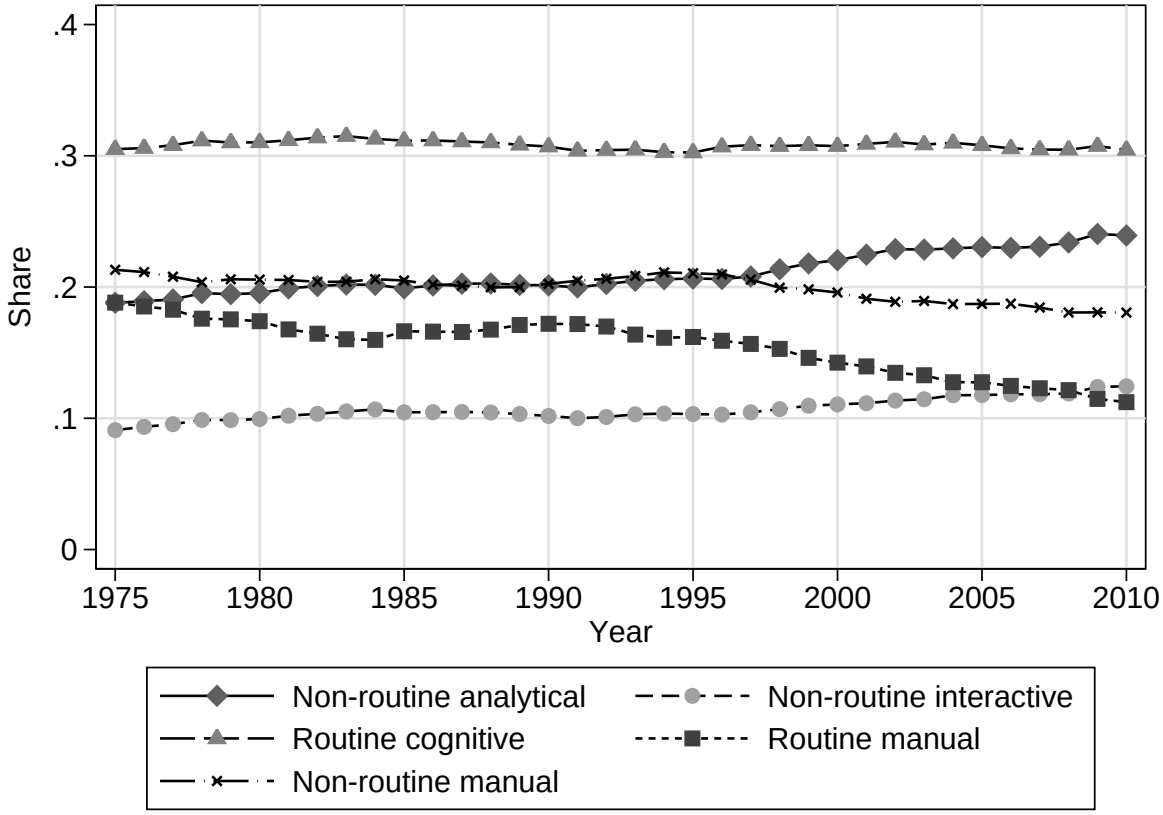
Source: 2% IABS Sample for full-time workers with a positive wage spell. N=11,780,901 for all workers and N=3,522,819 for young workers.
Note: Both lines represent the median log real daily wage. It is computed as the logarithm of the inflation-adjusted daily wage of workers with a non-negative wage 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.

