Received: 23 September 2019 | Revised: 30 August 2020 | Accepted: 19 August 2021

DOI: 10.1111/kykl.12283

ORIGINAL ARTICLE

KYKLOS WILEY

Flexible work organization and employer provided training: Evidence from German linked employer-employee data

Annika Campaner[1] | **John S. Heywood**[2] | **Uwe Jirjahn**[3]

[1]University of Trier, Germany

[2]University of Wisconsin-Milwaukee, GLO, United States

[3]University of Trier, Germany

Correspondence
Uwe Jirjahn, Universität Trier, Fachbereich IV, Lehrstuhl für Arbeitsmarktökonomik, Universitätsring 15, 54286 Trier, Germany.
Email: jirjahn@uni-trier.de

Abstract

We examine the hypothesis that flexible work organization involves greater skill requirements and, hence, an increased likelihood of receiving employer provided training. The analysis is based on unique linked employer-employee data from Germany for the years 2012, 2014 and 2016 (12,924 pooled observations from 9,440 employees in 1,903 establishments). Our results confirm that employees are more likely to receive training when their jobs are characterized by greater decision-making autonomy and task variety, two essential elements of flexibility. Critically, the training associated with workplace flexibility does not simply reflect technology. Skill-biased organizational change plays its own role. Moreover, we show that the training associated with workplace flexibility is disproportionately oriented toward employees with a greater formal education. We find little evidence of an age or a gender bias of workplace flexibility.

1 | INTRODUCTION

The last several decades have witnessed dramatic changes in the organization of work. These changes appear driven by a shift toward more flexible production emphasizing quality and speedy adjustments to changing market conditions. Increased multitasking and the delegation of responsibilities and decision rights to lower layers of hierarchy are key features of flexible production. These two key features of a flexible organization of work imply an increased

demand for human capital. If employees perform a broader set of tasks, they need a broader set of skills. If employees make decisions, they need more information-processing and problem-solving skills.

We argue that flexible organization of work not only induces employers to hire employees with greater formal education, but also to spend more resources on continuous training. Flexible production blurs occupational barriers and makes cross-occupational learning critical. It even requires greater social and interactive skills as employees have, for example, more contact with customers. Training also reduces the risk of mistakes made by employees. Mistakes have greater consequences when employees have more responsibilities. Moreover, training keeps employees' skills up to date. Flexible production generates frequent changes in skill requirements as it involves continuous process improvements and speedy adjustments to varying customer needs. Finally, training can have specific incentive effects under flexible production. It provides employees with multiple skills reducing the risk that they are replaced by labor-saving process improvements. This increases their willingness to cooperate when changes need to be made.

Using unique linked employer-employee data from Germany, we find that both increased task variety and decision-making responsibility are indeed associated with a higher probability that employees receive employer provided training. Our analysis shows that these associations do not simply reflect technological change. Markers of technological change, information and communication technologies and recent equipment changes, increase the likelihood of receiving training, but do not change the association between flexible workplace organization and employer provided training. Thus, the flexible organization of the workplace brings its own skill demand that is not completely determined by technological conditions. Our evidence suggests that employers respond to this demand with the increased provision of training.

However, our empirical analysis also shows that the link between flexible production and employer provided training depends on the employees' formal education. The training associated with flexible production is disproportionately oriented toward those with a greater formal education. The relationship between flexibility and training is larger for the university educated than for skilled employees and larger for skilled than for unskilled employees. Thus, the flexible organization of work widens the training gap between the more and the less educated. Additional wage estimations corroborate the view that a flexible work organization entails greater inequality in labor market opportunities of more and less educated employees.

We also examine if the age and the gender of employees play a role in the relationship between flexible production and employer provided training. Our estimates provide no evidence that the relationship differs between male and female employees. We also find no strong evidence of an age bias in the training associated with flexible workplace.

Our study contributes in several ways to the literature. Economists usually stress that skill-biased *technological* change drives the fundamental transformations of the workplace (see Acemoglu, 2002 and Acemoglu & Autor, 2011 for surveys). The role of skill-biased *organizational* change receives far less attention. Yet, some studies show that a flexible organization of work increases the demand for employees with greater formal education (e.g., Caroli & Van Reenen, 2001; Piva et al., 2005, 2006). Our examination joins those studies by finding that the flexible organization of work has an independent influence on the demand for skills that cannot be simply reduced to technological factors. However, importantly, our examination shows that a flexible organization of work leads employers also to generate the needed skills and not just buy them in the external labor market. Moreover, our examination demonstrates that flexible production entails a specific skill bias that goes beyond a simple increase in the demand for skills. While flexible workplaces provide more training, this training is oriented to those who already have the greatest skills. Thus, if earlier studies are correct that flexible workplaces hire disproportionately the more skilled, we show that the training decisions of these workplaces compound those hiring decisions.

Some earlier studies have used establishment-level data to demonstrate that indicators of flexible work organization correlate with employer provided training (Bilanakos et al., 2018; Bresnahan et al., 2002; Gerlach & Jirjahn, 2001; Lynch & Black, 1998; Osterman, 1995).[1] Our analysis is based on unique employer-employee data.

[1]A study by Xu & Lin (2011) uses linked employer-employee data. However, their indicators of flexible production are measured at the firm level. That study provides very mixed results on the influence of flexible production on training.

This has several advantages. First, the linked employer-employee data allow a very rich set of controls for both employee and establishment characteristics. Second, the data measure multitasking and delegated decision making at the individual employee level. Thus, we can examine if those who are in fact engaged in increased multitasking and delegated decision making have a higher likelihood of receiving training. Third, the data are unique in that they enable us to examine if the influences of multitasking and decision-making responsibility on training differ between various types of employees. The OECD (2003) has expressed concerns that in many countries less educated employees, older employees and women receive less training. Thus, it is important to know how the transformation of the workplace influences the training gaps between the more and the less educated, between the younger and the older and between men and women.

The rest of the paper is organized as follows. The second section provides a background discussion. The third section describes the data and variables. The estimates are presented in the fourth section. The fifth section concludes.

2 | BACKGROUND DISCUSSION

2.1 | Multitasking, Delegation and Training

The fundamental transformation of the workplace in the last decades has been a shift away from Tayloristic mass production to a more lean and flexible production concept that emphasizes quality and speedy responses to changing market conditions (Milgrom & Roberts, 1990, 1995). This development began in the Japanese automobile industry, but spread internationally not only to other areas of manufacturing, but also to service industries such as medicine (Armstrong & Armstrong, 2003; Chalice, 2008; Graban, 2009; Grunden, 2008) and education (Hines & Lethbridge, 2008; Johnson, 2014) and even to public administration (Vigour, 2015; Walshe et al., 2010). Employers became increasingly interested in concepts such as quality circles, job rotation and total quality management (Osterman, 2000).

A key feature of the transformation has been a decentralization of the organization of work involving increased multitasking and the delegation of responsibilities and decision rights to lower-level staff (Caroli et al., 2001; Lindbeck & Snower, 2000). Employees are more autonomous and perform a broader set of tasks. This allows the flexible use of local information available at lower layers of hierarchy (Aoki, 1986, 1990). Indeed, Bloom et al. (2012) show that failure to delegate authority and decentralize impedes firm growth while Boedker et al. (2011) find that of 32 practices, delegation correlates most closely with their index of high performing workplaces. Thus, it may be no surprise that scholars dedicate special issues to flexible work organization and fading hierarchies recognizing "the slow but steady replacement of traditional top-down hierarchies with more decentralized structures where employees are given significant autonomy in how to carry out their work or which projects to undertake" (Billinger & Workiewicz, 2019: p. 1).

This flexible organization of work should involve an increased demand for human capital. Multitasking means that employees perform a wider set of tasks. This requires a broader set of skills. Delegation means that employees make more and larger decisions. This requires problem-solving skills and higher ability to process information. Empirical research confirms that flexible production is associated with an increased demand for employees with a higher level of formal education (Caroli & Van Reenen, 2001; Piva et al., 2005, 2006). That fits the hypothesis of skill-biased organizational change.

Economists usually emphasize skill-biased technological change (Acemoglu, 2002; Acemoglu & Autor, 2011). This raises the issue of whether or not skill-biased organizational change simply reflects skill-biased technological change. On the one hand, technological change appears to foster the shift toward flexible production.[2]

[2]Further factors are an increased volatility of markets, a shortening in the length of batches, a better formal education of employees, and changes in employees' tastes (Caroli et al., 2001; Lindbeck & Snower, 2000).

Computerized information and communication technologies provide the individual employee better access to information about other employees' work within the firm and make it easier to communicate. This is important as employees must coordinate their actions if they have flexibility to tailor their tasks to the local information that can only be observed by them (Dessein & Santos, 2006). Moreover, information and communication technologies provide individual employees better information about customer needs, permitting them to respond in a timely manner to changing market conditions.

On the other hand, even if computers and telecommunications have stimulated a flexible organization of work, this flexible organization may have its own influence on the skill demand of firms (Bresnahan et al., 2002, Brynjolfson & Hitt, 2000, Hunter et al., 2001). New technologies are likely to require complementary organizational changes to be effective.[3] Thus, the influence of organizational change on the demand for human capital cannot be simply reduced to technological change. This brings us to the influence of flexible production on employer provided training.

For several reasons, a flexible organization of work should not only increase the employers' incentive to hire employees with greater formal education, but also to provide more continuous training to employees. The employees' formal education may not sufficiently match the skill requirements implied by a flexible organization of work. Such organization of work implies a blurring of traditional occupational barriers (Lindbeck & Snower, 2000). Workers are given tasks and responsibilities spanning more than one of the traditional occupational groupings. Thus, cross-occupational training and learning plays an important role in flexible production.

Furthermore, a flexible organization of work is associated with an increased importance of non-cognitive skills (Lindbeck & Snower, 2000; Piva et al., 2005). In addition to fulfilling their formal occupational requirements, employees need to exercise greater social and interactive skills. For example, they often have more interactions with customers to provide customer-specific solutions and individualized treatment. Training can provide the required social and interactive skills.

