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BIBB Establishment Panel on Training and Competence Development

The longitudinal data set***

Abstract: The BIBB Establishment Panel on Qualification and Competence Development is the second largest annual panel survey of firms in Germany. In this article, we present the harmonised longitudinal data set from the first wave in 2011 to the 2019 wave, comprising 32,135 observations from 15,918 firms. We present information on the sample, study design and data collection and describe the characteristics of the survey. We explain the structure of the long data set designed for facilitating panel analyses. The data provides comprehensive information on firms' human resources management, particularly in respect of vocational education and training and continuing training. Since 2016, the survey has also followed technological change and the training and employment of refugees. We present previous findings using the data, based on which we give an outline of the survey's potential for future research. The Research Data Centre at the Federal Institute for Vocational Education and Training provides and regularly updates the data set.

Keywords: Panel Survey; Longitudinal Data Set; Firms; VET; Continuing Training; Technological Change

BIBB-Betriebspanel zur Qualifizierung und Kompetenzentwicklung

Der Längsschnittdatensatz

Zusammenfassung: Das BIBB-Betriebspanel zur Qualifizierung und Kompetenzentwicklung ist die zweitgrößte jährliche Panelbefragung von Betrieben in Deutschland. In diesem Beitrag stellen wir den harmonisierten Längsschnittdatensatz von der ersten Welle im Jahr 2011 bis zur Welle 2019 vor, der 32.135 Beobachtungen von 15.918 Betrieben umfasst. Wir informieren über die Stichprobe, das Studien-

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design und die Datenerhebung sowie die Merkmale der Erhebung. Weiterhin erläutern wir die Struktur des long Datensatzes, der für Panelanalysen konzipiert ist. Die Daten liefern umfassende Informationen zum Personalmanagement der Unternehmen, insbesondere zu beruflicher Bildung und Weiterbildung. Seit 2016 verfolgt die Erhebung auch den technologischen Wandel sowie die Ausbildung und Beschäftigung von Geflüchteten. Wir stellen bisherige Ergebnisse anhand der Daten vor und skizzieren auf dieser Basis das Potenzial der Erhebung für die zukünftige Forschung. Das Forschungsdatenzentrum am Bundesinstitut für Berufsbildung stellt den Datensatz zur Verfügung und aktualisiert ihn regelmäßig.

Schworte: Panelbefragung; Längsschnittdatensatz; Betriebe; Berufsausbildung; Weiterbildung; Technologischer Wandel

1 Introduction

Firms play a major role in working life. They act as gatekeepers by deciding who enters vocational education and training (VET) and full-time, permanent or marginal jobs. Furthermore, firms determine wages, job positions, the quality of jobs, and job tasks. Given their importance, surveying firms is a key objective of empirical social research. The Federal Institute for Vocational Education and Training (BIBB) contributes to this objective by conducting the BIBB Establishment Panel on Qualification and Competence Development (BIBB Training Panel).¹

The BIBB Training Panel is a representative annual survey of firms in Germany, which started in 2011. The survey investigates firms' VET, human resources management (HRM), continuing training and basic firm characteristics complemented by annual thematic focuses. After the IAB (Institute for Employment Research) Establishment Panel, the BIBB Training Panel represents the second largest panel examining firms in Germany. The main advantage of the BIBB Training Panel is its detailed evaluation of qualification within firms in Germany.

The aim of this article is to introduce the longitudinal data set of the BIBB Training Panel 2011 to 2019 long (Friedrich et al. 2022), which is especially designed for longitudinal analyses. The data set comprises 32,135 observations from 15,918 firms. Despite a low average number of observations per firm between 2011 and 2019 the BIBB Training Panel 2011 to 2019 long provides the scientific community with an easy access to data enabling the analysis of differences between firms over time and also within firms for recent years. The Research Data Centre at BIBB (BIBB-FDZ) publishes and constantly updates the data.

1 The German name is "BIBB-Betriebspanel zu Qualifizierung und Kompetenzentwicklung" (referred to in abbreviated form as the "BIBB-Qualifizierungspanel"). In this article, we refer to establishments as firms, since it is the more commonly used term in the literature.