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



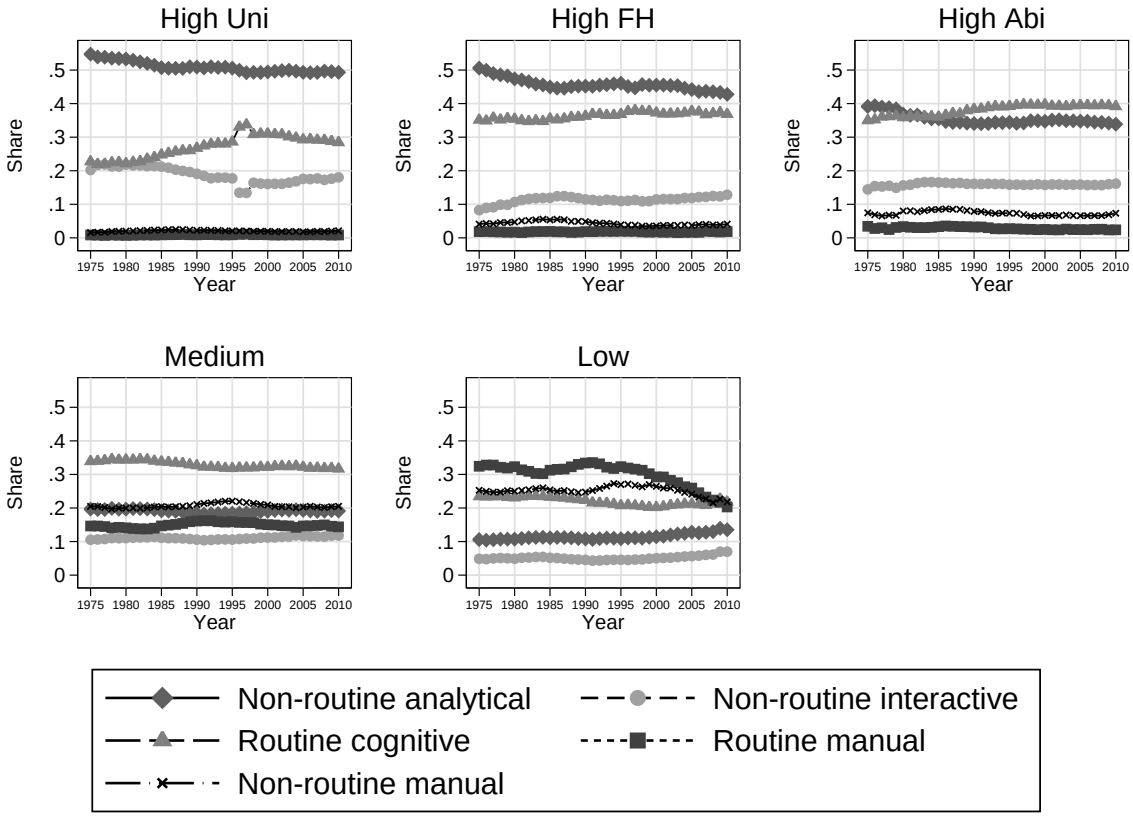
Source: 2% IABS Sample for full-time workers between 25 and 35 years of age with a postive wage spell and whose jobs can be grouped into a task field. N=3,428,680.
Note: All lines represent the deviation of the annual development of median log real daily wage in one task from the the median log real 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.

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



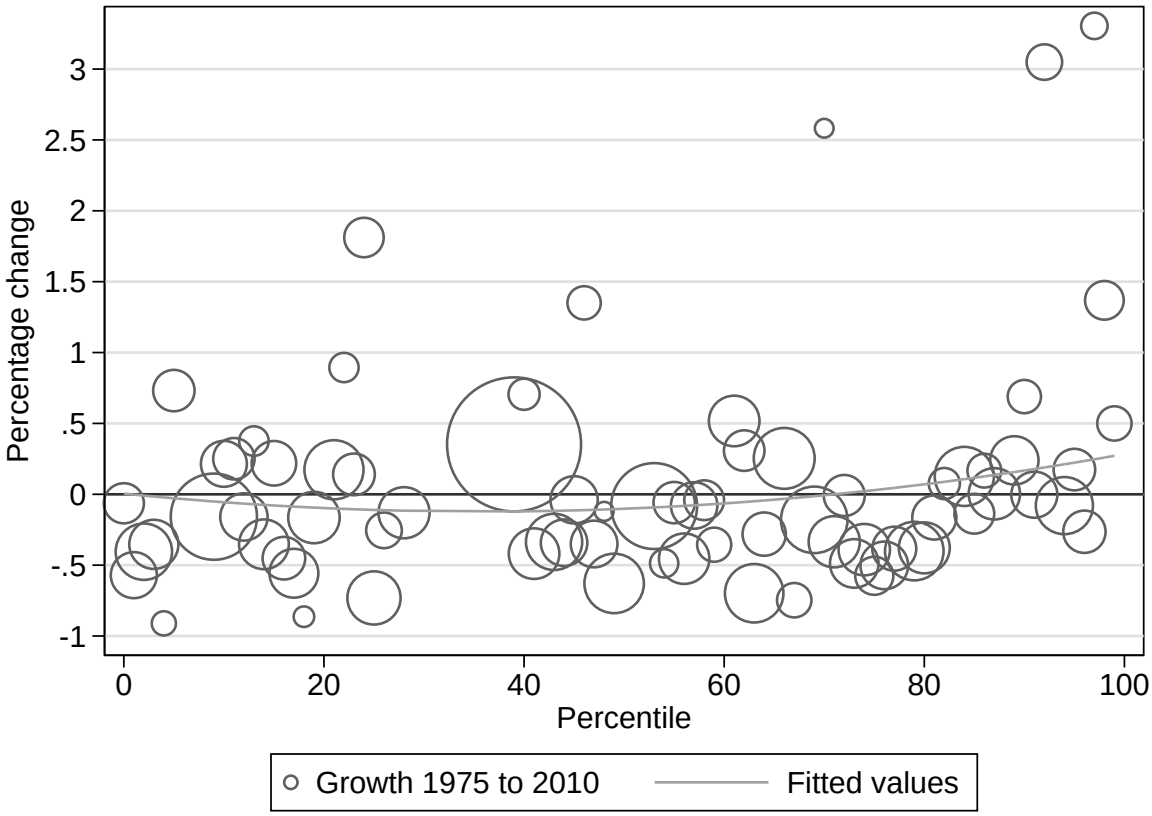
Source: 2% IABS Sample for full-time workers between 25 and 35 years of age. N=3,530,494. Number of observations vary from 125,295 in 1992 and 77,951 in 2009.
Note: All lines represent the annual average level of each task. Each job is assigned proportions of tasks performed according to Dengler et al. (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.