Employers may also provide training to reduce the risk of mistakes made by the employees. Mistakes are more costly under a flexible organization of work. If employees have greater responsibilities, mistakes have more far reaching consequence for firm performance. Relatedly, as employees are involved in each other's tasks, the increased interdependence of worker productivity implies that an employee's mistake negatively affects the productivity of coworkers (Heywood & Jirjahn, 2004, 2009). In this context it is important to note that a flexible organization of work appears to entail an intensification of work and an increase in mental health problems (Askenazy & Caroli, 2010; Brenner et al., 2004; Cottini & Lucifora, 2013; Green, 2004). This intensification may itself increase the occurrence of mistakes (Caroli & Van Reenen, 2001). Thus, in order to reduce the risk of mistakes, employers may not only provide training that improves employees' problem solving and information processing skills, but also training that is related to stress and health issues.

Moreover, the skill requirements associated with a flexible organization of work have a crucial dynamic dimension. For at least two reasons these skill requirements change frequently. First, firms with flexible organization of work rapidly adjust their production and services to changing market conditions and varying customer needs. Second, continuous process improvements play a key role in flexible production (Morita, 2005). For example, employees may participate in quality circles to conduct continuous process improvements. The basic point is that changes in skill requirements involve a need for continuous training to keep employees' skills up to date.

[3]In the extreme, the introduction of new technologies may increase firm performance only if firms undergo complementary organizational changes. Technological change alone may be not enough. Doms et al. (1997) show that new production technologies have little influence on the skill requirements for production workers. Jirjahn & Kraft (2010) provide evidence that the influence of a modern production technology on the intra-firm wage differential between skilled and unskilled blue-collar workers crucially depends on the organization of work. A modern production technology has a positive influence on the wage differential when the firm uses self-autonomous production teams, but it has a negative influence if the firm has no such teams. This suggests that new technologies have a deskilling effect on blue-collar workers when there is no reorganization of work and workers have little scope for decision-making. By contrast, new technologies coupled with increased responsibilities and expanded involvement in decision making increase the skill requirements for blue-collar workers.

Employer provided training can also have important incentive effects under flexible production (Carmichael & MacLeod, 1993). Training provides employees with multiple skills. Multiple skills reduce the likelihood that employees are replaced when labor-saving process improvements occur or market demand shifts. Instead, organizational change may even involve new career opportunities for multi-skilled employees who can cope with the changes. Thus, multiple skills increase employees' willingness to come up with ideas for process improvements and to cooperate with organizational changes.

More generally put, delegating authority entails a loss of control for the employer (Acemoglu et al., 2007; Aghion & Tirole, 1997). If employees act upon a sharply different objective function than that of the employer, they may make choices that are not in the employer's best interest. In this view, delegation is profitable only when there is sufficient congruence between the interests of the employer and the interests of the employees. While this congruity might be achieved through financial incentive schemes (Bloom et al., 2012; De Varo & Kurtulus, 2010), part of the calculus is the effort cost at which employees can learn and communicate information. Employer provided training lowers this cost and, hence, increases the probability that employees make decisions that are in the employer's interest (Bilanakos et al., 2018).

Altogether, our theoretical considerations suggest that multitasking and delegation should be positively associated with employer provided training. However, this gives rise to the question of whether this holds in general or only for particular types of employees. The question is motivated by the fact that training is currently very unequally distributed across employees.

2.2 | Initial Education, Age and Gender

In many countries, less educated employees, older employees and women appear to receive less training (OECD, 2003). This also holds for Germany (Fitzenberger & Muehler, 2015; Grund & Martin, 2012). The training gap between educated and less educated employees suggests a complementary relationship between formal education and employer provided training. Employers tend to find it more profitable to train employees who have increased their trainability by learning how to learn through formal education (Heckman, 1999; Rosen, 1976). The training gap between younger and older employees may be explained by the fact that older workers have a shorter amortization period of human capital investments (Becker, 1964; Oi, 1962). Finally, the gender training gap may reflect a lower labor force attachment of women (Barron et al., 1993).

At issue is how the various training gaps are influenced by a flexible organization of work. From a theoretical viewpoint, the influence of flexible production on each of the training gaps is ambiguous. Flexible production can involve a series of opposing influences on these gaps. Thus, it depends on the relative strength of these opposing influences whether flexible production widens or narrows the training gaps.

Consider first the training gap between the more and the less educated. On the one hand, the less educated have greater training needs than the educated to cope with the requirements entailed by flexible production. This suggests that flexible production may lead employers to provide more training to the less educated shrinking the training gap.[4] On the other hand, flexible organization of work may strengthen the complementarity between initial education and training implying a widened training gap. The ability to learn has even greater importance if firm strategy emphasizes quality and speedy adjustments to changing market conditions. In this context, flexible production can imply a change in the division of labor between the more and the less educated even when both types of employees are engaged in multitasking and have more scope for decision making (Jirjahn & Kraft, 2010). Under flexible production, educated employees may become team leaders and specialize in problem solving. Thus, greater multitasking and responsibility for decision making means for the educated that the complexity and the skill requirements of their jobs increase. Thus, the employer may disproportionately train the more educated employees.

[4]Bartel & Sicherman (1998) provide evidence from the U.S. that technological change narrows the training gap between the more and less educated.

A flexible organization of work can also have implications for the training gap between younger and older employees. On the one hand, older employees might have more experience to cope with change. Thus, the employer may provide more training to older workers to strengthen their role in a successful implementation of flexible production. On the other hand, flexible production may accelerate the obsolescence of the skills of older employees. Moreover, their age may imply a lower adaptability to change. Empirical research finds that organizational change negatively affects the labor demand for older employees (Aubert et al., 2006). This suggests that flexible production entails an age bias.[5] There is even evidence that training does not reduce this age bias (Behaghel et al., 2014). Against this background, one might hypothesize that flexible production does not increase employers' incentive to provide training for older employees. This would imply a widened training gap between younger and older employees.

Finally, flexible organization can have opposing effects on the gender training gap. On the one hand, longer employment interruptions due to childcare responsibilities imply less work experience so that women need greater training to cope with flexible production. On the other hand, women's lower labor force attachment may negatively influence the return to such training. Anticipating longer employment interruptions or a higher incidence of part-time work, employers have an incentive to provide less training to women than to men even if both types of employees engage in multitasking and have increased responsibilities. Moreover, even if women work, they remain disproportionately responsible for family. Thus, they sort and are sorted into jobs that allow combining work and family, e.g. jobs allowing taking time off to care for a sick child (Heywood & Jirjahn, 2002). Thus, women participating in flexible production may be assigned to more menial multitasking and responsibility for decision making requiring a less strong need for training.[6]

The theoretical viewpoint makes clear that it remains an open question whether flexible work organization widens or narrows the various training gaps. Thus, only empirical research can determine which of the opposing influences dominates.

3 | DATA AND VARIABLES

3.1 | The Data Set

Our empirical investigation uses the Linked Personnel Panel (LPP), a unique longitudinal linked-employer-employee data set (Mackeben et al., 2018a, 2018b). The LPP is a biannual additional survey of a subsample of establishments participating in the IAB Establishment Panel. The IAB Establishment Panel is a representative sample of establishments from all sectors in Germany (Fischer et al., 2009). Infratest Sozialforschung, a professional survey and opinion research institute, conducts the interviews on behalf of the Institute for Employment Research (IAB) which belongs to the German Federal Employment Agency (BA). The data are collected on the basis of a questionnaire and follow-up personal interviews with the owner or top manager of the establishment. Each year since 1993 (1996), the IAB Establishment Panel has surveyed several thousand establishments in Western (Eastern) Germany. The IAB Establishment Panel contains longitudinal information on workplace characteristics (e.g., establishment size, workforce structure and investment activities).

The add-on survey, the LPP, links employer-level with employee-level information (Kampkoetter et al., 2016). The LPP consists of an additional questionnaire for the employers and a questionnaire for the employees. The employer questionnaire, answered by top managers or the owner of the establishment, focusses more than the IAB Establishment Panel on HR management instruments and strategies (Tschersich & Gensicke, 2018). The LPP is representative of private sector establishments with at least 50 employees in manufacturing and services industries.

[5]This age bias in the provision of training is independent from any influence that flexible work organization and its associated increase in required labor force attachment and effort (Karasek, 1979) may have on the retirement decision of the elderly. See Been and van Vliet (2017) for the role that labor force attachment and effort play on retirement.

[6]Indeed, evidence suggests that as women move from part-time to full-time work they see little change in the provision of training while men see a large increase (see Backes-Gellner et al., 2014).

The employee questionnaire asks about job characteristics and the socio-demographic background of the employees (Schütz et al., 2018). The LPP covers unskilled employees and employees with a completed apprenticeship training or university degree. Apprentices are not surveyed. This makes sense for our analysis as employer provided further training takes place after an apprenticeship training or an initial period of work experience.

Our empirical analysis is based on the waves 2012, 2014 and 2016 of the LPP.[7] The survey is complemented by further establishment characteristics of the IAB Establishment Panel. For the analysis, we focus on employees in privately owned commercial establishments. After eliminating observations for which full information is not available, our analysis is based on an unbalanced panel of 12,924 pooled observations from 9,440 employees in 1,903 establishments.

3.2 | Employer Provided Training

In Germany, employers can provide two types of training, apprenticeship training and further training. The distinctive feature of the German system of apprenticeship training is its dual structure (Harhoff & Kane, 1997; Winkelmann, 1996). Apprentices typically attend publicly-funded vocational part-time schools 1–2 days a week in addition to working and learning at the workplace. Employers bear the cost of within-firm training voluntarily. The apprenticeship training ends after 2–3.5 years. Detailed curricula are developed in cooperation with state institutions, employer organizations and trade unions. Regionally organized chambers of commerce and chambers of crafts coordinate and administer the programs.

In contrast to apprenticeship training, employer provided further training is characterized by a very low degree of regulation by the state (Allaart et al., 2009). There is no legal framework regulating the content, financing or structure of such training. Employer provided further training is an investment in workers' human capital that aims at a better understanding of, or coping with, current job tasks (Brussig & Leber, 2006). Usually further training takes place after an apprenticeship training and/or an initial period of work experience (Gerlach & Jirjahn, 2001). It can be organized as courses and seminars or it can be integrated in the process of work itself. Further training can take place internally or externally. Employer provided further training plays an important role in Germany. In 2013 employers in Germany invested about 33.5 billion Euro in further training (Seyda & Werner, 2014).

