Do German Works Councils Foster or Counter the Implementation of Digital Technologies?

First Evidence from the IAB-Establishment Panel

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Summary

As works councils' information, consultation and co-determination rights affect the decision process of the management, works councils play a key role in the implementation of digital technologies in the establishments. However, previous research on digital transformation focuses on the impact of introduction of digital technologies and its effects on labor market outcomes of workers. This paper adds the role of industrial relations to existing literature by analyzing the impact of works councils on the implementation process of digitalization. Theoretically, the role of works councils in the digital transformation is ambiguous. We examine the relation between works councils and digitalization using establishment data from the IAB Establishment Survey of 2016 combined with employee data from the Employment History of the Federal Agency and occupational level data about the physical job exposure. Our empirical results confirm the ambivalence of works councils' position towards digitalization. The pure existence of works councils leads to statistically significant lower consideration levels of as well as worse equipment with digitalization technologies. However, works councils foster the implementation of digital technologies if new technologies are beneficial for the workforce as for example they lessen the physical strain for workers. Furthermore, we find that works councils counter the investment into digitalization devices if the establishment experiences high competitive pressure as the technology poses risks on the workforce as for example to lose jobs. This study highlights works councils' role for the digital transformation.

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1 Introduction

Tremendous technological progress has occurred in the last years in the information and communication sector. Smart factories, big data, industry 4.0, robotic, artificial intelligence and cloud services are exemplary buzzwords which belong to the general term digitalization. Modern automation and digitalization technologies allow new forms of interaction and communication between humans and machines. The capability of this technology to connect facilities, products, workers and customers might substantially change previous working conditions and working environments. Machines might lessen the physical strain of employees by taking over physical demanding activities or monotonous and repetitive tasks. Technology might contribute to saver working environments due to automated monitoring processes based on real time responses and the performance of work in hazardous workplace environments (Korupp et al. 2006). From the management perspective digital technologies are beneficial as they potentially increase the level of productivity and increase profits.

The benefits of new digitalization technology are supplemented by several challenges. The most prominent concern is the fear of massive employment loss (Frey/Osborne 2017). Especially workers who carry out routine tasks are concerned to lose their job as automation and digitalization technology is introduced in the establishment. Automated data collection with is accompanying the digitalization process bears the risk of data collection about the efficiency and performance of each employee. Therefore workers might suffer under high control and performance pressure. From the management perspective the investment into new technology and a comprehensive restructuring of the working process is associated with high investment costs.

The tremendous speed of innovation in the field of digitalization technologies has contributed to a lack of scientific research about the evolution process and the effect of this new technology as the availability of new technologies is much faster than the availability of scientific data and studies which might evaluate this transformation. One of the first studies which capture the usage of digitalization technologies in Germany is based on the IAB-ZEW-Establishment survey “Working World 4.0“ (Arntz et al. 2016a). This study reveals that 31 % of the establishments have not even considered digital technology while 50 % of the establishments state to already use digital technologies (Arntz et al. 2016a, p. 3). However the reasons for this disparity in the implementation of digitalization technologies remains unexplained in the literature up to now. This paper contributes to fill this research gap by analyzing differences in the industrial relations of establishments as a potential explanation mechanisms for the heterogeneity of digitalization usage in Germany.

In Germany one essential component of industrial relations are works councils. Traditionally, works councils play an important role for the personnel development, equal employment opportunities of the workforce. The recent technological innovations open up the potential scope of action of co-determination of works councils and emphasize their role as conflict solving institution between employees and management. On the one side, works councils should represent the employees’ interests, which are primarily are interested in saving jobs. On the other side they preserve the cooperative relation with the management, who are focused on efficiency enhancement and investments into digitalization

technologies. The positioning of the works councils is therefore crucial for the process of digitalization implementation within establishmernts. Georg et al. 2017 conduct a qualitative study about the impact of works councils on digitalization. Our study is the first quantitative study examining the effect of works councils on the implementation of digitalization technologies.

Based on the rights of works councils as set out in the Works Constitution Act (*Betriebsverfassungsgesetz, BetrVG*) we develop four theoretical arguments for the mechanism of action of works councils on the implementation of digitalization. On the one hand, works councils might use their information and co-determination rights to enhance the consideration of digitalization within the establishment. This argument speaks for the ability of works councils to foster digitalization implementation. On the other hand, wide-ranging codetermination rights regarding the structure of work and working environments might potentially counter investment in digitalization technology. This latter argument is limited by two special cases. In establishments where the workforce is exposed to high physical demands, works councils might acknowledge the benefit of new technologies which lessen the physical strain. Furthermore, in establishments which are under high competitive pressure, works councils might be aware of a technology's potential to increase productivity and aid the survival of the establishment. In these two cases, the existence of a works council might increase the consideration and the investment in digitalization technologies. We also test empirically the influence of the presence of works councils on digitalization.

Such an empirical analysis is confronted with two major challenges. First, the existence of works councils is strongly correlated with the establishment size. Particularly in large establishments the workers are represented by works councils and large establishments are interested in digitalization technologies. Therefore, a positive effect of works councils might arise due to spurious correlation. Second, an endogeneity problem might distort our results as workers might establish a works council as a reaction to the announcement of future restructuring of the workforce and the investment into digital technologies. In order to conduct a convincing empirical analysis, we use entropy balancing. This non-parametric matching approach uses a flexible weighting mechanism in order to achieve balancing in presence of a binary treatment. The results of an empirical investigation of works councils are presented based on establishment data from the IAB-Establishment Panel of 2016 and cross-sectional information of the Employee History.

The paper is the first to analyze the economic impact of works councils on the implementation of digitalization in German establishments. Literature has focused on the effect of works councils on establishment performance and innovation activity of the establishment (for an overview see Addison et al. 2004; Frege 2002; Addison et al. 2001). Several studies examine the influence of works councils on. However, this strand of literature has not yet focused on the very recent and crucial technical development of digitalization. In contrast, the literature strand which focuses the economic impact of the introduction and usage of digitalization technologies, does not take the institutional framework into account. This paper closes this research gap by highlighting the role of differences in the industrial relations, namely the existence of works councils, for the implementation of digitalization technologies.