Figure 6: Average task performed by educational group



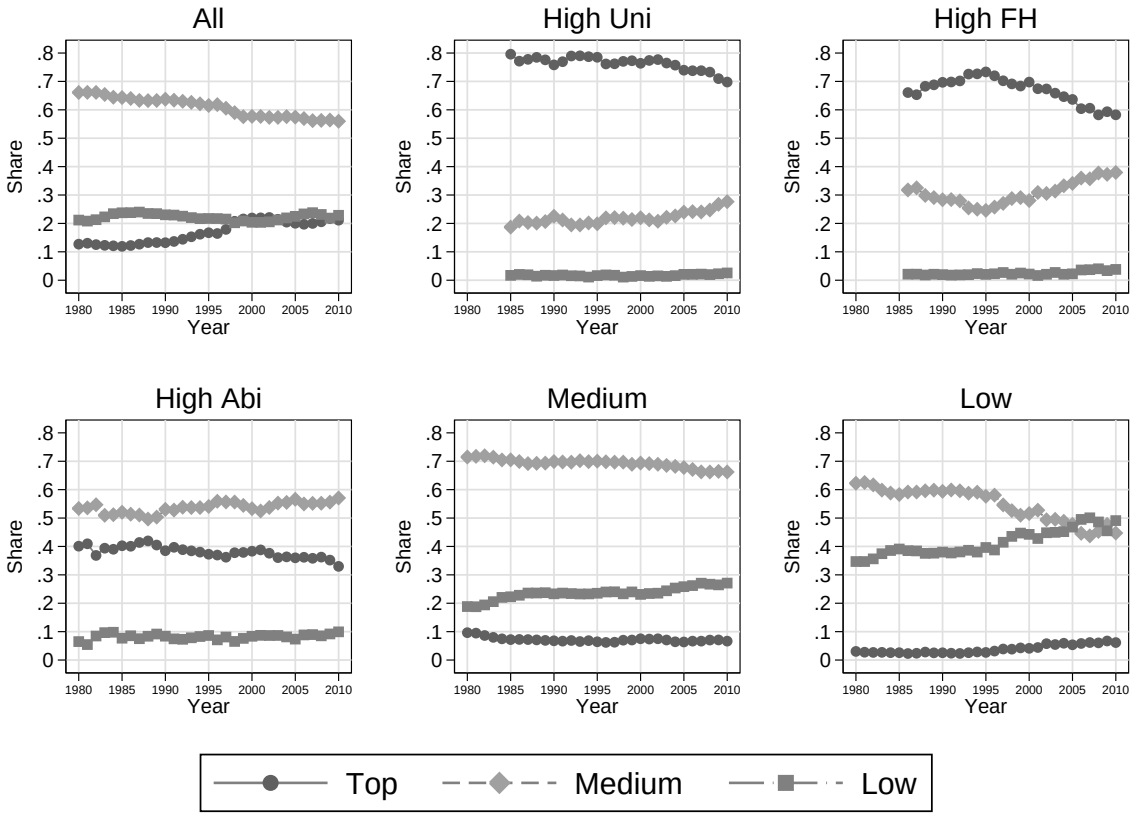
Source: 2% IABS Sample for full-time workers between 25 and 35 years of age. N=3,530,494.
Note: All lines represent the annual mean of each task performed. Each job is assigned proportions of tasks performed according to Dengler et al. (2014). The means represent the task shares within each job. The 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%.