Our dependent variable builds from a two-part question in the employee questionnaire of the LPP. The first part asks if the employee participated in courses of further training during the respective year. The second part identifies if the costs were borne by the firm in release time and/or paying explicit training costs. These two questions allow us to distinguish three outcomes: employer provided further training, employee paid further training, and no further training. Table 1 provides the descriptive statistics on these constellations. There are 35% of observations with employer provided further training, 1% with employee paid further training and 64% with no further training.

For the major part of our empirical analysis, we use a dummy dependent variable equal to 1 if the employee received employer provided further training in the respective year. The reference group consists of employees who received no further training or paid the further training for themselves. However, we also provide a robustness check by distinguishing between employer provided and employee paid further training. In that case, the reference group consists of employees who received no further training.

3.3 | Flexible Organization of Work

The data provide a rich set of explanatory variables capturing a variety of employee and establishment characteristics. Appendix Tables A1 and A2 show the definitions and descriptive statistics of the explanatory variables. Our two

[7]Data access was provided via on-site use at the Research Data Centre (FDZ) at the IAB and subsequently remote data access.

TABLE 1 Further Training

Category	Definition	Share of observations
Employer provided further training	The employee participated in courses of further training in the respective year and the costs were partially or completely borne by the employer in release time and/or paying explicit training costs.	0.35
Employee paid further training	The employee participated in courses of further training in the respective year and he or she completely paid the further training for themselves (i.e., there was no release time and the explicit costs were not partially or completely borne by the employer).	0.01
No further training	The employee did not participate in courses of further training in the respective year.	0.64

Number of pooled observations of employees = 12,924.

key explanatory variables identify the extent to which each employee's job has conditions associated with a flexible organization of work. Thus, we match the information on work organization and the information on training at the employee level. Delegated decision making is measured with a Likert scale variable ranking the employee's job on a five-point scale according to the extent to which the employee can make many decisions autonomously (5 is the greatest extent). Multitasking is measured with a Likert scale variable ranking the employee's job on a five-point scale according to the degree of task variety (5 is the greatest extent).[8] We hypothesize that when jobs have greater delegated decision making and multitasking, the likelihood of employer provided training is greater.

We recognize that testing our hypothesis empirically requires variation across employees in the degree of multitasking and delegated decision making. It might be thought that in equilibrium all employees would share the same degree. Yet, variation will exist if the employees' jobs differ in the cost of implementing a flexible work organization. Moreover, variation in multitasking and delegated decision making can result if employers have imperfect information on the potential advantages and disadvantages of flexible work organization (Bresnahan et al., 2002; Caroli & van Reenen, 2001). Imperfect information on the advantages and disadvantages of flexible work organization implies that employers may experiment with the organization of work for their employees' jobs.

3.4 | Technology

As stressed in the background discussion, there exists concern that the organization of work simply reflects underlying technological factors. Skill-biased technological change could drive the decision of employers to train employees. Empirical evidence, indeed, suggests that technological change has a positive influence on employer provided training (Gashi et al., 2008, 2010). Thus, we test whether or not the organization of work has its own influence on training. In order to disentangle the influences of technological change and work organization, we include a series of control variables capturing technology. Technology at the establishment level is captured by a dummy equal to 1 if production technology is of a more recent vintage than the industry median.

Moreover, as our focus is on the training of individual employees and the dimensions of their job, we also ultimately measure technological change at the employee level using two indicators. The first identifies whether the employee uses information or communication technologies at work. The second identifies if the technological equipment of the employee's workplace has changed recently. These two variables exist only in the 2014 wave of the LPP. Thus, we use these variables for robustness checks. First, we examine how the estimated influences of delegation

[8]The statements underlying our key explanatory variables are 'In my job, I can make many decisions autonomously' and 'In my job, I perform a variety of tasks'. Interviewees respond to each of the statements on a five-point Likert scale ranging from 1 'agree completely' to 5 'disagree completely'. For the empirical analysis, the items are recoded in inverse order.

and task variety are changed by including these markers of technological change. Second, we examine separate regimes, those with and without the markers of technological change. We can then measure whether or not the influence of flexible work organization is confined to, or substantially larger in, the regime where the markers of technological change are present. This sheds light on the relationship between flexibility, technological change and training.

3.5 | Initial Education, Age and Gender

In the regressions, we also include variables for the employee's initial education, age and gender. Initial education, age and gender may have both a direct influence on receiving employer provided further training and an indirect influence. As emphasized in our background discussion, they may moderate the link between work organization and employer provided training. Thus, in order to examine whether flexible work organization widens or narrows training gaps, we also run separate estimations by education, age and gender.

3.6 | Control Variables

We include a series of individual level variables capturing additional employment related and demographic characteristics. Variables for spousal relationship and German citizenship account for further demographic characteristics of the employees. Variables for flexible working hours, part-time status, having a fixed-term contract, and being a blue-collar worker take into account employment related characteristics. We also control for a managerial function of an employee. Here we use the number of subordinates a manager has. The variable is set equal to 0 if the employee has no managerial functions.

The data provide also a series of control variables for further characteristics of the interviewee's job. We identify the extent to which the jobs of other workers depend on the interviewee's performance and the extent to which the interviewee's performance depends on other workers. We include measures of the physical effort required on the job, the time pressure on the job and the extent of unpleasant working conditions. These five variables help proxy for other critical aspects of an employee's job that may stand as determinants of training and be correlated with delegation and flexibility.

An employee's probability of receiving training may depend not only on his or her job and individual characteristics, but also on the characteristics of the establishment. Thus, we control for the share of university graduates and the share of skilled employees. Such establishment-level variables may capture skill or education spillovers associated with high human capital workplaces. We also include the share of apprentices. This variable indicates the general propensity of an employer to train workers. Furthermore, we control for the use of temporary agency workers and for the shares of women and part-timers. The influence of these variables is ambiguous. On the one hand, they may be seen as indicating a low expected tenure of the workforce resulting in less training. On the other hand, they may reflect a high share of peripheral workers protecting a core group of workers who receive more training.

Industrial relations are captured by variables for collective bargaining coverage, works council presence and alternative forms of employee representation. Collective agreements are usually negotiated on a broad industrial level between unions and employers' associations. Establishments are covered if they are members of an employers' association. Works councils provide a highly developed mechanism for establishment-level codetermination. The Works Constitution Act expressly provides for them, but their creation depends on the initiative of the establishment's employees. Thus, works councils are not present in all eligible establishments (Jirjahn & Smith, 2006). Works councils can be seen as a collective voice institution ensuring that managers take employees' interest into account. They promote the internal labor market and reduce personnel turnover. Reduced mobility of the employees, in turn, increases employers' incentives to invest in the human capital of their employees (Gerlach & Jirjahn, 2001). Alternative forms of employee representation such staff spokesmen and round tables are voluntarily implemented by the

employer and, hence, depend on the discretion of the employer. Similar to works councils, they provide channels for improved communication and information sharing between management and workers. However, they have no legally defined rights and are far less powerful than works councils.

We recognize the debate over the role that product market competition may play as a spur to training. Indeed, Heywood et al. (2020) review a dozen studies across several countries that show no consistent pattern. Using German data, they present evidence that competition threatening survival of the establishment reduces training incentives by shortening the expected payback period for training investments. In this work we also include variables indicating high competitive pressure with a threat of liquidation and high competitive pressure without such a threat. These serve largely as needed controls that might be correlated with the measures of flexibility.

Furthermore, we control for multi-establishment status. If training involves fixed costs, these can be spread over several establishments suggesting a positive association with training. Similar reasoning may also apply to the role of establishment size. In order to account for possible nonlinearity, we include variables for both establishment size and establishment size squared.

Dummy variables for job vacancies for unskilled and for skilled and highly skilled employees are also included. If employers face difficulties in filling vacancies, they may train current employees who temporarily take on tasks of the unfilled positions. This may apply particularly to vacancies for skilled and highly skilled employees. Finally, we control for establishment age, foreign ownership, industry, region and year of observation.

4 | RESULTS

4.1 | Initial Estimates

Table 2 provides the initial estimations. A random effects probit model estimates the determinants of employer provided training. The random effects probit accounts for cross-period correlation of individual-specific error terms. Furthermore, we cluster the standard errors at the establishment level using the Huber-White sandwich estimator of variance to recognize that error terms may be correlated within establishments.[9] The estimations start with our two key explanatory variables and add ever more extensive controls. This serves to demonstrate the durability of the relationship between the two key indicators of flexible work organization and training.

The first column of Table 2 presents the very parsimonious probit estimate of the training dummy against the two key explanatory variables. This indicates that a unit change in either decision-making autonomy or task variety is associated with about a 5 percentage point increase in the probability of receiving employer provided training. The second column adds the variables for other characteristics of the employee's job. Physical effort, unpleasant working conditions and others' performance being dependent on the employee's performance are associated with a smaller probability of training. Time pressure and the employee's performance depending upon others' performance are associated with a larger probability of training. The important point is that while controlling for other job characteristics reduces the marginal effects of decision-making autonomy and task variety, they remain large and statistically significant.

The third column adds the remainder of the basic individual-level controls. Skilled employees (with a completed apprenticeship training) and those with a university degree are more likely to receive training whereas older employees and women are less likely to receive training. These findings confirm training gaps between the more and the less educated, between the younger and the older, and between men and women. In particular, the training gap between the educated and the less educated is very large. Compared to the reference group of unskilled employees, employees with a completed apprenticeship training have a 17-percentage point and employees with a university

[9]Ignoring clustering is likely to produce downward biased standard errors (Moulton, 1990) as establishment characteristics and the training provided to the individual employee differ in the level of aggregation. Note that we alternatively used clustering at the individual level. This did not change the key pattern of results. These alternative results are available from the authors upon request.