The outline of the paper is as follows. Section 2 briefly discusses the industrial relations system and the German works councils and develops on that basis the theoretical considerations. Section 3 presents the dataset and descriptive

statistics. Section 4 demonstrates the applied methods and displays the results of the econometric investigation of the impact of works councils on digitalization involvement, including robustness checks. Section 5 concludes.

2 Digitalization and works councils in Germany

A sharp definition which technology is summarized under "digitalization" is not available. Throughout this article smart factories, big data, autonomous robotic and cloud services are exemplarily classified to be digital technology. Furthermore, we use the term "digitalization" whereas we are aware that other disciplines refer to "digitizing" and "digitization".

2.1 Current state of digitalization in German establishments

The impact of new communication and information technology on the labor market is subject of a broad discussion in modern societies. The study by Frey/Osborne (2017)[2] has stimulated the fear about massive employment loss by forecasting that 47 % of the total employment in the U.S. is at risk to be substituted by robots and computer algorithms. The role of modern technology and its potential to substitute workers has also been carried out for Germany (see for example Arntz et al. 2016b; Bonin et al. 2015; Dengler/Matthes 2015). Other threats of an introduction of digitalization technologies which are examined are among others increasing physical strain resulting from multitasking and higher pace of work (Chesley 2014), blurring boundaries between private and working life (Galvin/Schiemann 2012; Chesley 2014) and higher work intensity (Kraan et al. 2014). The most prominent benefits of digitalization out of an establishments' perspective are higher productivity, new potentials for product innovation, enlarged understanding of consumer behavior and new possibilities to create customer loyalty (Friedrich et al. 2011).

Early in the distribution process of computers and internet it has been pointed out that unequal access to digital technologies increases inequality (OECD 2002; OCED 2004). Surprisingly, still relatively little is known about the decision processes within establishments about the timing, extend and manner how to adapt their value chain to automation and digitalization technologies. For Germany, Arntz et al. (2016a) have analyzed the state of digitalization technology usage across different sectors. Based on the IAB-ZEW-Establishment survey "Working World 4.0" they reveal a significant disparity in the implementation of modern technologies such as autonomous robotics, smart factories, cyber-physical systems and cloud computing systems. While 31 % of the firms have not yet considered digital technologies, already 50 % of the firms state to use digital technologies (Arntz et al. 2016a, p. 3).

Up to the recent moment, the causes for this disparity in the implementation of digitalization technologies remains unexplained in literature. This study contributes to fill this research gap by analyzing differences in the industrial relations of establishments as a potential explanation mechanisms for the heterogeneity of digitalization usage in Germany. More specifically, we examine on an establishment-based analysis if works councils affect the knowledge about and the investment in digital technologies. Earlier studies analyzing the impact of new technologies on the labor market have

[2] First version published in 2014.

already presumed that active participation of works councils potentially shapes the use of modern technologies within German establishments (Pfeiffer 2005) and how employees are involved in innovation processes (Kirchner/Wolf 2015).

2.2 Works councils and technological change

Works councils are an important element of the industrial relations in Germany. If an establishment has more than 5 permanent employees, they have the right to elect a works council which represents their interests towards the management or owner of the establishment. This formation right as well as their information, consultation and co-determination rights are set out in the Works Constitution Act (*Betriebsverfassungsgesetz, BetrVG*). Traditionally, works councils play an important role for the personnel development, equal employment opportunities of the workforce. For a more detailed overview of the election process of works councils, their rights and their duties can be found for example in Addison et al. (2001). The majority of rights are granted to every elected works council. However, the scope of power set for works councils expands with increasing establishment size. For example, the right to obtain at an early stage complete information about changing work methods must be given to works councils from 21 employees and onwards (§111 BetrVG). If the workforce exceeds the threshold of 100 employees works councils may set up additional works committees assign them specific tasks and they have the right to delegate certain tasks to working groups (§ 28 BetrVG).

A comprehensive picture about the presence of works councils in Germany can be found in Ellguth/Kohaut (2017). In 9 % of German establishments a works council is constituted in the year 2016. The existence of works councils does not show a regional difference between Western and Eastern Germany. However, coverage of works councils which is defined the industrial relations literature to be the proportion of employees working in establishments with works councils, is much higher with 43 % in West Germany and 34 % in East Germany. One important factor which determines the presence of works councils is the establishment size. Only in the segment with 21 and 199 permanent workers the proportion of estrablishments with and without works councils is relatively balanced. Very few exceptions of small establishments have a works council while the majority of the large establishments is characterized by the presence of works councils (Ellguth/Kohaut 2017).

The importance of industrial relations is a well-established research field. Literature has focused on the effect of works councils on establishment performance and innovation activity of the establishment (for an overview see Addison et al. 2004; Frege 2002; Addison et al. 2001). Addison et al. (2001) present arguments for both negative and positive effects of works councils on innovation activity of establishments; however, the empirical evidence reveals neither convincing positive influence on product or process innovations nor evidence for hindering innovation activities. One theoretical "collective voice" argument asserts that works councils act as a voice instrument which establishes trust and better communication and information flows between management and employees. Thereby, the existence of works councils might lead to higher innovation activity within establishments. Several empirical studies tried to find evidence for this positive relation. Blume/Gerstelberger (2007) do not find statistical significant results, Jirjahn/Kraft (2011) find a positive influence on incremental product innovations, however, no significant influence can be found for process innovation

(Askildsen et al. 2006). A recent study finds only a significant positive influence of works councils when collective agreements are present (Addison et al. 2017).

However, this strand of literature has not yet focused on the very recent and crucial technical development of digitalization. The relation between works councils and digitalization technologies has recently been examined throughout a qualitative study (Georg et al. 2017). Interviews with works councils reveal considerable uncertainties and challenges regarding the digital transformation in the majority of German establishments. Works councils are unsure how the new technologies might affect the workforce and which role they can take over in the creation of a new work organization. Our study is the first quantitative study examining the effect of works councils on the implementation of digitalization technologies and thus closing this research gap.

2.3 The role of works councils for the implementation of digital technologies

Recent digitalization innovations open up the potential scope of action of co-determination of works councils and emphasize their role as conflict solving institution between employees and management. The implementation of digital technology bears such a risk of a conflict between employees and management. For employees the threat of losing their job is dominating the discussion about digital technologies. Whereas the management is focused on the benefits of digitalization such as efficiency enhancement, increasing productivity and prestige. We discuss the theoretical scope for action for works councils applied to the process of digitalization implementation considering mainly different paragraphs of the Works Constitution Act. As there is no theory available which allows predictions how works councils react to the implementation of digitalization technologies, deriving predictions for their position from the rights and duties as set out in different paragraphs of the Works Constitution Act seems to be a reasonable procedure.