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



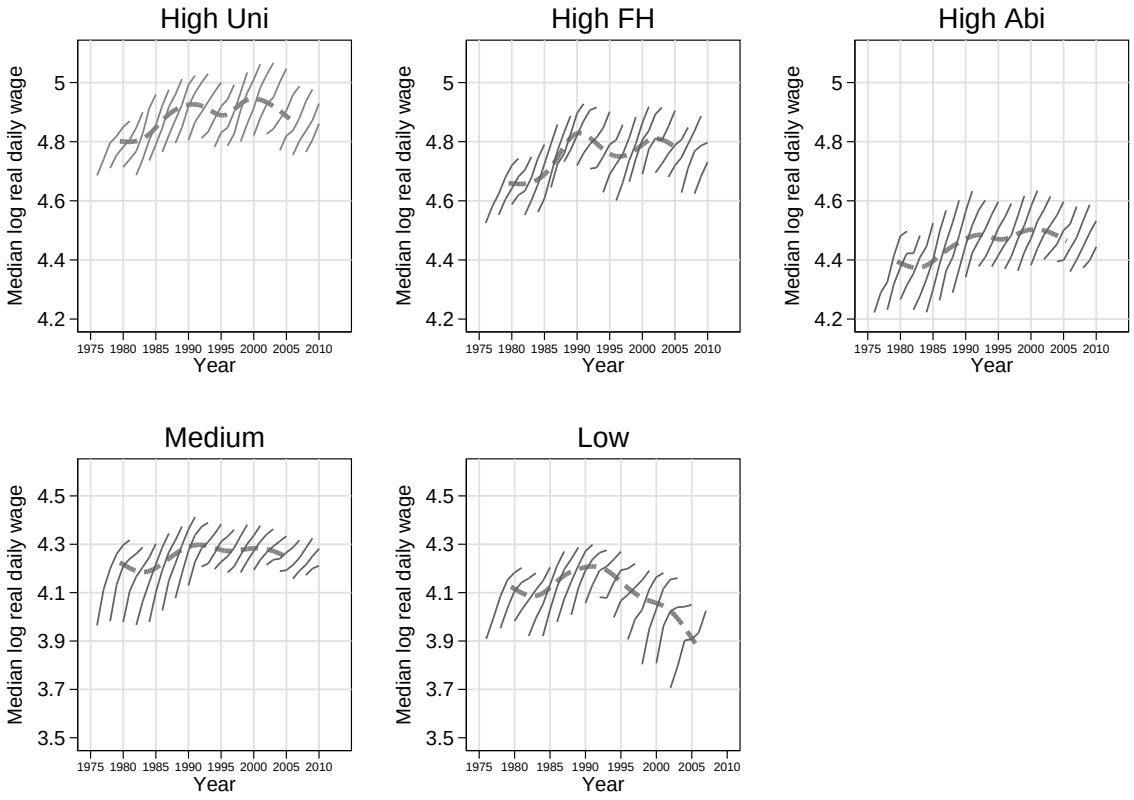
Source: 2% IABS Sample for full-time workers with information on job. N=318,186 in 1975, N=310,303 in 2010. Note: Jobs are ordered according to their 1990 mean wage and assigned a percentile in the 1990 wage distribution. One percentile can contain more than one job. The percentage change represent the 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.

Figure 8: Job ordering, five years of potential experience



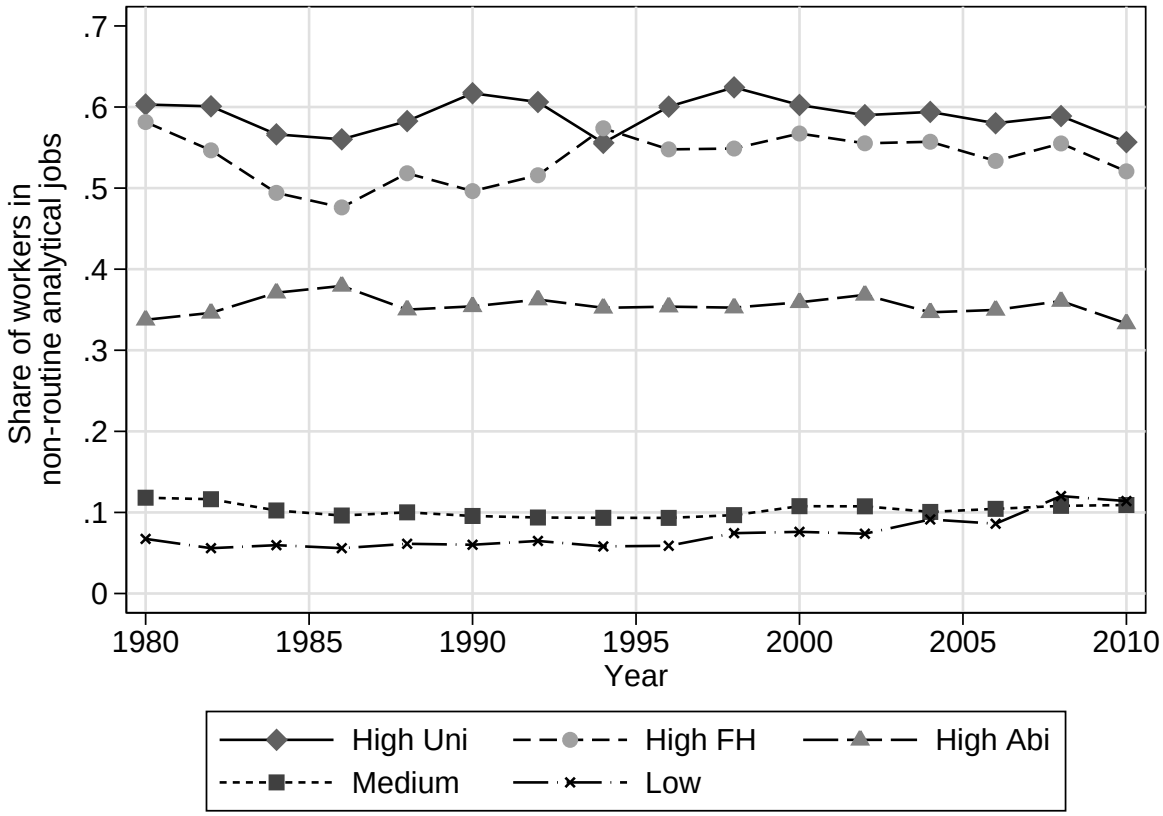
Source: 2% IABS Sample for full-time workers between 25 and 35 years of age with information on job. N=937,786 for all workers. N=63,549 for high-uni, N=39,380 for high-fh, N=45,498 for high-abi, N= 641,974 for medium, N=147,134 for low.
Note: Jobs are ordered according to their mean wage and assigned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