TABLE 2 Initial Estimates

Variable	(1)	(2)	(3)	(4)
Decision-making autonomy	0.166 [0.054] (8.43)***	0.107 [0.034] (5.63)***	0.085 [0.026] (4.47)***	0.093 [0.027] (4.90)***
Task variety	0.155 [0.051] (7.11)***	0.139 [0.044] (6.32)***	0.131 [0.040] (5.95)***	0.139 [0.041] (6.20)***
Others' performance depends on employee	---	−0.026 [−0.008] (1.86)*	−0.031 [−0.010] (2.19)**	−0.006 [−0.002] (0.38)
Employee's performance depends on others	---	0.029 [0.009] (2.13)**	0.027 [0.008] (1.96)**	0.021 [0.006] (1.60)
Physical effort required	---	−0.162 [−0.051] (9.25)***	−0.078 [−0.024] (4.47)***	−0.085 [−0.025] (5.04)***
Unpleasant working conditions	---	−0.099 [−0.031] (6.92)***	−0.057 [−0.018] (3.95)***	−0.061 [−0.018] (4.17)***
Time pressure and work overload	---	0.114 [0.036] (7.69)***	0.060 [0.018] (4.02)***	0.055 [0.016] (3.70)***
Older employee	---	---	−0.189 [−0.054] (5.13)***	−0.228 [−0.059] (6.17)***
Blue-collar worker	---	---	−0.455 [−0.079] (8.66)***	−0.370 [−0.070] (7.17)***
Skilled employee	---	---	0.594 [0.168] (3.97)***	0.553 [0.152] (3.70)***
University degree	---	---	0.849 [0.259] (5.17)***	0.758 [0.221] (4.66)***
Woman	---	---	−0.186 [−0.053] (3.39)***	−0.182 [−0.048] (3.56)***
German citizenship	---	---	0.083 [0.025] (1.03)	0.058 [0.016] (0.71)
Employee has partner	---	---	0.166 [0.052] (3.52)***	0.181 [0.052] (3.83)***
Number of subordinates	---	---	4×10^{-4} [1×10^{-4}] (0.86)	5×10^{-4} [2×10^{-4}] (0.93)
Flexible working hours	---	---	0.112 [0.026] (2.38)**	0.094 [0.022] (2.02)**
Fixed-term contract	---	---	−0.244 [−0.068] (2.91)**	−0.178 [−0.047] (2.08)**
Part-time employee	---	---	−0.100 [−0.029] (1.43)	−0.178 [−0.047] (2.43)**
Vintage of technology	---	---	---	0.166 [0.048] (2.90)**
Multi-establishment firm	---	---	---	0.090 [0.026] (1.50)
Foreign ownership	---	---	---	0.131 [0.038] (1.89)*
Founded after 1990	---	---	---	0.058 [0.017] (0.90)
Establishment size	---	---	---	4×10^{-5} [1×10^{-5}] (3.19)**
Establishment size squared	---	---	---	-7×10^{-10} [2×10^{-10}] (2.84)**
High competitive pressure with threat of liquidation	---	---	---	−0.156 [−0.045] (1.92)*
High competitive pressure without threat of liquidation	---	---	---	−0.056 [−0.017] (1.06)

(Continues)

TABLE 2 (Continued)

Variable	(1)	(2)	(3)	(4)
Collective bargaining	---	---	---	0.023 [0.007] (0.36)
Works council	---	---	---	0.159 [0.046] (2.22)**
Alternative worker representation	---	---	---	0.100 [0.028] (1.34)
Temporary agency employees	---	---	---	−0.010 [0.003] (0.18)
Share of part-time employees	---	---	---	0.383 [0.113] (1.59)
Share of women	---	---	---	-9×10^{-5} [3×10^{-5}] (0.00)
Share of apprentices	---	---	---	3.133 [0.924] (4.23)***
Share of skilled employees	---	---	---	0.490 [0.144] (3.48)***
Share of university graduates	---	---	---	0.583 [0.172] (2.36)**
Vacancies for unskilled employees	---	---	---	0.049 [0.014] (0.50)
Vacancies for skilled and high-skilled employees	---	---	---	0.009 [0.003] (0.19)
Constant	−1.918 (16.19)***	−1.335 (10.37)***	−1.877 (8.35)***	−2.713 (9.13)***
Industries dummies	Not included	Not included	Not included	Included
Region dummy	Not included	Not included	Not included	Included
Time dummies	Not included	Not included	Not included	Included
Pseudo R^2	0.013	0.040	0.059	0.079
Number of observations	12,924	12,924	12,924	12,924
Number of employees	9,440	9,440	9,440	9,440

Estimations are based on the 2012, 2014 and the 2016 wave of the LPP. The dummy dependent variable equals 1 if the employee received employer provided training in the respective year. Method: Random effects probit. The table shows the estimated coefficients. Z-statistics in parentheses are based on standard errors clustered at the establishment level. Average marginal effects are in square brackets. Marginal effects of dummy variables are evaluated for a discrete change from 0 to 1.
*Statistically significant at the 10% level>; **at the 5% level; ***at the 1% level.

degree a 26 percentage point higher likelihood of receiving training. The training gaps between men and women and between younger and older employees amount to five percentage points, respectively. Furthermore, those with a partner are more likely to receive training. Blue-collar workers are less likely to receive training. Most importantly, including the additional individual-level controls leaves largely in place the role of flexible work organization. The magnitudes are again somewhat smaller, but the coefficients still remain large and highly significant supporting the hypothesis that flexible work organization is associated with a greater likelihood of training.

Finally, the fourth column adds all the establishment level controls. The establishment variables suggest that the presence of a works council, establishment size and foreign ownership are positively associated with training. The shares of apprentices, skilled employees and university graduates are also positive covariates. The fact that the shares of more educated employees has an influence that persists beyond whether the individual employee is skilled or a university graduate indicates the complementarities between more educated employees that raise the value of training. Product market competition that threatens liquidation is associated with a smaller likelihood of training. Finally, a production technology of a more recent vintage is associated with a greater likelihood of training. This suggests that skill-biased technological change also plays a role in employer provided training.

Despite the many significant influences of the establishment level variables, the inclusion of these variables does not change the role of the indicators of flexible work organization. The coefficients on our two key explanatory variables remain highly significant and the magnitudes of the influences are still substantial. Reflecting approximately a standard deviation for each variable, a one unit increase in decision-making autonomy is associated with a 3 percentage point increase in the likelihood of being trained while a one unit increase in task variety is associated with a 4 percentage point increase in the likelihood of receiving training. Given that the mean of the training variable is 35%, the combined increase of 7 percentage points implies an increase in the likelihood of training by 20%.

In the Appendix, we present a series of additional estimations to check the robustness of our key results. First, we provide separate estimations for the three years of the sample. As shown in Table A3, we find for each year that decision-making autonomy and task variety are significantly associated with a higher probability of being trained.

Second, we return to the pooled sample and use a dependent variable distinguishing between completely self-paid training and employer provided training. While the reference group of our dummy for employer provided training consists of both employees without further training and employees with completely self-paid training, the reference group of the alternative dependent variable consists only of those without training. This more differentiated variable helps address the question of whether employees find it in their interest to undertake their own training in order to retain a position and thrive in the flexible environment. The multinomial probit estimation shown in Table A4 provides no evidence that task variety or decision-making autonomy play a role in self-paid training. This may reflect the relatively small number of observations with completely self-paid training, but it gives no indication that a flexible organization of work generates additional training paid for by the employee. Most importantly, the multinomial probit estimation does little to change the roles of task variety and decision-making autonomy in employer provided training.

Third, in Table A5, we use the number of days the employee participated in employer provided further training as an alternative dependent variable. This variable is set equal to 0 if the employee did not receive employer provided further training. The specifications of regressions (1)–(4) in Table A5 correspond to the specifications shown in Table 2. These regressions show a significantly positive influence of decision-making autonomy and task variety on the number of days the employee participated in employer provided training. Thus, our key results are confirmed even when using an indicator of the amount of training.

4.2 | Skill-Biased Organizational vs. Skill-Biased Technological Change

Our estimates show a significant influence of decision-making autonomy and task variety on training even controlling for the vintage of production technology. This suggests that skill-biased organizational factors play their own role

beyond reflecting technological factors. However, the variable for the vintage of production technology is only measured at the establishment level. At issue is whether or not our key results persist when controlling for individual-level technology variables. The 2014 wave of the LPP provides such variables. Thus, we now move to that wave and return to our dummy dependent variable for employer provided training. In Table 3, we provide estimations with two alternative technology markers. Our first marker of skill-biased technology is whether or not the employee uses information or communication technologies (ICT) at work. The second technology marker is whether or not the technological equipment of the employee's workplace has changed in the last five years. The estimations with these two alternative technology markers yield very similar patterns of results.

For a matter of comparison, the estimations in the first column do not include the variables for technology. The estimations reproduce the key results only for 2014 confirming that decision-making autonomy and task variety play their usual role. In the second column, we add the variable for the respective technological marker. These estimations show that technology plays an important role in employer provided training. In the regression with our first technology marker, the variable for ICT takes a very large and significant coefficient implying a very large marginal effect of 15 percentage points on the probability of training. Considering the regression with our second technology marker, the variable for technological change also shows a very large marginal effect of 12 percentage points and a highly significant coefficient. Yet, most salient, controlling for technology does little or nothing to diminish the importance of workplace flexibility. The variables for task variety and decision-making autonomy work organization retain their significance and both the coefficients and marginal effects show only very small changes. This suggests that excluding the variables for technology, as important as they are, does not change the key pattern of results. Our findings

TABLE 3 The Role of Technology

Variable	(1) All employees	(2) All employees	(3) Only employees using ICT	(4) Only employees not using ICT
Information and communication technologies (ICT)				
Information or communication technologies	---	0.451 [0.154] (7.19)***	---	---
Decision-making autonomy	0.078 [0.027] (3.43)***	0.073 [0.025] (3.20)**	0.079 [0.029] (3.13)**	0.061 [0.014] (1.23)
Task variety	0.106 [0.037] (4.36)***	0.100 [0.034] (4.03)***	0.097 [0.036] (3.49)***	0.107 [0.025] (2.26)**
Pseudo-R^2	0.097	0.087	0.061	0.073
Number of observations	4,418	4,418	3,406	1,012
Technological change				
Technological change	---	0.362 [0.123] (6.99)***	---	---
Decision-making autonomy	0.078 [0.027] (3.41)***	0.069 [0.023] (2.97)**	0.070 [0.026] (2.57)**	0.066 [0.017] (1.51)
Task variety	0.105 [0.036] (4.27)***	0.101 [0.034] (4.06)***	0.097 [0.036] (3.45)***	0.124 [0.032] (2.66)**
Pseudo R^2	0.096	0.087	0.060	0.146
Number of observations	4,398	4,398	3,175	1,223

Estimations are only based on the 2014 wave of the LPP. The dummy dependent variable equals 1 if the employee received employer provided training. Method: Probit. The table shows the estimated coefficients. Z-statistics in parentheses are based on standard errors clustered at the establishment level. Average marginal effects are in square brackets.