One of the general duties of works councils is to make recommendations to the employer which are benefiting the establishment and the workforce (see § 80 BetrVG). On the one side, new digital technology potentially increases productivity and the establishment's surplus. On the other side, automated process monitoring and robotic use offer saver working conditions for employees. Automation technology furthermore can release workers from repetitive, monotonous and physical demanding tasks. Thus, digital technology can be considered to benefit the establishment as well as the workforce. It can be expected that the works council actively gathers detailed information about the potentials of digital technology and which technology might be beneficial for the specific needs of the establishment. We formulate the hypothesis:

Hypothesis 1: Establishments with works councils deal more intensively with digitalization technologies.

Beyond general information rights, works councils are given wide-ranging co-determination rights (see § 91 BetrVG). Changes in work places, work operations or working environment enable works councils to verify the impact on the existing workforce. If a special burden is exposed to the employees, works councils may request appropriate interventions to obviate the burden. If this not feasible works councils are allowed to claim compensation for additional physical and psychological strain for the employees. This substantial scope for action for the works councils narrows the freedom

of action of the management. Even though the management has taken the decision to invest into digital technology the process until the investment can be undertaken and the technology can be implemented in the place of work might consume considerably longer time as the works council has not only to be informed but also to be convinced. Thus, we formulate the second hypothesis:

Hypothesis 2: Establishments with works councils are poorer equipped with digitalization technologies.

The second hypothesis that works councils might counter the implementation of digitalization might not be true in two special cases. In establishments where the workforce is exposed to high physical demands, works councils might acknowledge the benefit of new technologies which lessen the physical strain. Physical demands are classified according to Krolll (2011) to consist of ergonomically demanding work activities and environmental stress. Ergonomically demanding tasks are for example lifting heavy items, working in forced postures such as bending, kneeling, crouching, as well as occasional overhead work. Environmental stress is imposed by work involving exposure to noises, dusts, fumes, gases, insufficient illumination, shocks, oscillations or vibrations. Works councils are explicitly instructed to protect health and safety at work (see § 89 BetrVG). Therefore works councils might use their co-determination rights referring to the design of work places, work operations and working environments (according to § 91 BetrVG) in order to enforce an improvement of the working conditions for the employees. Particularly the implementation of digital technology might be actively supported by works councils in this case and we formulate the third hypothesis:

Hypothesis 3: Establishments with works councils where the workforce is exposed to high physical demands, are better equipped with digitalization technologies.

The second exception applies to establishments which are under high competitive pressure. High competition between competitors puts pressure on the profitability of establishments. As labor costs constitute a large proportion of the fixed debt on establishments' balance sheets, management might think about layoffs first. Works councils are instructed by law to secure employment. Works councils may submit proposals to the employer relating to the security and the promotion of employment (see § 92a BetrVG). An alternative suggestion to increase profitability and raise productivity might be to invest into digital technology. We formulate the hypothesis:

Hypothesis 4: Establishments with works councils which are under high competitive pressure, are better equipped with digitalization technologies.

3 Data and descriptive results

The main data set for our empirical analysis is the IAB Establishment Panel, which is a large-scale annual establishment-level survey on personnel developments and establishment policies for Germany. We use the latest survey data of the year 2016. In this survey 15,300 German establishments are asked a large number of subjects, including employment and business development, investment activities, innovations in the establishment, personnel structure, wages and salaries, working times in the establishment, and general data on the establishment. Additionally to those

questions the focal topic about digitalization technologies is addressed. The data comprises German establishments with at least one employee who is liable for social security as of June, 30th of the previous year. The stratified sample is drawn across 10 different establishment sizes, 16 German states ("Bundesländer") and 17 different industries. For more detailed information and comprehensive descriptions see Fischer et al. (2009) and Ellguth et al. (2014).

In order to analyze the occupational structure of the workforce employed in the surveyed etasblishments of the IAB Establishment Panel, cross-sectional information of the Employee History ("Beschäftigtenhistorik" BeH) is merged to the dataset. The BeH combines all of the employment notifications which have been stored since 1975 by the Federal Agency ("Bundesagentur für Arbeit" BA) in Germany in accordance with the DEVO (Data Collection Regulation "Datenerfassungsverordnung"), DÜVO (Data Transmission Regulation "Datenübermittlungsverordnung") and the DEÜV (Regulation on Data Collection and Transmission "Datenerfassungs- und übermittlungsverordnung"). The information in the BeH is restricted to workers covered by social security and marginal part-time employees in accordance with § 27 SGB III. This data allows insight into the entire individual work histories of workers who have been employed on the 30st June 2015 in one of the establishments surveyed by the IAB Establishment Panel 2016.

Additionally we use information about physical job exposure of the Index for Job Demands in Occupations Based on KldB-2010 following Kroll (2011). Kroll (2011) constructed the index based on data from the BIBB/BAuA Employment Survey 2011, which is a large-scale representative employee survey conducted by the German Federal Institute for Vocational Education and Training (BIBB). The Index for Job Demands comprises comprehensive scales for physical job demands such as ergonomic strain of the musculoskeletal system due to demanding or one-sided, stressful activities.

We want to identify the effect of works councils on the implementation of digitalization technologies in German establishments. In the survey three questions about the involvement of the establishment with digitalization technologies are asked. A detailed description of the questions can be found in the appendix. As Arntz et al. (2016a) highlight the difference between the information about new digital technologies and the actual investment into equipment we focus in this study on two of the three questions. The question "How intensive has your establishment dealt with this topic so far?" is used in order to measure the establishment's level of information about digitalization technologies. The question "How good is your establishment equipped with this technology compared to other establishments in your industry?" is used to measure the actual state of digitalization usage in the establishment. For the descriptive analysis we restrict our sample to private sector establishments with at least 5 employees as only those have the right to establish a works council according to the Work Constitution Act. Following relevant literature we exclude establishments from the agricultural sector and non-profit organizations. We do not conduct regional analyses separately for Western and Eastern Germany, as previous examinations of the used data shows that they are not existent with regards to the answer behavior of those three digitalization questions (see Müller et al. forthcoming). Across this sample it can be noticed a disparity between establishments with and without works councils with regards to the two states of implementation of digital practices.