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



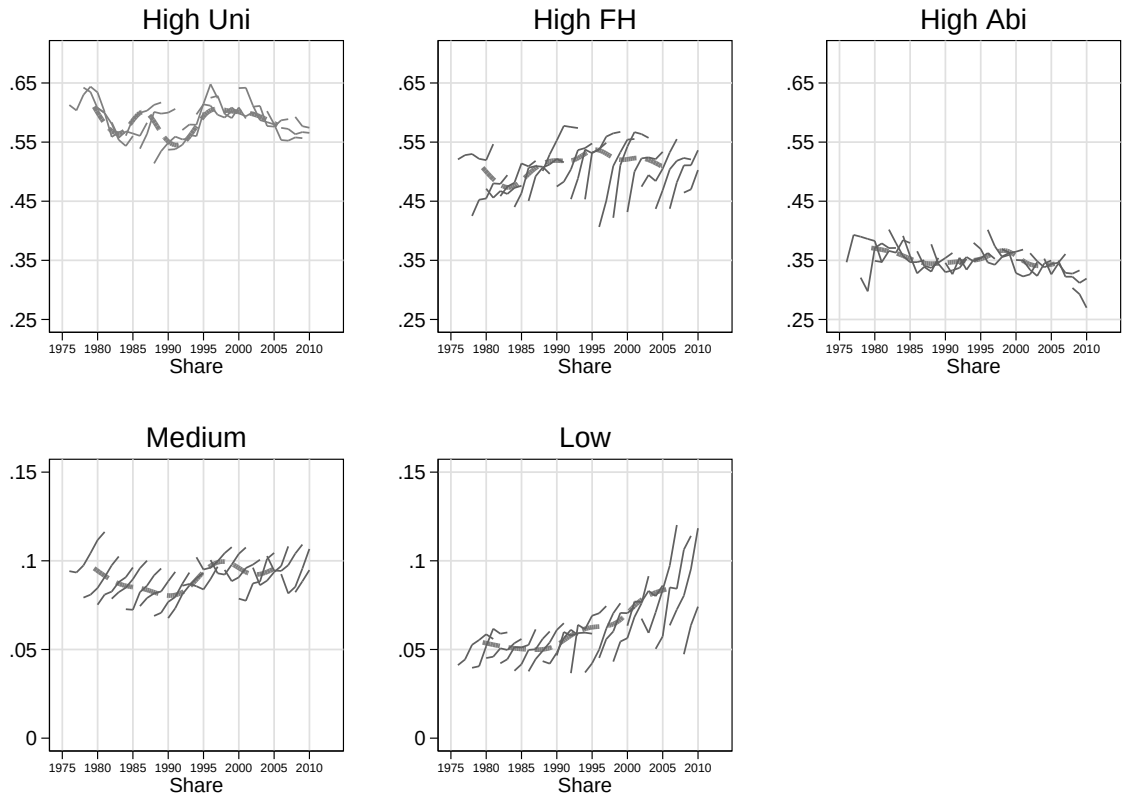
Source: 2% IABS Sample for full-time workers with less than five years of potential experience with a positive lor real daily wage. N=1,391,358. N= 104,348 for high-uni-skilled, N= 59,623 for high-fh-skilled, N=77,569 for high-abi-skilled, N= 934,052 for medium-skilled, N= 215,766 for low-skilled.
Note: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