**Statistically significant at the 5% level; ***at the 1% level.

Results on the other explanatory variables are suppressed to save space.

support the view that flexible work organization plays a role that is not entirely driven by technology. Decision-making autonomy and task variety play an independent role in determining employer provided training.

We recognize that technology may play a moderating role. The link between flexible work organization and training might depend on technology. Thus, in a further step, we split the sample by whether or not the respective marker of technology is present. As shown in the third and the fourth columns, the influence of task variety on training is not moderated by technology. The variable for task variety takes significantly positive coefficients of similar magnitude for employees using and not using ICT and for employees with and without changes in the technological equipment of their workplace. The variable for decision-making autonomy also takes positive coefficients in the split regressions. However, the coefficients are significant only for employees using ICT and for employees with changes in the technological equipment of their workplace. This may indicate some complementarity of technology and decision-making autonomy. However, we note that the sample sizes for those not using ICT and for those without technological changes of their workplaces are relatively small. This may make it more difficult to identify a significant relationship between decision-making autonomy and training for these groups.

In summary, we find significant influences for decision-making autonomy and task variety even when controlling for individual-level technological variables. The findings suggest that technology does not eliminate the role of flexible work organization in driving greater training. This hints that the training associated with organizational change differs in type from that associated with technological change. The former presumably has more emphasis on communication skills, decision-making skills and making efficient use of time across many tasks. Moreover, our split regressions by the technology markers provide only weak evidence of a moderating role of technology. While the results on decision-making autonomy might indicate some moderating influence of technology, the results on task variety suggest that the influence of this indicator of flexible production on training is independent of technology.

4.3 | The Training Gap between the Less and the More Educated

To this point, we have shown that two key features of flexible work organization, task variety and decision-making autonomy, are associated with a higher probability of receiving training. This supports the notion of skill-biased organizational change. We now consider how the increase in training associated with task variety and decision-making autonomy is distributed across initial education levels. To do this we return to our panel data for the years 2012, 2014 and 2016 and divide the sample into three subsamples: employees with a university degree, skilled employees with a completed apprenticeship training as the highest degree, and unskilled employees without completed apprenticeship training. The estimations from Table 2 confirmed a training gap between the less and the more educated. We now examine how the link between workplace flexibility and training varies across these three subsamples. This reveals whether workplace flexibility reinforces or reduces the training gap between the less and the more educated.

Table 4 provides the key results and shows a clear pattern. The greater the initial education, the larger is the influence of workplace flexibility on the likelihood of receiving employer provided training. Among the university educated, decision-making autonomy is associated with a 6 percentage point increase in the likelihood of training. Among skilled workers this falls to two percentage points but remains still statistically different from zero. For unskilled workers, the estimation show no significant influence on training and the coefficient on decision-making autonomy even takes a negative sign. This pattern is largely replicated with task variety: the largest influence with 6 percentage points for those with a university degree, a smaller one with about four percentage points for the skilled and none for the unskilled.

Our results show that flexible workplaces are associated with additional training but only for the more educated. Thus, the skill bias of workplace flexibility goes beyond simply generating more training. Instead, the resulting training associated with flexible work organization is concentrated among the already more educated. This widens the training gap between less and more educated employees. The importance of this widening can be quantified in several ways. One could note that the constants in the probits represent the z-scores for those with zeros for all right-hand side

TABLE 4 Separate Estimations by the Employees' Initial Education

Variable	(1) Employees with a university degree	(2) Skilled employees (with apprenticeship training)	(3) Unskilled employees (without apprenticeship training)
Decision-making autonomy	0.172 [0.062] (3.36)***	0.084 [0.024] (4.07)***	−0.107 [−0.011] (0.84)
Task variety	0.163 [0.058] (3.22)***	0.135 [0.038] (5.35)***	0.037 [0.004] (0.23)
Constant	−1.528 [0.063] (2.89)**	−2.342 [.010] (8.14)***	−6.136 [0.0001] (2.14)**
Pseudo R^2	0.054	0.071	0.228
Number of observations	2,410	10,240	274
Number of employees	1,720	7,494	226

Estimations are based on the 2012, 2014 and the 2016 wave of the LPP. The dummy dependent variable equals 1 if the employee received employer provided training in the respective year. Method: Random effects probit. The table shows the estimated coefficients. Z-statistics in parentheses are based on standard errors clustered at the establishment level. Average marginal effects are in square brackets except for the constants which represent the marginal effect when all other variables take a value of zero.

**Statistically significant at the 5% level; ***at the 1% level.

Results on the other explanatory variables are suppressed to save space.

variables. Such an imagined person would have a probability of training of 6.3% if university educated, 1.0% if skilled and essentially 0 if unskilled as shown in the "effect sizes" for the constant. Adding the average marginal effects for a unit of decision-making autonomy and task variety (from Table 4) increases the probability of training to 18.3% for the university educated, 7.2% for the skilled but remains essentially 0 for the unskilled. Such calculations can also be performed at the mean level of training provision within each of the educational categories, the simple percent of the category receiving training. These are 51.2% for university graduates, 33.2% for the skilled and 14.1% for the unskilled. Adding the same average marginal effects for an increased unit of decision-making autonomy and an increased unit of task variety makes those 63.2% for graduates, 39.4% for the skilled and the same 14.1% for the unskilled. These demonstrate substantial changes for graduates and the skilled and essentially no change for the unskilled.

At issue is whether the widening of the training gap means that flexible production contributes to higher inequality in the labor market opportunities of the educated and the less educated. One might argue that a flexible work organization could possibly entail an increased obsolescence of the initial human capital of more educated employees making training necessary to update and retain their skills. In this case, flexible work organization may not entail higher inequality in labor market opportunities of the more and the less educated. In order to get deeper insights into this issue, we run wage regressions with the logarithm of the hourly wage as the dependent variable. Table 5 provides the key results for employees with a university degree, skilled employees, and unskilled employees. In these estimations we include employee and establishment characteristics, but do not include the training variable to assess the overall influence of flexible work organization on wages.

Decision-making autonomy has a significantly positive influence on the hourly wages of university graduates and skilled employees. A one unit increase in decision-making autonomy is associated with an approximately 4% higher hourly wage for university graduates and a 1% higher hourly wage for skilled employees. For unskilled employees, the coefficient on decision-making autonomy is of similar magnitude as the coefficient for skilled employees. The insignificance of the former coefficient may be due to the small number of observations in the subsample with unskilled employees. Yet, the basic point remains that the university educated disproportionately benefit from flexible work organization implying that flexible work organization contributes to an increased inequality in labor market opportunities of the more and the less educated.

TABLE 5 Wage Estimations

Variable	(1) Employees with a university degree	(2) Skilled employees (with apprenticeship training)	(3) Unskilled employees (without apprenticeship training)
Decision-making autonomy	0.035 (3.88)***	0.014 (3.60)***	0.015 (0.98)
Task variety	0.019 (1.73)*	0.008 (1.84)*	−0.047 (2.38)**
R^2	0.6111	0.5406	0.5408
Number of observations	2,153	9,084	248
Number of employees	1,569	6,782	209

Dependent variable: Logarithm of the employee's hourly gross wage. Estimations are based on the 2012, 2014 and the 2016 wave of the LPP. Method: Random effects GLS. The table shows the estimated coefficients. Z-statistics in parentheses are based on standard errors clustered at the establishment level.
*Statistically significant at the 10% level; **at the 5% level; ***at the 1% level.
Results on the other explanatory variables are suppressed to save space.

The results on task variety corroborate this view. Task variety has a significantly positive influence on the hourly wages of university graduates and skilled employees with the influence being strongest for university graduates. A one unit increase in task variety is associated with an approximately 2% higher hourly wage of university graduates and a 1% higher hourly wage of skilled employees. By contrast, for unskilled workers, task variety is significantly associated with a lower hourly wage. This may indicate that, under flexible work organization, unskilled workers perform a variety of more simple tasks. This fits Jirjahn & Kraft's (2010) hypothesis that a flexible work organization involves increased specialization between more educated and less educated employees within establishments. A flexible work organization implies that more educated employees have an increased responsibility for complex and difficult tasks while more menial tasks are left for unskilled employees.

In Table A6, we additionally include the variable for employer provided training in the wage regressions. As shown in columns (1) to (3), training has a significantly positive influence on hourly wages for all three groups of employees. Interestingly, the influence is stronger for the less educated. This suggests that training has the potential to reduce wage inequality between the more and the less educated. However, realizing this potential would require that the training gap between the more and the less educated is overcome. Turning to our indicators of flexible work organization, controlling for training does not change the results on decision-making autonomy. Decision making autonomy still has a significantly positive influence on the wages of university graduates and skilled employees and the magnitudes of the coefficients remain largely unchanged. The variable for task variety also retains coefficients of similar magnitudes, but the coefficients are now insignificant with relatively high z-statistics of about 1.5. In regressions (4) to (6), we additionally include interaction terms of training with decision-making autonomy and task variety. While this does not change the results on decision-making autonomy, it renders the coefficients on training insignificant. Most of the interaction terms do not take significant coefficients. Only for skilled employees do we find a significantly positive interaction of training and task variety.

Altogether, our estimations suggest that a flexible work organization widens the training gap between the more and the less educated. The wage estimations provide no evidence that more educated employees just receive more training because flexible work organization entails an increased obsolescence of their initial human capital. Instead, more educated employees disproportionately benefit from flexible work organization in terms of higher wages. This suggests that the widening of the training gap driven by flexible production is, indeed, associated with disproportionately better labor market outcomes for more educated employees.