[Figure 1 about to be here.]

[Figure 2 about to be here.]

Almost one third of the establishments without works councils indicate that they do not consider digital technologies at all. The fraction of establishments where the workers are represented by works councils giving the same answer is considerably lower with only 10.6 %. The share of establishments considering themselves to have an above average information level is higher among those firms with a works council established. Almost the same picture arises for the answers to the question about the equipment with digitalization technology. The fraction of establishments stating to be badly equipped with new digital technologies is higher among establishments without works councils. In contrast, the majority of the establishments with works councils assess themselves to have be better equipped with digitalization devices than the average of the establishments within their sector.

[Table 1 about to be here.]

[Table 2 about to be here.]

The affiliation to different industries is a very important aspect of the analysis. The availability of digital technologies across sectors is very heterogeneous. This can also be seen by differentiating between seven different sectors.

4 Methodology and econometric estimations

4.1 The relation between works councils and the implementation of digitalization

In order to estimate the effect of works councils on the implementation of digitalization within German establishments we estimate two separate ordinary least squares models. First, we identify the effect of the existence of works councils on the consideration of digitalization technologies. Second, we examine the role of works councils for the state of digital technologies within the establishment in comparison to other establishments within the sector. We keep the analysis restricted to establishments in the private sector with more than 5 employees and exclude agricultural establishments and non-profit organizations.

[Table 3 about to be here.]

The existence of works councils has a statistically negative effect on both, the consideration of as well as the equipment with digital technologies. This is in line with the second hypothesis which suspects that establishments with works councils are poorer equipped with digitalization technologies. However, this contrasts the first hypothesis which assumes that the information level about those new technologies is higher within establishments with works councils. The general duty to make recommendations to the employer which are benefiting the establishment and the workforce seems not to be used in order to foster the consideration of the digitalization topic within establishments. Those results indicate that the existence of works councils counter the implementation of digitalization technologies within German establishments.

In establishments where the workforce is exposed to high physical demands, the position of works councils might, however, change. As works councils are explicitly instructed to protect health and safety at work, they might take over an active role which tries to foster the implementation of digital technologies within the establishment. The inclusion of the share of workers conduction high physically demanding work activities into the analysis confirms this presumption.

Works councils have a statistically significant positive influence on the consideration of digital technologies as well as the actual equipment with those technologies in establishments where the workforce is exposed to physical risks. This confirms the third hypothesis. Interestingly, those establishments are statistically less informed and poorer equipped with digital technologies.

Furthermore, works councils may submit proposals to the employer relating to the security and the promotion of employment as they are instructed by law to secure employment. Therefore, in hypothesis four we assumed that in establishments which are under high competitive pressure, works councils might actively foster the implementation of digital technologies. The coefficients of the interaction between the existence of works councils and competitive pressure indicate those positive effects for the information about as well as the equipment with digital technologies. However, both coefficients are not statistically significant at conventional significance levels.

4.2 Econometric challenges and alternative estimation strategies

Given the research goal, to identify the effect of works councils on the implementation of digitalization technology, the analysis is confronted with an endogeneity problem (for a more detailed explanation of endogeneity problems in cross sectional data see Wooldridge 2002: 51). Works councils might be introduced as a reaction of the consideration or equipment with new digital technologies might be a plausible scenario. The broad general debate in German media underlines the fear of the society that digitalization imposes drastic employment losses. Thus, if establishments without works councils announce to investment into digitalization technology the workforce might choose to constitute a worker representation in form of a works council in order to prevent employment reduction. Kraft/Lang (2008) found empirical evidence that one of the driving factors for the constitution of works councils are concerns of the workforce about their job stability. Alternatively digitalization technologies might lead to establishment foundations as new technological possibilities yield scope for innovative business ideas. The causal relationship would go in those cases in the opposite direction. In this analysis the estimated effect of works councils would be biased due to reverse causality. Therefore, we restrict our analysis to those establishments without works councils and those where the works council was established already before 1996. We also exclude all establishmets which are founded after 1996. The sample size is almost halved by introducing this restriction on the works council's existence. The results are very stable in comparison with the first estimation specification.

[Table 4 about to be here.]

The model estimating the effect of works councils on the consideration of digitalization technologies loses mostly all significant explanation power. The only significant effect to be found is the negative effect of the share of workers with high physical strain. All the other effects keep the sign of the influence from the previous model without any significant effect mechanism.

The second estimation model analyzing the effect of works councils on the equipment with digital technologies remains relatively unchanged in comparison to the baseline model. The negative impact of the existence of works councils shirks in size as well as significance levels but still remains statistically significant at the 10% level. This effect is again offset

if the workforce is exposed to high physical demands. This confirms once more the formulation of the second and third hypothesis.

4.3 Robustness checks

The identification of the influence of works councils on the implementation of digitalization, however, raises two further challenges. First, previous studies have demonstrated that works councils are more likely to exist in large establishments. Indeed, works councils are established in the majority of large establishments (for a recent analysis, see Ellguth/Kohaut 2017). Additionally, large establishments are more likely to be better informed and equipped with digitalization technologies as otherwise comparable small establishments. This confronts the analysis with the problem of spurious correlation. The positive influence of works councils on the implementation of digitalization might artificially arise by the fact that works councils exists in large establishments and large establishments are more involved to digitalization. This establishment size problem has been addressed in related literature by restricting the data set also to a subsample of those establishments with 21-199 employees (see Addison et al. 2001, Bellmann/Ellguth 2006). Within this range establishments the amount and the rights of the elected works councils is constant. Furthermore this range lies relatively in the middle of the establishment size distribution which rules out the extreme cases where either almost no works council is established or almost automatically a works council is introduced. Second, a major concern is the comparability of establishments with (treatment group) and without (control group) works councils. In order to achieve a sufficient the similarity of treated and control group establishments we base our econometric specification on entropy balancing weights (Hainmueller 2012). This method can be applied for binary treatments in order to achieve covariate balance. Entropy balancing weights reweigh establishments without works councils such that the moment conditions are equal across all establishments irrespectively of the treatment status. In our econometric specification we require the first and the second moment of all control variables to be the same in the control group as in the treatment group[3].