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



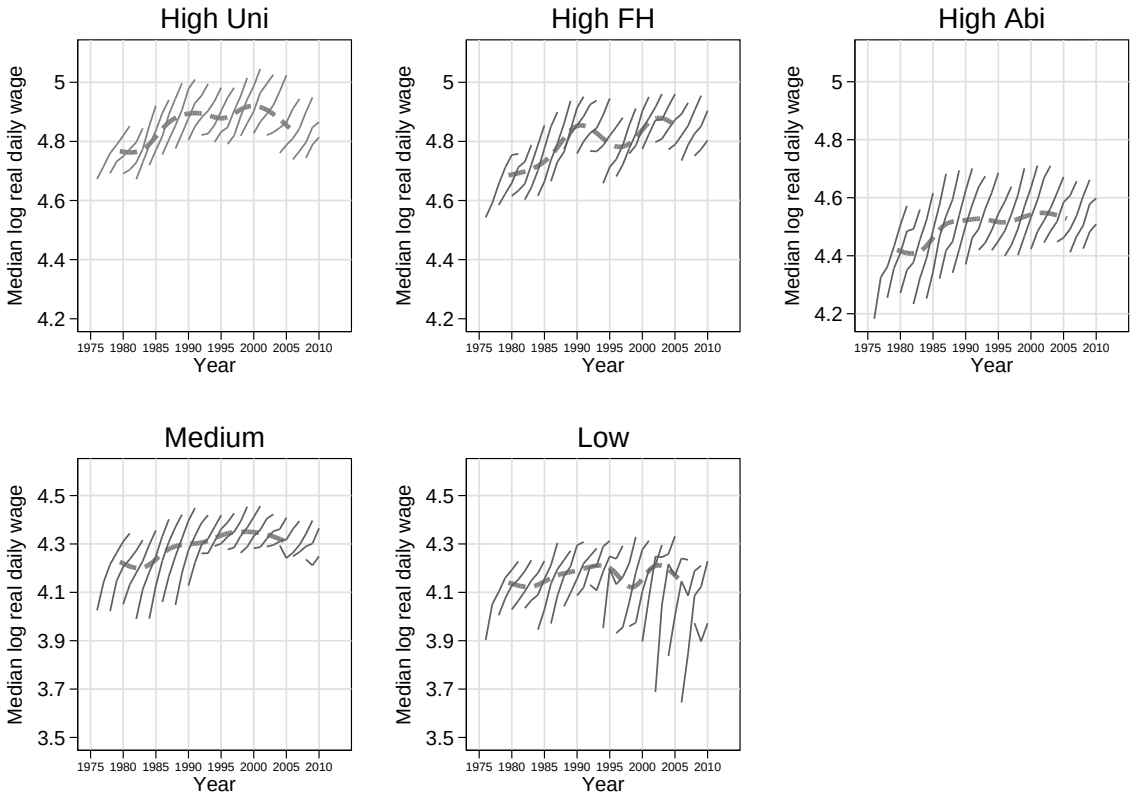
Source: 2% IABS Sample for full-time workers with less than five years of observed experience with a positive lor real daily wage. N= 305,904. N= 21,251 for high-skilled, N= 13,161 for high-fh-skilled, N=15,070 for high-abi-skilled, N= 211,603 for medium-skilled, N= 44,819 for low-skilled.
Note: The 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 analitcal job. Each line represents a varying education attainment. Two years are pooled to increase the number of observations.