TABLE 6 Separate Estimations by the Employees' Age

Variable	(1) Employees younger than 50	(2) Employees older than 50	(3) Employees younger than 55	(4) Employees older than 55
Decision-making autonomy	0.105 [0.033] (4.25)***	0.086 [0.024] (3.09)**	0.117 [0.036] (5.34)***	0.026 [0.007] (0.67)
Task variety	0.132 [0.041] (4.86)***	0.150 [0.041] (4.71)**	0.132 [0.040] (5.38)***	0.163 [0.042] (3.55)***
Pseudo R^2	0.078	0.088	0.082	0.089
Number of observations	6,787	6,137	9,525	3,399
Number of employees	5,256	4,503	7,231	2,589

Estimations are based on the 2012, 2014 and the 2016 wave of the LPP. The dummy dependent variable equals 1 if the employee received employer provided training in the respective year. Method: Random effects probit. The table shows the estimated coefficients. Z-statistics in parentheses are based on standard errors clustered at the establishment level. Average marginal effects are in square brackets.

**Statistically significant at the 5% level; ***the 1% level.

Results on the other explanatory variables are suppressed to save space.

TABLE 7 Separate Estimations by the Employees' Gender

Variable	(1) Men	(2) Women
Decision-making autonomy	0.083 [0.025] (3.80)***	0.110 [0.029] (2.91)**
Task variety	0.145 [0.044] (5.70)***	0.116 [0.031] (2.77)**
Pseudo R^2	0.072	0.125
Number of observations	9,561	3,363
Number of employees	6,955	2,485

Estimations are based on the 2012, 2014 and the 2016 wave of the LPP. The dummy dependent variable equals 1 if the employee received employer provided training in the respective year. Method: Random effects probit. The table shows the estimated coefficients. Z-statistics in parentheses are based on standard errors clustered at the establishment level. Average marginal effects are in square brackets.
**Statistically significant at the 5% level; ***at the 1% level.
Results on the other explanatory variables are suppressed to save space.

4.4 | The Training Gap between the Older and the Younger

Our initial results also confirmed a training gap between older and younger employees. Recalling the argument that flexible work organization can be age biased (Aubert et al., 2006; Behaghel et al., 2014), we also examine if the link between workplace flexibility and training differs between older and younger employees.

Table 6 first provides separate estimations for employees less than 50 years of age and employees that are 50 years of age or older. These estimations provide little evidence of an age bias of flexible work organization. For both age groups, decision-making autonomy and task variety are significantly positive determinants of training. The coefficients and marginal effects of decision-making autonomy are larger for the younger workers but it is clear that the coefficients for the younger and the older are within each other's confidence interval. The marginal effects of task variety are the same for both age groups and the coefficients on task variety is even somewhat larger for older employees.

In our second split, we compare employees less than 55 to those that are 55 or older. This split shows a significant influence of decision-making autonomy on training only for employees younger than 55, but not for those older than 55. This may indicate an age bias. However, the finding on the other indicator of workplace flexibility shows no difference. Task variety continues to exhibit essentially the same influence on training for those above and below age 55. Thus, our second split also provides only weak evidence that workplace flexibility is age biased.

4.5 | The Training Gap between Women and Men

Finally, our initial results confirmed a training gap between women and men. Thus, in a further step, we split the sample by gender. As shown in Table 7, the pattern by gender suggests few important differences. For both men and women, decision-making autonomy and task variety take significantly positive coefficients. The marginal effect of decision-making autonomy is somewhat larger for females but the marginal effect of task variety is larger for males. All remain of roughly the magnitude we started with in the overall sample.

5 | CONCLUSION

Modern workplaces are increasingly characterized by flatter hierarchies, greater delegation of decision making and a wider variety of tasks. These flexible workplaces have evolved together with technological change but have brought

their own skill bias. Those more skilled will be in increasing demand by firms with flexible work organization. While previous studies on skill-biased organizational change have largely focused on the formal education of employees, our examination focuses on employer provided training. We argue that the firm may benefit by generating the needed skills rather than simply trying to buy them in the labor market. Thus, using unique employer-employee data from Germany, we test whether two major indicators of flexible workplaces, decision-making autonomy and task variety, are associated with an increased likelihood of receiving employer provided training. Our results strongly confirm this association and, hence, support the notion that flexible work organization is indeed skill-biased.

In an attempt to disentangle the unique role of workplace flexibility, we show that several markers of technological change, use of ICT and recent equipment change, strongly increase the likelihood of training but do not change the incremental training associated with flexible workplace organization. Decision-making autonomy and task variety bring their own skill demands. Our evidence suggests that firms respond to these demands with employer provided training.

Moreover, we demonstrate a number of important patterns. Among the most interesting results is that the skill bias goes beyond a uniform increase in the demand for skills. The training associated with decision-making autonomy and task variety is disproportionately oriented toward those employees with greater formal education. While flexible workplaces provide greater training, it is oriented to those employees already with the greatest initial skills. Thus, if earlier researchers are correct that flexible workplaces hire disproportionately more skilled employees, we show that the training decisions of these workplaces compound that hiring decision.

We find no evidence that workplace flexibility widens the training gap between women and men. There are similar associations between workplace flexibility and employer provided training for both female and male employees. Finally, we find little evidence that flexible work organization widens the training gap between older and younger employees. There appears to be no difference in the link between flexible production and training for those above and below the age of 50. Considering employees younger and older than 55, we find that decision-making autonomy is only associated with training for those below the age of 55. However, task variety is associated with increased training for both employees younger and employees older than 55.

We think our focus on training in response to workplace organization is important and recognize additional aspects that could be explored by future research. Our data set does not allow us to identify the actual content of training. It would be instructive to know if the training associated with a flexible workplace differs and if so, how. One might anticipate that the training associated with workplace flexibility is more nearly focused on social skills, decision-making skills, making efficient use of time across many tasks and providing an improved understanding of production and markets.

DATA AVAILABILITY STATEMENT

The data are available at the Research Data Centre (FDZ) of the IAB (Mackeben et al., 2018a, 2018b):
https://fdz.iab.de/en/Integrated_Establishment_and_Individual_Data/lpp/LPP1617.aspx
Replication files are provided in the Supporting Information.

REFERENCES

Acemoglu, D. (2002) Technical Change, Inequality and the Labor Market. *Journal of Economic Literature*, 40(1), 7–72.

Acemoglu, D., Aghion, P., Lelarge, C., Van Reenen, J. & Zilibotti, F. (2007) Technology, Information, and the Decentralization of the Firm. *Quarterly Journal of Economics*, 122(4), 1759–1799.

Acemoglu, D. & Autor, D. (2011) Skills, Tasks and Technololgies: Implications for Employment and Earnings. In: Ashenfelter, O. & Card, D. (Eds.) *Handbook of Labor Economics*, Vol. 4, Part B. Amsterdam: Elsevier, pp. 1043–1171.

Aghion, P. & Tirole, J. (1997) Formal and Real Authority in Organizations. *Journal of Political Economy*, 105, 1–29.

Allaart, P., Bellmann, L. & Leber, U. (2009) Company-Provided Further Training in Germany and the Netherlands. *Empirical Research in Vocational Education and Training*, 1(2), 103–121.

Aoki, M. (1986) Horizontal vs. Vertical Information Structure of the Firm. *American Economic Review*, 76, 971–983.

Aoki, M. (1990) The Participatory Generation of Information Rents and the Theory of the Firm. In: Aoki, M., Gustafsson, B. & Williamson, O.E. (Eds.) *The Firm as Nexus of Treatises*. Thousand Oaks, CA: Sage, pp. 26–55.

Armstrong, P. & Armstrong, H. (2003) *Wasting Away: The Undermining of Canadian Health Care*, 2nd edition. Toronto: Oxford University Press.

Askenazy, P. & Caroli, E. (2010) Innovative Work Practices, Information Technologies, and Working Conditions: Evidence for France. *Industrial Relations*, 49, 544–565.

Aubert, P., Caroli, E. & Roger, M. (2006) New Technologies, Organisation and Age: Firm Level Evidence. *Economic Journal*, 116(509), F73–F93.

Backes-Gellner, U., Oswald, Y. & Sartore, S.T. (2014) Part-Time Employment—Boon to Women but Bane to Men? New Insights on Employer Provided Training. *Kyklos*, 67, 461–483.

Barron, J.M., Black, D.A. & Loewenstein, M.A. (1993) Gender Differences in Training, Capital and Wages. *Journal of Human Resources*, 28(2), 343–364.

Bartel, A.P. & Sicherman, N. (1998) Technological Change and the Skill Acquisition of Young Workers. *Journal of Labor Economics*, 16(4), 718–755.

Becker, G. (1964) *Human Capital*. Chicago: University of Chicago Press.

Been, J. & van Vliet, O. (2017) Early Retirement across Europe. Does Non-Standard Employment Increase Participation of Older Workers? *Kyklos*, 70(2), 163–188.

Behaghel, L., Caroli, E. & Roger, M. (2014) Age Biased Technical and Organizational Change, Training and Employment Prospects of Older Workers. *Economica*, 81, 268–389.

Bilanakos, C., Heywood, J.S., Sessions, J.G. & Theodoropoulos, N. (2018) Does Delegation Increase Worker Training? *Economic Inquiry*, 56(2), 1089–1115.

Billinger, S. & Workiewicz, M. (2019) Hierarchies and the Emergence of New Forms of Organization. *Journal of Organizational Design*, 8(1).

Bloom, N., Sadun, R. & Van Reenen, J. (2012) Americans Do It Better: US Multinationals and the Productivity Miracle. *American Economic Review*, 102, 167–201.

Boedker, C., Vidgen, R., Meahgher, K., Cogin, J., Mouritsen, J. & Runnnalls, J.M. (2011) *Leadership, Culture and Management Practices of High Performing Workplaces in Australia: High Performing Workplace Index*. Sydney: Society for Knowledge Economics.

Brenner, M.D., Fairris, D. & Ruser, J. (2004) Flexible Work Practices and Occupational Safety and Health: Exploring the Relationship Between Cumulative Trauma Disorders and Workplace Transformation. *Industrial Relations*, 43, 242–266.

Bresnahan, T.F., Brynjolfsson, E. & Hitt, L.M. (2002) Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-Level Evidence. *Quarterly Journal of Economics*, 117(1), 339–376.