Previous studies trying to isolate an effect of works councils on establishment performance or innovation activity of the establishment rely on methods such as nearest neighbor matching (for example Bellmann/Ellguth 2006). This approach either matches or discards observations in order to achieve a sufficient level of comparability across observations. One of the main benefits of the used entropy balancing method is the higher flexibility with respect to the reweighting procedure. It reweights all units in order to achieve balance without discarding observations and still retains efficiency by closely following the base weights. Furthermore, entropy balancing automatically adjusts the weights to pre-specified moment conditions and thereby obviates the need for repeated balance checking and iterative searching over different propensity score specifications that may stochastically balance the covariates (Hainmueller 2012).

Variables affecting the treatment (existence of works council) and the outcome (digitalization variables) should be considered in the reweighting scheme as the entropy balancing also relies on the conditional independence assumption.

[3] In this study the Stata package EBALANCE is used within Stata 14 to implement entropy balancing following Hainmueller/Xu (2013).

Following related literature (Addison et al. 2003; Addison et al. 2004; Bellmann/Ellguth 2006) the probability of the existence of a works council depends on the following variables. The probability of works councils to exist increases with the establishment size, if the establishment is a branch plant and not a single establishment. Further positive influence factors are the fraction of commercial workers, the fraction of qualified workers and the existence of sectoral agreements or establishment agreements. Negative influence factors are a good profit situation, high competitive pressure and the membership in a chamber of crafts. Furthermore the balancing takes into account the population density, regional location in Germany and the foundation year of the establishment.

The estimation results for the ordinary least squares estimation after restricting the sample to those establishments with 21 up to 199 employees and after applying entropy balancing can be found in the following table.

[Table 5 about to be here]

The effect of works councils' presence on the level of consideration of digitalization technologies remains negatively but insignificant. For both special cases, if the workforce suffers from physical strain or if the establishment experiences high competitive pressure, the influence of works councils keeps to be positive and insignificant. Again, establishments with a high share of workers exposed to physical strain are significantly less informed about digitalization technologies. The interpretation of the effect of high competitive pressure for the establishment is contrary to the previous subsamples. In this estimation the effect turns to be negative what indicates that establishments do consider digital technologies less under high competitive pressure. However, the effect is statistically insignificant. The negative effect is comprehensible as there might be more urgent aspects to be addressed in order to guarantee the survival of the establishment. Surprisingly the model which estimates the effect of works councils on the equipment with digitalization technologies yields a different picture. The presence of works councils leads to better equipment with digital technologies with respect to other establishments within the same sector. This positive effect is statistically significant at the 10 % significant level. In this specification it seems to be irrelevant if the establishment is characterized by a high share of workers conducting physical demanding activities. Neither the negative effect alone nor the interaction with the works councils' presence remains statistically significant. However, the existence of competitive pressure turns out to be a considerable factor. Establishments exposed to high competitive pressure are statistically significant better equipped with digital technologies. This is plausible as the investment into modern digital technologies offers the potential to reposition market shares between establishments. Our analysis shows that those establishments who consider themselves to be under high competitive pressure are those undertaking investments into digital technologies. In this case, the presence of works councils is however counteractive. The presence of workforce representation offsets the positive effect of works councils and yields an overall negative influence of works councils within establishments under high competitive pressure. Keeping the main goal of protecting the existent level of employment in mind, it seems to be intuitive that the workforce fears employment losses if the establishment is exposed to high competitive pressure. Representing the workforce might in this case explain the countering position of works councils with respect to investments into digital technologies. Those technologies would add an additional threat for the existing level of employment.

Further robustness checks have been carried out to assess the stability of our results. If the subsample is further restricted to establishments with 21 to 100 employees the direction of the effects mainly are unchanged, however, the statistically significance the results shrinks as the observation number is considerably reduced. We also tested another restriction of the endogeneity problem with regards to the foundation of works councils. We allowed establishments and works councils to be founded before 2010. This leaves the results after entropy balancing unchanged however their effects are less statistically significant. A further restriction of the high competitive pressure variable to not account for "middle" competitive pressure leaves the effects unchanged. The level of significance decreases slightly. For the entropy balancing procedure we calculated as a robustness check the results for all models requiring only the first moment of all control variables to be the same in the control group as in the treatment group. However, also this release of the moment conditions does not changed the interpretation of the results.

5 Summary and conclusions

The aim of the present research was to examine the role of works councils within the implementation process of digital technologies. The impact of works councils on digitalization is ambiguous. On the one hand, they are interested to counter the implementation of digital technologies as new machinery potentially could lead to a substitution of labor. On the other hand, works councils tend to foster new technologies to lessen the physical strain of the workforce.

Using the IAB Establishment Survey of 2016 and administrative data about employee histories, we find empirical evidence for both of directions of action. A basic econometric model confirms that the existence of works councils is associated with less information about new technologies and worse equipment with digital technologies in establishments. However, this countering attitude of works councils disappears as the workforce is exposed to physical demands at the workplace. In those establishments works councils lead to more consideration and better equipment with digital technologies. The market tightness within the establishments market does not influence the impact of works councils on digitalization.

This basic econometric approach is, however, confronted with the problem that works councils might be founded in anticipation that the establishment will soon invest into new technologies. Therefore we restrict the sample in the second econometric specification to those establishments who are founded before 1996 and who have either no works council or a works council also founded before 1996. This reduces considerably the level of significance of all coefficients. This specification reveals no statistically significant impact of works councils on the consideration of digitalization. The relation between works councils and the equipment with digitalization technologies remains unchanged. The pure presence of works councils has a countering effect on digitalization. However, in establishments whose workforce is exposed to high physical demands, works councils foster the implementation of digitalization and their presence is associated with statistically significant better equipment with digital devices within the establishment.