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



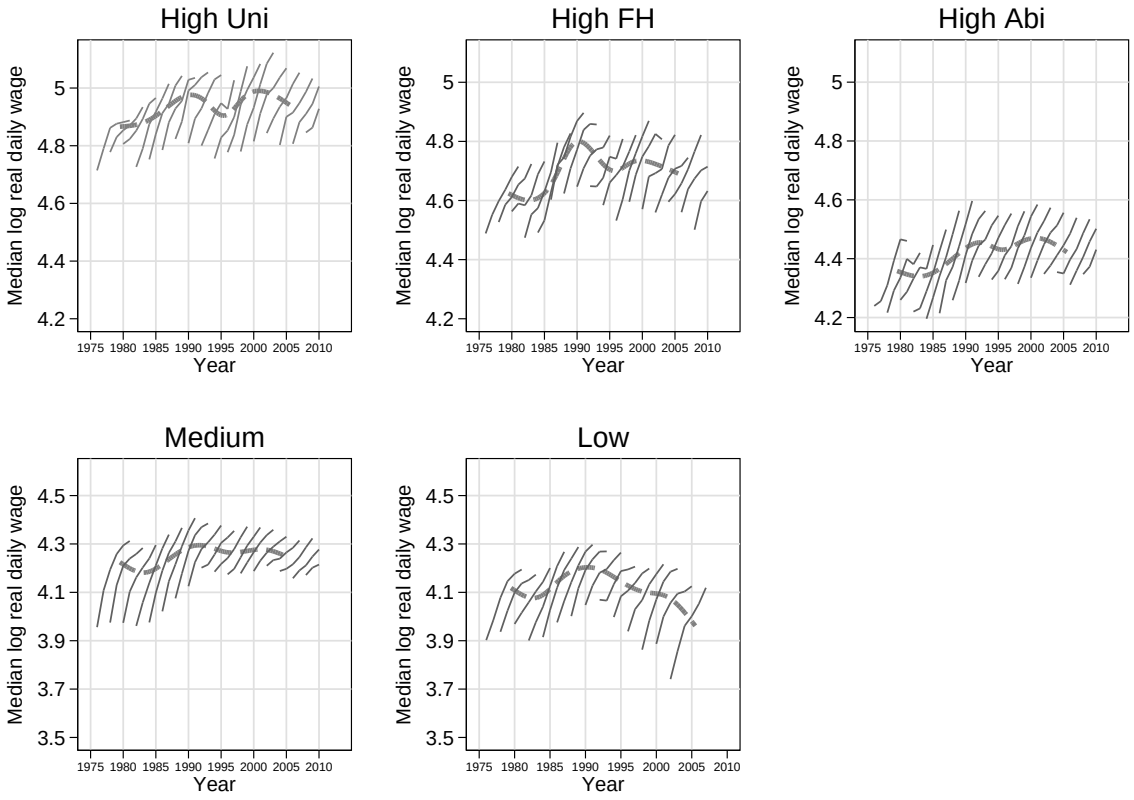
Source: 2% IABS Sample for full-time workers with less than five years of observed experience with a positive lor real daily wage. N= 1,475,672, N= 110,802 for high-skilled, N= 63,385 for high-fh-skilled, N= 80,499 for high-abi-skilled, N= 1,002,687 for medium-skilled, N= 218,299 for low-skilled.
Note: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

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



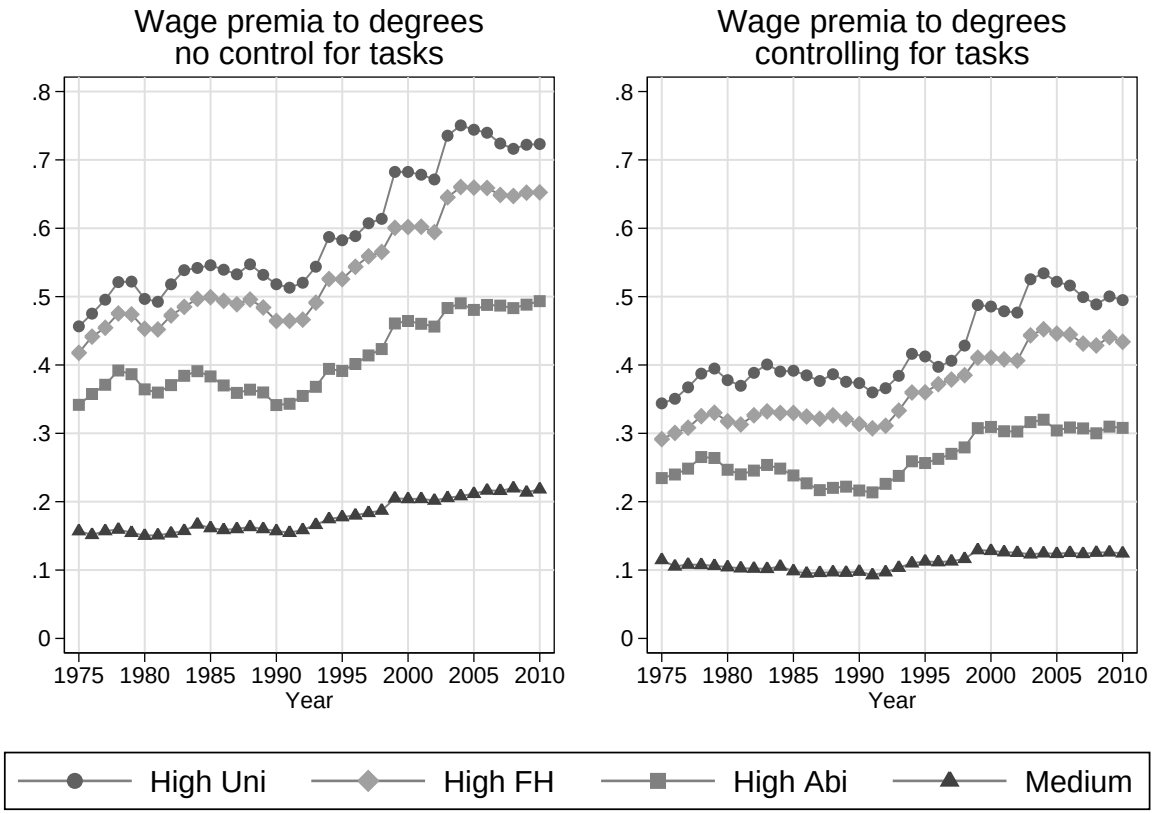
Source: 2% IABS Sample for full-time workers with less than five years of observed experience with a positive lor real daily wage. N= 216,695. N= 63,073 for high-skilled, N= 31178 for high-fh-skilled, N= 27,477 for high-abi-skilled, N= 83,822 for medium-skilled, N= 11,175 for low-skilled.
Note: Median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