Brussig, M. & Leber, U. (2006) Formal and Informal Ways of Learning in Employer-Provided Further Training in East and West German Enterprises: Results from a Large-Scale Establishment Survey. *Journal of East European Management Studies*, 11(4), 305–325.

Brynjolfson, E. & Hitt, L.M. (2000) Beyond Computation: Information Technology, Organizational Transformation and Business Performance. *Journal of Economic Perspectives*, 14(4), 23–48.

Carmichael, H.L. & MacLeod, W.B. (1993) Multiskilling, Technical Change and the Japanese Firm. *Economic Journal*, 103(416), 142–160.

Caroli, E., Greenan, N. & Guellec, D. (2001) Organization Change and Skill Accumulation. *Industrial and Corporate Change*, 10(2), 481–506.

Caroli, E. & Van Reenen, J. (2001) Skill-Biased Organizational Change? Evidence from a Panel of British and French Establishments. *Quarterly Journal of Economics*, 116(4), 1449–1492.

Chalice, R. (2008) *Improving Health Care Using Toyota Lean Production Methods*. Milwaukee: ASQ Press.

Cottini, E. & Lucifora, C. (2013) Mental Health and Working Conditions in Europe. *Industrial and Labor Relations Review*, 66(4), 958–988.

De Varo, J. & Kurtulus, F.A. (2010) An Empirical Analysis of Risk, Incentives and the Delegation of Work Authority. *Industrial and Labor Relations Review*, 64, 641–661.

Dessein, W. & Santos, T. (2006) Adaptive Organizations. *Journal of Political Economy*, 114(5), 956–995. https://doi.org/10.1086/508031

Doms, M., Dunne, T. & Troske, K.R. (1997) Workers, Wages and Technology. *Quarterly Journal of Economics*, 112(1), 253–290.

Fischer, G., Janik, F., Mueller, D. & Schmucker, A. (2009) The IAB Establishment Panel – Things Users Should Know. *Journal of Applied Social Science Studies*, 129, 133–148.

Fitzenberger, B. & Muehler, G. (2015) Dips and Floors in Workplace Training: Using Personnel Records to Estimate Gender Differences. *Scottish Journal of Political Economy*, 62, 325–429.

Gashi, A.N., Pugh, G. & Adnett, N. (2008) Technological Change and Employer Provided Training: Evidence from German Establishments. Leading House Working Paper No. 26, Zurich.

Gashi, A.N., Pugh, G. & Adnett, N. (2010) Technological Change and Employer-Provided Training: Evidence from UK Workplaces. *International Journal of Manpower*, 31(4), 426–448.

Gerlach, K. & Jirjahn, U. (2001) Employer Provided Further Training: Evidence from German Establishment Data. *Schmollers Jahrbuch – Journal of Applied Social Science Studies*, 121, 1–26.

Graban, M. (2009) *Lean Hospitals*. Boca Raton: CRC Press.

Green, F. (2004) Why Has Work Become More Intense? *Industrial Relations*, 43(4), 709–741.

Grund, C. & Martin, J. (2012) Determinants of Further Training – Evidence for Germany. *International Journal of Human Resource Management*, 23, 3536–3558.

Grunden, N. (2008) *The Pittsburgh Way to Efficient Health Care: Improving Patient Care Using Toyota Based Methods*. Boca Raton: CRC Press.

Harhoff, D. & Kane, T.J. (1997) Is the German Apprenticeship System a Panacea for the U.S. Labor Market? *Journal of Population Economics*, 10(2), 171–196.

Heckman, J.J. (1999). Policies to Foster Human Capital. NBER Working Paper No. 7288.

Heywood, J.S. & Jirjahn, U. (2002) Payment Schemes and Gender in Germany. *Industrial and Labor Relations Review*, 56(1), 44–64.

Heywood, J.S. & Jirjahn, U. (2004) Teams, Teamwork and Absence. *Scandinavian Journal of Economics*, 106(4), 765–782.

Heywood, J.S. & Jirjahn, U. (2009) Profit Sharing and Firm Size: The Role of Team Production. *Journal of Economic Behavior and Organization*, 71(2), 246–258.

Heywood, J.S., Jirjahn, U. & Pfister, A. (2020) Product Market Competition and Employer Provided Training in Germany. *Industrial and Corporate Change*, 29, 533–556.

Hines, P. & Lethbridge, S. (2008) New Development: Creating a Lean University. *Public Money and Management*, 28, 53–56.

Hunter, L.W., Bernhardt, A., Hughes, K.L. & Skuratowicz, E. (2001) It's Not Just the ATMs: Technology, Firm Strategies, Jobs, and Earnings in Retail Banking. *Industrial and Labor Relations Review*, 54(2A), 402–424.

Jirjahn, U. & Smith, S.C. (2006) What Factors Lead Management to Support or Oppose Employee Participation – With and Without Works Councils? Hypotheses and Evidence from Germany. *Industrial Relations*, 45, 650–680.

Jirjahn, U. & Kraft, K. (2010) Teamwork and Intra-Firm Wage Dispersion among Blue-Collar Workers. *Scottish Journal of Political Economy*, 57(4), 404–429.

Johnson, W. (2014) Lean Production Hits Public Education. *Labor Notes*, 421, 14–16.

Kampkoetter, P., Mohrenweiser, J., Sliwka, D., Steffes, S. & Wolter, S. (2016) Measuring the Use of Human Resources Practices and Employee Attitudes: The Linked Personnel Panel. *Evidence-Based Human Resource Management*, 4(2), 94–115.

Karasek, R.A. (1979) Job Demands, Job Decision Latitude, and Mental Strain: Implications for Job Redesign. *Administrative Science Quarterly*, 24(2), 285–308.

Lindbeck, A. & Snower, D.J. (2000) Multitask Learning and the Reorganization of Work: From Tayloristic to Holistic Organization. *Journal of Labor Economics*, 19(3), 353–376.

Lynch, L.M. & Black, S.E. (1998) Beyond the Incidence of Employer-Provided Training. *Industrial and Labor Relations Review*, 52(1), 64–81.

Mackeben, J., Ruf, K. Grunau, P. & Wolter, S. (2018a) Linked Personnel Panel (LPP) – Version 1617v1, Research Data Centre of the Federal Employment Agency (BA) at the Institute for Employment Research (IAB). https://doi.org/10.5164/IAB.LPP1617.de.en.v1

Mackeben, J., Ruf, K. Grunau, P. & Wolter, S. (2018b) Linked Personnel Panel (LPP) 1617 – Quality of Work and Economic Success: Longitudinal Study in German Establishments (Data Documentation on the Third Wave), FDZ-Datenreport 04/2018, Nürnberg, https://doi.org/10.5164/IAB.FDZD.1804.en.v1

Milgrom, P. & Roberts, J. (1990) The Economics of Modern Manufacturing: Technology, Strategy, and Organization. *American Economic Review*, 89, 511–528.

Milgrom, P. & Roberts, J. (1995) Complementarities and Fit: Strategy, Structure, and Organizational Change in Manufacturing. *Journal of Accounting and Economics*, 19(2-3), 179–208.

Morita, H. (2005) Multi-skilling, Delegation and Continuous Process Improvement: A Comparative Analysis of US- Japanese Work Organizations. *Economica*, 72(285), 69–93.

Moulton, B. (1990) An illustration of a Pitfall in Estimating the Effects of Aggregate Variables on Micro Units. *Review of Economics and Statistics*, 72(2), 334–338.

OECD. (2003) *Employment Outlook*. Paris: OECD Publishing.

Oi, W. (1962) Labor as a Quasi-Fixed Factor. *Journal of Political Economy*, 70(6), 538–555. https://doi.org/10.1086/258715

Osterman, P. (1995) Skill, Training, and Work Organization in American Establishments. *Industrial Relations*, 34(2), 125–147.

Osterman, P. (2000) Work Reorganization in an Era of Restructuring: Trends in Diffusion and Effects on Employee Welfare. *Industrial and Labor Relations Review*, 53(2), 179–196.

Piva, M., Santarelli, E. & Vivarelli, M. (2005) The Skill Bias Effect of Technological and Organisational Change: Evidence and Policy Implications. *Research Policy*, 34(2), 141–157.

Piva, M., Santarelli, E. & Vivarelli, M. (2006) Technological and Organizational Changes as Determinants of the Skill Bias: Evidence from the Italian Machinery Industry. *Managerial and Decision Economics*, 27(1), 63–73.

Rosen, S. (1976) A Theory of Life Earnings. *Journal of Political Economy*, 84(4, Part 2), S45–S67.

Schütz, H., P. Knerr, C. Metselaar and L. Middendorf (2018) IAB Beschäftigtenbefragung – Projekt Arbeitsqualität und wirtschaftlicher Erfolg: Panelstudie zu Entwicklungsverläufen in deutschen Betrieben – Personenbefragung, – 3. Erhebungswelle, FDZ-Methodenreport 11/2018, Nürnberg, https://doi.org/10.5164/IAB.FDZM.1811.de.v1

Seyda, S. and Werner, D. (2014) IW-Weiterbildungserhebung 2014 – Höheres Engagement und mehr Investitionen in betriebliche Weiterbildung, IW-Trends 4/2014, Köln.

Tschersich, N. and M. Gensicke (2018) Vertiefende Betriebsbefragung – Arbeitsqualität und wirtschaftlicher Erfolg – 2016 – Welle 3, FDZ-Methodenreport 12/2018, Nürnberg, https://doi.org/10.5164/IAB.FDZM.1812.de.v1

Vigour, C. (2015) Professions in Policy and Knowledge Transfer: Adaptions of Lean Management, and Jurisdictional Conflict in a Reform of the French Public Service. *International Journal of Sociology*, 45(2), 112–132.

Walshe, Kieran, Gill Harvey and Pauline Jas (2010) *Connecting Knowledge and Performance in Public Service: From Knowing to Doing*. Cambridge: Cambridge University Press, https://doi.org/10.1017/CBO9780511762000

Winkelmann, R. (1996) Employment Prospects and Skill Acquisition of Apprenticeship-Trained Workers in Germany. *Industrial and Labor Relations Review*, 49(4), 658–672.