Still, some doubts about the comparability of establishments with and without works councils remain. Therefore, as a robustness check we restrict the sample to establishments with 21 to 199 employees and apply entropy balancing before estimating the effect of works councils. Again, no statistically significant impact of works councils on the consideration of digital technologies can be found. Works councils' impact on the equipment with digitalization devices of an establishment compared to other establishments within the same sector differs from previous estimations. Accounting for differences in covariates between establishments with and without works councils by applying entropy balancing weights highlights the supporting impact of works councils on digitalization. The presence of works councils is related to statistically higher level of equipment with digitalization. The presence of physical strain for the workforce has no statistically significant effect on the state of digitalization within establishments. However, our results show that establishments under high competitive pressure are better equipped with digital devices. Works councils in establishments under competitive pressure are taking over a countering attitude towards digitalization. The equipment with digital devices is statistically significant worse if a works councils exists in those establishments. We interpret this as a hint that works councils in establishments under high competitive pressure act following their most important rule to protect the

existing workforce and secure their job stability. Therefore other interests like applying modern technologies are overshadowed. Especially since this modern technology is associated with the potential threat of substituting labor what the works councils tries to avoid.

Surprisingly, the share of employees conducting their work under high physical strain has a significant negative influence on the consideration of digitalization technologies as well as the equipment with digital technology across all different econometric specifications. Especially those establishments could potentially benefit from the introduction of new technologies as this potentially lessens the physical strain and thereby decreases the number of sickness days, increases the overall productivity and might increase the job satisfaction of the workforce. The challenge now is to understand why those establishments have not yet realized the digital potentials.

Taken together, these results confirm that the effect of works councils on digitalization is ambiguous and that works councils' actions depend considerably on the current environment of the establishment. We also want to emphasize that works councils scope on action depends on the number of employees within the establishment as this determines the rights set out in the Works Constitution Act. The contribution of this study has been to confirm the importance of one pillar of the German industrial relation system, namely works councils, within the digital transformation in German establishments. This research will serve as a base for future studies as still several questions remain unexplained considering the circumstance under which works councils actively foster digitalization. In the future, more research is required to determine the efficacy of works councils once investments into digital technologies are made and the machinery is established in the establishment. Works councils might play an essential role within the process of restructuring the work operations and working environment.

6 References

Addison, J. T.; L. Bellmann, C. Schnabel, J. Wagner (2003), German works councils old and new. Incidence, coverage and determinants. Schmollers Jahrbuch 123(3): 339-358.

Addison, J. T., C. Schnabel, J. Wagner (2001), Works councils in Germany: their effects on establishment performance. Oxford Economic Papers 53(4): 659-694.

Addison, J. T., C. Schnabel, J. Wagner (2004), The course of research into the economic consequences of German works councils. British Journal of Industrial Relations 42(2): 255-281.

Addison, J. T., P. Teixeira, A. Pahnke, L. Bellmann (2017), The demise of a model? The state of collective bargaining and worker representation in Germany. Economic and Industrial Democracy 38(2): 193-234.

Arntz, M., T. Gregory, F. Lehmer, B. Matthes, U. Zierahn (2016a), Arbeitswelt 4.0 - Stand der Digitalisierung in Deutschland: Dienstleister haben die Nase vorn. IAB-Kurzbericht Nr. 22: 1-8.

Arntz, M., T. Gregory, U. Zierahn (2016b), The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis. OECD Social, Employment and Migration Working Papers No 189: 1-32.

Askildsen, J. E., U. Jirjahn, S. C. Smith (2006), Works councils and environmental investment: Theory and evidence from German panel data. Journal of Economic Behavior & Organization 60(3): 346-372.

Bellmann, L., P. Ellguth (2006), Verbreitung von Betriebsräten und ihr Einfluss auf die betriebliche Weiterbildung/Works Council Presence and Impact on Training of the Workforce. Jahrbücher für Nationalökonomie und Statistik 226(5): 487-504.

Blume, L., W. Gerstlberger (2007), Determinanten betrieblicher Innovation: Partizipation von Beschaeftigten als vernachlaessigter Einflussfaktor. Industrielle Beziehungen - The German Journal of Industrial Relations 14(3): 223-223.

Bonin, H., T. Gregory, U. Zierahn (2015), Übertragung der Studie von Frey/Osborne (2013) auf Deutschland. ZEW Kurzexpertise No. 57: 1-44.

Chesley, N. (2014), Information and communication technology use, work intensification and employee strain and distress. Work, Employment & Society 28(4): 589-610.

Dengler, K., B. Matthes (2015), Folgen der Digitalisierung für die Arbeitswelt: In kaum einem Beruf ist der Mensch vollständig ersetzbar. IAB-Kurzbericht Nr. 24: 1-7.

Ellguth, P., S. Kohaut, I. Möller (2014), The IAB Establishment Panel. Methodological essentials and data quality. Journal for Labour Market Research 47(1-2): 27-41.

Ellguth, P., S. Kohaut (2017), Tarifbindung und betriebliche Interessenvertretung. Ergebnisse aus dem IAB-Betriebspanel 2016. WSI-Mitteilungen 70(4): 278-286.

Fischer, G., F. Janik, D. Müller, A. Schmucker (2009), The IAB Establishment Panel. Things users should know. Schmollers Jahrbuch 129(1): 133-148.

Frege, C. M. (2002), A critical assessment of the theoretical and empirical research on German works councils. British Journal of Industrial Relations 40(2): 221-248.

Frey, C. B., M. A. Osborne (2017), The future of employment: How susceptible are jobs to computerisation? Technological Forecasting and Social Change 114: 254-280.

Friedrich, R., F. Gröne, A. Koster, M. Le Merle (2011), Measuring industry digitization: Leaders and laggards in the digital economy. PWC Strategy; Booz & Company.

Glavin, P., S. Schieman (2012), Work–family role blurring and work–family conflict: The moderating influence of job resources and job demands. Work and Occupations 39(1): 71-98.

Georg, A., O. Katenkamp, K. Guhlemann (2017), Digitalisierungsprozesse und das Handeln von Betriebsräten. Arbeit 26(2): 251-274.

Hainmueller, J. (2012), Entropy Balancing for Causal Effects: A Multivariate Reweighting Method to Produce Balanced Samples in Observational Studies. Political Analysis 20(1): 25-46.

Hainmueller, J., Y. Xu (2013), Ebalance: A Stata Package for Entropy Balancing. Journal of Statistical Software 54(7): 1-18.

Jirjahn, U., K. Kraft (2011), Do Spillovers Stimulate Incremental or Drastic Product Innovations? Evidence from German Establishment Data. Oxford Bulletin of Economics and Statistics 73(4): 509-538

Kirchner, S., M. Wolf (2015), Digitale Arbeitswelten im europäischen Vergleich. WSI Mitteilungen 68: 253–262.