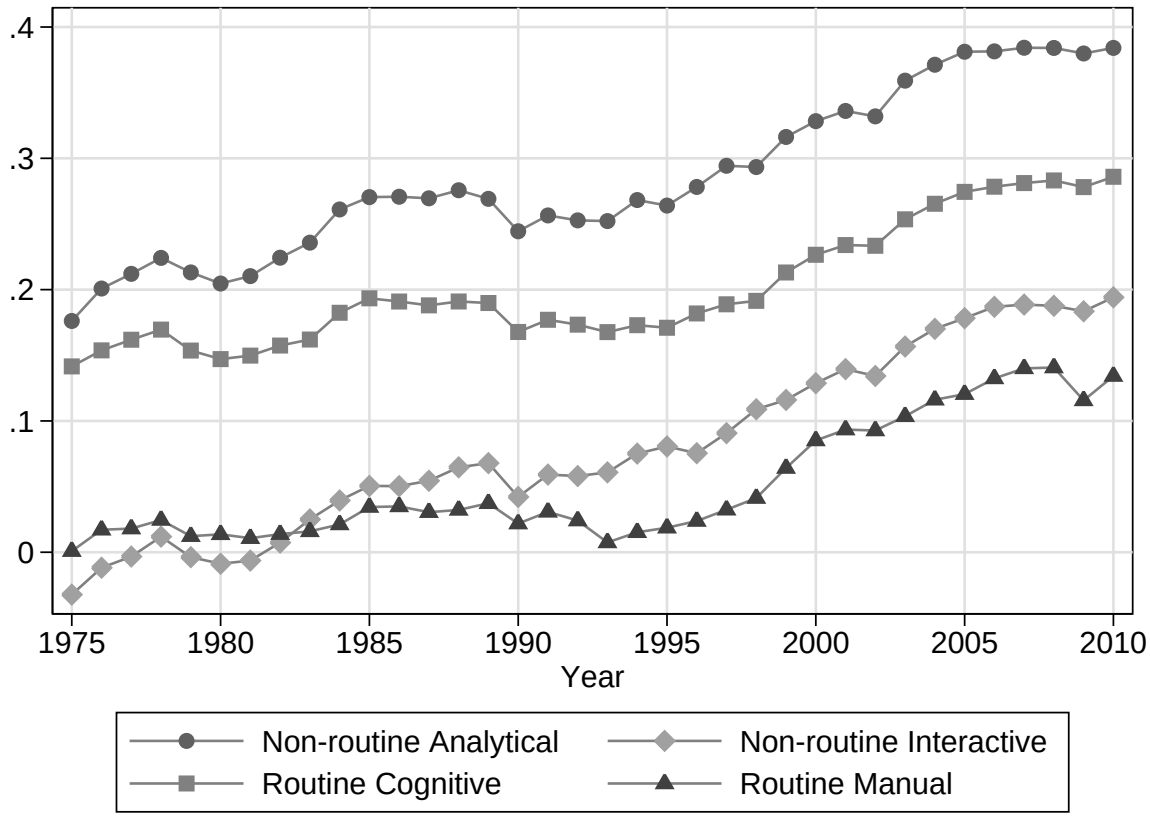
Source: 2% IABS Sample for full-time workers with less than five years of observed experience with a positive lor real daily wage. N= 1,154,402. N= 44,311 for high-skilled, N= 29,533 for high-fh-skilled, N= 51,591 for high-abi-skilled, N= 843,577 for medium-skilled, N= 185,390 for low-skilled.
Note: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

Figure 14: Wage premia to Degrees (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 lor 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 coefficients obtained from year-by-year estimations for each educational attainment level 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 coefficients plotted are statistically significant at the 1% confidence level.

Figure 15: Wage premia by 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 lor 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: Wage premia represent the coefficients obtained from year-by-year estimations for each educational attainment level 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 coefficients plotted are statistically significant at the 1% confidence level,except for routine manual in 1975, and non-routine interactive in 1977, 1979, 1981, and 1982.