Xu, K. & Lin, Z. (2011) Participation in Workplace Employer-Sponsored Training in Canada: Role of Firm Characteristics and Worker Attributes. *Contemporary Economic Policy*, 29(3), 416–430.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

How to cite this article: Campaner, A., Heywood, J.S. & Jirjahn, U. (2022) Flexible work organization and employer provided training: Evidence from German linked employer-employee data. *Kyklos*, 75(1), 3–29. Available from: https://doi.org/10.1111/kykl.12283

APPENDIX A

TABLE A1 Explanatory Variables: Employee Characteristics

Variable	Definition (Mean, Standard Deviation)
Decision-making autonomy	The employee's job is ranked on a five-point Likert scale according to the extent to which the employee can make many decisions autonomously where 1 = does not apply at all, ..., 5 = fully applies (3.98, 1.02).
Task variety	The employee's job is ranked on a five-point Likert scale according to the degree of task variety where 1 = does not apply at all, ..., 5 = fully applies (4.21, 0.95).
Others' performance depends on employee	The employee's job is ranked on a five-point Likert scale according to the degree to which the performance of others depends on the employee's performance where 1 = does not apply at all, ..., 5 = fully applies (3.80, 1.24).
Employee's performance depends on others	The employee's job is ranked on a five-point Likert scale according to the degree to which his or her performance depends on the performance of others where 1 = does not apply at all, ..., 5 = fully applies (3.35, 1.31).
Physical effort required	The employee's job is ranked on a five-point Likert scale according to the degree of required physical effort where 1 = does not apply at all, ..., 5 = fully applies (2.42, 1.48).
Unpleasant working conditions	The employee's job is ranked on a five-point scale according to the degree the employee is exposed to unpleasant working conditions where 1 = does not apply at all, ..., 5 = fully applies (2.86, 1.56).
Time pressure and work overload	The employee's job is ranked on a five-point Likert scale according to the degree of time pressure and work overload where 1 = does not apply at all, ..., 5 = fully applies (3.57, 1.23).
Older employee	Dummy equals 1 if the employee is older than 50 years (0.47, 0.50).
Blue-collar worker	Dummy equals 1 if the employee is a blue-collar worker (0.41, 0.49).
Skilled employee	Dummy equals 1 if the employee's highest educational attainment is a completed apprenticeship training (0.79, 0.41).
University degree	Dummy equals 1 if the employee has a university degree (0.19, 0.39).
Woman	Dummy equals 1 if the employee is a woman (0.26, 0.44).
German citizenship	Dummy equals 1 if the employee has a German citizenship (0.95, 0.21).
Employee has a partner	Dummy equals 1 if the employee has a stable partner or spouse (0.84, 0.36).
Number of subordinates	Variable capturing the number of subordinates if the employee has a managerial function; the variable is set equal to 0 if the employee has no managerial functions (6.87, 40.85).
Flexible working hours	Dummy equals 1 if the employee has flexible working hours (0.46, 0.50).
Fixed-term contract	Dummy equals 1 if the employee has a fixed-term contract (0.05, 0.22).
Part-time employee	Dummy equals 1 if the employee is a part-time employee (0.11, 0.32).
Information and communication technology	Dummy equals 1 if the employee uses information or communication technologies during working time (0.77, 0.42).
Technological change	Dummy equals 1 if the technological equipment of the employee's workplace changed during the past five years (0.72, 0.45).
Time dummies	2 dummies for the the years 2014 and 2016 are included.

Number of pooled observations of employees = 12,924. The variables for information and communication technology and for technological change are only available from the 2014 wave of the LPP. For these two variables, the number of observations are 4,418 and 4,398, respectively.

TABLE A2 Explanatory Variables: Establishment Characteristics

Variable	Definition (Mean, Standard Deviation)
Vintage of technology	Dummy equals 1 if production technology is of a more recent vintage than the industry median (0.73, 0.44).
Multi-establishment firm	Dummy equals 1 if the establishment is part of a multi-establishment firm (0.44, 0.50).
Foreign ownership	Dummy equals 1 if the establishment has a dominant foreign owner (0.17, 0.38).
Founded after 1990	Dummy equals 1 if the establishment was founded after the year 1990 (0.45, 0.50).
Establishment size	Number of employees at the establishment (451.42, 2391.43).
Establishment size squared	Number of employees squared.
High competitive pressure with threat of liquidation	Dummy equals 1 if the establishment reports high competitive pressure entailing a threat of liquidation (0.11, 0.31).
High competitive pressure without threat of liquidation	Dummy equals 1 if the establishment reports high competitive pressure, but faces no threat of liquidation (0.42, 0.49).
Collective bargaining	Dummy equals 1 if the establishment is covered by a collective bargaining agreement (0.58, 0.49).
Works council	Dummy equals 1 if a works council is present in the establishment (0.66, 0.48).
Alternative worker representation	Dummy equals 1 if the establishment uses alternative forms of employee involvement such as staff spokesmen, round tables or worker committees (0.13, 0.34).
Temporary agency employees	Dummy equals 1 if the establishment uses temporary agency workers (0.52, 0.50).
Share of part-time employees	Part-time employees as a share of the establishment's workforce (0.13, 0.18).
Share of women	Female employees as a share of the establishment's workforce (0.30, 0.23).
Share of apprentices	Apprentices as a share of the establishment's workforce (0.04, 0.04).
Share of skilled employees	Employees with completed apprenticeship training as a share of the establishment's workforce (0.65, 0.24).
Share of university graduates	University graduates as a share of the establishment's workforce (0.11, 0.15).
Vacancies for unskilled employees	Dummy equals 1 if the establishment has job vacancies for unskilled workers (0.12, 0.32).
Vacancies for skilled and high-skilled employees	Dummy equals 1 if the establishment has job vacancies for skilled workers and university graduates (0.52, 0.50).
Industry dummies	3 broad industry dummies are included.
Region dummy	Dummy equals 1 if the establishment is located in West Germany (0.64, 0.48).

Number of pooled observations of establishments = 1,903.

TABLE A3 Separate Estimations for 2012, 2014 and 2016

Variable	(1) 2012	(2) 2014	(3) 2016
Decision-making autonomy	0.058 [0.018] (2.49)**	0.078 [0.027] (3.43)***	0.098 [0.033] (3.80)***
Task variety	0.115 [0.036] (4.56)***	0.106 [0.037] (4.36)***	0.099 [0.034] (3.42)***
Pseudo R^2	0.087	0.087	0.102
Number of observations	5,157	4,418	3,349

The dummy dependent variable equals 1 if the employee received employer provided training in the respective year. Method: Probit. The table shows the estimated coefficients. Z-statistics in parentheses are based on standard errors clustered at the establishment level. Average marginal effects are in square brackets.
**Statistically significant at the 5% level; ***at the 1% level.
Results on the other explanatory variables are suppressed to save space.

TABLE A4 Self-Paid Training and Employer Provided Training

Variable	Self-paid training	Employer provided training
Decision-making autonomy	0.058 [3×10^{-4}] (1.35)	0.111 [0.026] (5.76)***
Task variety	0.005 [−0.002] (0.10)	0.145 [0.035] (6.43)***
Log likelihood	−8437.670	
Number of observations	12,924	
Number of employees	9,440	

Estimations are based on the 2012, 2014 and the 2016 wave of the LPP. The reference group consists of employees who received no training in the respective year. Method: Multinomial probit. The table shows the estimated coefficients. Z-statistics in parentheses are based on standard errors clustered at the establishment level. Average marginal effects are in square brackets.
***Statistically significant at the 1% level.
Results on the other explanatory variables are suppressed to save space.

TABLE A5 Determinants of Days of Employer Provided Further Training

Variable	(1)	(2)	(3)	(4)
Decision-making autonomy	0.274 (3.65)***	0.197 (2.58)**	0.150 (2.06)**	0.160 (2.29)**
Task variety	0.362 (4.71)***	0.354 (4.44)***	0.347 (4.42)***	0.353 (4.64)***
R^2	0.0053	0.0097	0.0170	0.0240
Number of observations	12,862	12,862	12,862	12,862
Number of employees	9,401	9,401	9,401	9,401

Dependent variable: Number of days the employee participated in courses of employer provided further training. The variable is set equal to 0 if the employee did not receive employer provided further training. Estimations are based on the 2012, 2014 and 2016 wave of the LPP. Method: Random effects GLS. The specifications of regressions 1–4 correspond to the specifications 1–4 in Table 2. The table shows the estimated coefficients. Z-statistics in parentheses are based on standard errors clustered at the establishment level.
**Statistically significant at the 5% level; ***at the 1% level.
Results on the other explanatory variables are suppressed to save space.

TABLE A6 Wage Estimations with Employer Provided Training as a Control

Variable	(1) Employees with a university degree	(2) Skilled employees (with apprenticeship training)	(3) Unskilled employees (without apprenticeship training)	(4) Employees with a university degree	(5) Skilled employees (with apprenticeship training)	(6) Unskilled employees (without apprenticeship training)
Employer provided further training	0.036 (3.28)***	0.058 (7.97)***	0.126 (1.90)*	−0.036 (0.37)	−0.030 (0.95)	0.281 (1.09)
Decision-making autonomy	0.033 (3.75)***	0.013 (3.43)***	0.017 (1.15)	0.032 (3.14)**	0.014 (3.05)**	0.017 (1.11)
Task variety	0.017 (1.64)	0.006 (1.46)	−0.050 (2.51)**	0.012 (0.79)	0.001 (0.10)	−0.048 (2.39)**
Decision-making autonomy x employer provided training	-----	-----	-----	0.004 (0.27)	−0.002 (0.30)	0.017 (0.39)
Task variety x employer provided training	-----	-----	-----	0.013 (0.66)	0.023 (3.19)**	−0.053 (0.70)
R^2	0.6131	0.5458	0.5524	0.6132	0.5462	0.5586
Number of observations	2,153	9,084	248	2,153	9,084	248
Number of employees	1,569	6,782	209	1,569	6,782	209

Estimations are based on the 2012, 2014 and 2016 wave of the LPP. The dependent variable is the logarithm of the employees' gross wage. Method: Random effects GLS. The table shows the estimated coefficients. Z-statistics in parentheses are based on standard errors clustered at the establishment level.
**Statistically significant at the 5% level; ***at the 1% level.
Results on the other explanatory variables are suppressed to save space.