Korupp, S. E., H. Künemund, J. Schupp (2006), Digitale Spaltung in Deutschland: Geringere Bildung – seltener am PC, DIW Wochenbericht 73(19): 289-294.

Kraan, K. O., S. Dhondt, I. L. D. Houtman, R. S. Batenburg, M. A. J. Kompier, T. W. Taris (2014), Computers and types of control in relation to work stress and learning. Behaviour & Information Technology 33(10): 1013 – 1026.

Kraft, K., J. Lang (2008), The causes and consequences of adopting a works council. Jahrbücher für Nationalökonomie und Statistik 228(5-6): 512-532.

Kroll, L. E. (2011), Konstruktion und Validierung eines allgemeinen Index für die Arbeitsbelastung in beruflichen Tätigkeiten anhand von ISCO-88 und KldB-92. Construction and Validation of a General Index for Job Demands in Occupations Based on ISCO-88 and KldB-92. Methoden – Daten – Analysen 5(1): 63-90.

Müller, S. et al. (forthcoming)

OECD (2002), Understanding the Digital Divide. OECD Digital Economy Papers, No. 49: 1-32.

OECD (2004), Regulatory reform as a tool for bridging the digital divide: 1-29.

Pfeiffer, S. (2005), Arbeitsforschung – Gute Arbeit – Gute Technik. WSI-Mitteilungen 58(11): 645 – 650.

Wooldridge, J. M. (2002). Econometric analysis of cross section and panel data. MIT press.

7 Appendix

7.1 Digitalization Questions

Modern automation and digitization technologies are capable to transform communication and cooperation between employees, facilities, logistics, products and customers. These include among others autonomous robotics, smart factories, internet of things, or even analysis tools with big data, cloud services or online platforms.

Please respond to the following 3 sub-questions based on a 10 scale!

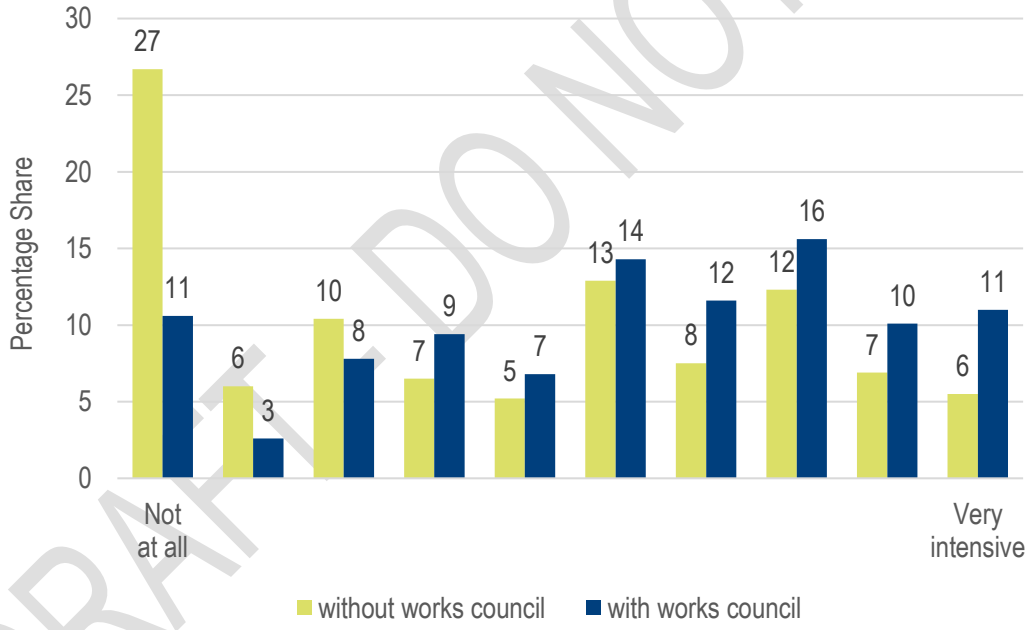
a) How intensive has your establishment dealt with this topic so far?

b) What potential do you see to apply such technologies in your establishment?

c) How good is your establishment equipped with this technology compared to other establishments in your industry?

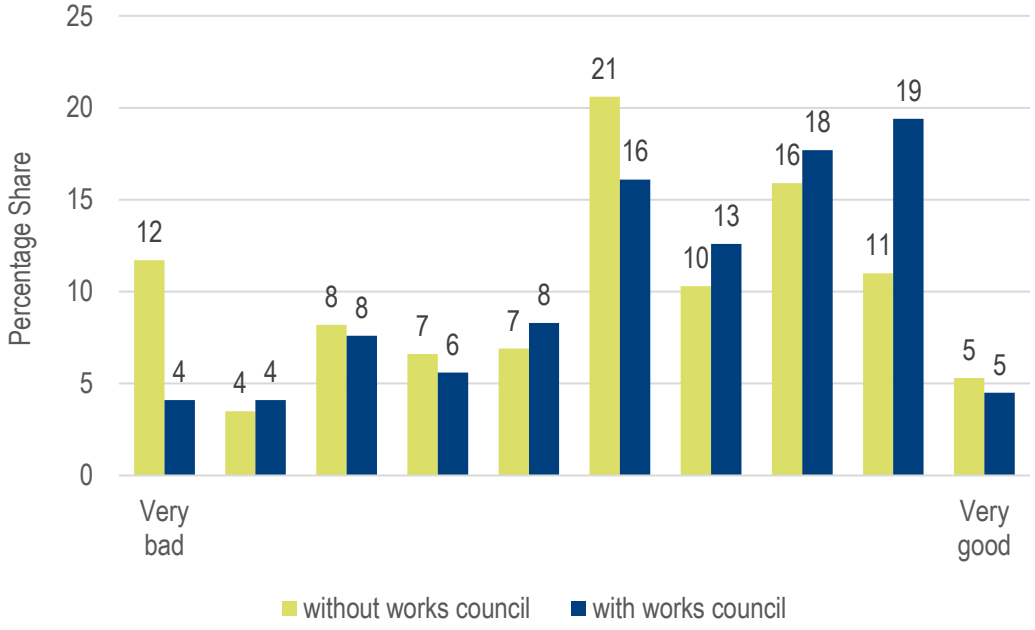
7.2 Descriptives

Figure 1: Consideration of Digitalization Technologies



Note: private sector establishments with at least 5 employees, without establishments in agriculture and non-profit organizations
Source: IAB-Establishment Panel 2016, own calculations

Figure 2: Equipment with Digitalization Technologies



Note: private sector establishments with at least 5 employees, without establishments in agriculture and non-profit organizations
Source: IAB-Establishment Panel 2016, own calculations

Table 1: Consideration of Digital Technologies across Sectors

Answer Categories		*Sectors*						
	Works Council	Manu-facturing	Construc-tion	Trade	Transport	Finance	Service activities	Other services
Not at all	No	19.34	27.14	21.60	27.17	16.67	11.05	24.23
	Yes	5.14	7.27	8.33	11.11	1.04	5.45	16.99
Few	No	27.45	23.68	20.65	20.43	17.50	17.13	22.95
	Yes	24.59	21.82	17.75	3.70	11.46	14.55	24.32
Average	No	30.75	27.87	26.98	19.57	23.33	28.45	27.95
	Yes	35.74	29.09	35.14	18.52	27.08	36.36	27.03
Intensive	No	22.46	21.31	30.77	32.83	42.50	43.37	24.87
	Yes	34.54	41.82	38.77	66.67	60.42	43.64	31.66
No. observations		2,580	604	1,225	514	216	417	1,200

Note: private sector establishments with at least 5 employees, without establishments in agriculture and non-profit organizations; missings and "do not know" excluded
Source: IAB-Establishment Panel 2016, own calculations

Table 2: Equipment with Digitalization Technologies across Sectors

Answer Categories		*Sectors*						
	Works Council	Manu-facturing	Construc-tion	Trade	Transport	Finance	Service activities	Other services
Not at all	No	10.23	12.73	8.59	12.13	6.19	4.83	10.50
	Yes	3.13	2.17	4.41	2.22	0.00	2.00	6.57
Few	No	20.71	18.44	14.93	18.34	14.43	11.03	15.98
	Yes	17.64	10.87	15.42	6.67	7.50	10.00	16.67
Average	No	40.55	36.10	40.56	29.59	29.9	31.03	38.91
	Yes	45.95	32.61	41.85	31.11	38.75	40.00	36.36
Intensive	No	28.51	32.73	35.92	39.94	49.48	53.10	34.62
	Yes	33.29	54.35	38.33	60.00	53.75	48.00	40.40
No. observations		1,857	431	937	383	177	340	874

Note: private sector establishments with at least 5 employees, without establishments in agriculture and non-profit organizations; missings and "do not know" excluded
Source: IAB-Establishment Panel 2016, own calculations

7.3 Multivariate Results

Table 3: Ordinary least square regression - baseline model

Dependent variable:	Consideration of digitalization technologies		Equipment with digitalization technologies	
	coefficient	t-value	coefficient	t-value
Works council (1=yes)	-0.550**	-2.55	-0.642***	-2.91
Share employees with physical strain	-1.348***	-9.46	-1.173***	-7.38
Interaction Works council*Share physical strain	0.758***	2.86	0.780***	2.94
Competition pressure (1=middle/high)	0.0932	0.95	-0.140	-1.40
Interaction Works council* Competition pressure	0.262	1.25	0.172	0.80
No. observations	6,777		5,012	
Adj. R^2	0.160		0.149	

*Note: private sector establishments with at least 5 employees, without establishments in agriculture and non-profit organizations; Controlled for: profit situation, modern technology, no. employees, share of routine workers, share of qualified workers, sector level agreements, firm level agreements, craft chamber membership, individual owned company, founded before 1990, urban area, location in East Germany and sectors; ***, **, * indicate statistical significance at the 1 %-/5%-/10% level*
Source: IAB-Establishment Panel 2016, own calculations

Table 4: Ordinary least square regression - model with works council restriction

Dependent variable:	Consideration of digitalization technologies		Equipment with digitalization technologies	
	coefficient	t-value	coefficient	t-value
Works council (1=yes)	-0.383	-1.30	-0.568*	-1.87
Share employees with physical strain	-1.371***	-6.99	-0.988***	-4.62
Interaction Works council*Share physical strain	0.578	1.60	0.661*	1.84
Competition pressure (1=middle/high)	0.146	1.03	-0.141	-0.95
Interaction Works council* Competition pressure	0.116	0.40	0.0875	0.29
No. observations	3,657		2,681	
Adj. R^2	0.176		0.165	

Note: private sector establishments with at least 5 employees, without establishments in agriculture and non-profit organizations; Restricted to establishments founded before 1996 and those establishments which have no works council or have founded the works council before 1996; Controlled for: profit situation, modern technology, no. employees, share of routine workers, share of qualified workers, sector level agreements, firm level agreements, craft chamber membership, individual owned company, founded before 1990, urban area, location in East Germany and sectors;
****, **, * indicate statistical significance at the 1 %-/5%-/10% level*
Source: IAB-Establishment Panel 2016, own calculations

Table 5: Ordinary least square regression after entropy balancing - with works council restriction for restricted sample

Dependent variable:	Consideration of digitalization technologies		Equipment with digitalization technologies	
	coefficient	t-value	coefficient	t-value
Works council (1=yes)	-0.583	-0.67	0.768*	1.73
Share employees with physical strain	-2.219***	-3.35	-0.231	-0.38
Interaction Works council*Share physical strain	0.350	0.45	-1.100	-1.48
Competition pressure (1=middle/high)	-0.319	-0.40	0.759**	2.24
Interaction Works counil* Competition pressure	0.385	0.45	-0.977**	-1.97
No. observations	1,795		1,345	
R^2	0.050		0.027	

Note: private sector establishments with 21-199 employees, without establishments in agriculture and non-profit organizations; Restricted to establishments founded before 1996 and those establishments which have no works council or have founded the works council before 1996; Results after entropy balancing with respect to first and second moment;
Controlled for: profit situation, modern technology, no. employees, share of routine workers, share of qualified workers, sector level agreements, firm level agreements, craft chamber membership, individual owned company, founded before 1990, urban area, location in East Germany and sectors;
****, **, * indicate statistical significance at the 1 %-/5%-/10% level*
Source: IAB-Establishment Panel 2016, own calculations