Scientific progress relies heavily on the replicability of results, thus making the accessibility and reuse of research data an important goal (Fecher et al. 2015). Reusing firm-level data is particularly important because of the relatively limited number of firms. About two million firms exist in Germany, a comparatively low number in light of the fact that the country has approximately 33 million employees (Bundesagentur für Arbeit 2019) and some 83 million inhabitants (Destatis 2020). The probability that firms will be included in more than one survey is higher than the likelihood that individuals will be surveyed more than once. This problem particularly arises for large firms with over 200 employees who comprise the majority of employees in Germany but are few in number. Hence, the probability to be contacted by more than one survey is higher for large than for small firms. Sharing research data helps to avoid over-surveying and enables researchers to analyse firm-level data without conducting their own time-consuming and expensive survey.

The article proceeds as follows. Firstly, we scrutinise the key characteristics of the BIBB Training Panel such as the study design, the fieldwork, non-response and weighting. We then give more details about the subject and the instruments of the survey. The next section describes the analytical potential of the data by introducing studies based on the BIBB Training Panel. We subsequently outline the strength and weaknesses of the data set and conclude by presenting information on data access.

2 Sample, study design and data collection

2.1 The sample

The target population of the BIBB Training Panel comprises firms in Germany with at least one employee subject to social insurance contributions as of 31st December of the year previous to the data collection. The observational unit of the survey is a firm's local business site. The sample is drawn from the establishment database of the Federal Employment Agency (BA) that includes all addresses of firms in Germany with at least one employee subject to social insurance contributions and is provided by the IAB.² Employers are obliged to report the hiring or the leaving of an employee who is subject to social insurance contributions. Among other, the information is transferred into the establishment database, which comprises e.g. information on the firm's region, industry and size (cf. Brixy/Fritsch 2002; Fritsch/Brixy 2004).

When drawing a probability sample for a survey, researchers can divide the sample in strata, i.e. subgroups of interest to the researcher (cf. Lohr 2019). The sample is stratified across the following four characteristics:

- Region of the firm (Western and Eastern Germany)³

2 Some panel firms separate from their employees subject to social insurance contributions. These firms are still kept in the sample for longitudinal analyses.

3 Since the survey wave 2019, region has not been a stratification characteristic anymore.

- Firm size (1-19 employees, 20–99 employees, 100-199 employees, 200 and more employees)
- Industry (agriculture/mining and energy; manufacturing; construction; trade and repair; business services; personal services; medical services; public services and education)⁴
- Whether or not the firm offers VET.

The distribution of the strata in the target population is known from the establishment database of the BA.

To achieve sufficient case numbers even for firms with rather rare characteristics the stratification is disproportional. The BIBB Training Panel oversamples firms in Eastern Germany⁵, firms with 200 and more employees and firms offering VET. Table A1 in the appendix illustrates the disproportional sampling by showing the distribution of stratification variables in the population and in the BIBB Training Panel. Concerning the firm size, the table clearly illustrates that firms with 200 and more employees (2019: 1% [population] vs. 23% [data]) and firms with 100 to 199 employees (2019: 1% [population] vs. 13% [data]) are massively overrepresented. Further, Eastern firms (2018: 20% [population] vs. 30% [data]) and firms offering VET (2019: 20% [population] vs. 53% [data]) are overrepresented as well (cf. Table A1).

2.2 Fieldwork and response rates

The BIBB Training Panel takes place via Computer Assisted Personal Interviews (CAPI). From 2011 to 2014, it was carried out by Kantar TNS⁶ and has been conducted by the infas Institute for Applied Social Sciences since 2015. Only if firms do not wish a personal interview, the interviewers exceptionally offer the opportunity to participate via Computer Assisted Web Interviews (CAWI).⁷ CAPI interviews are well-suited for relatively complex topics and long surveys, since interviewers can provide more support during the interview, e.g. by providing additional (standardised) explanations or using supplementary materials (Loosveldt 2008).

The interviews were conducted with employees who are able to provide information on the main topics of the survey, i.e. who are responsible for the HRM. In small firms, this could be the owner, the managing director or a shareholder. In large firms, the interviewee also could be the head of VET, the human resources manager, a commercial manager or a technical manager. The decision who actually takes part in the interview is taken by the firm (cf. Häring et al. 2017a).

4 The industry classification aggregates the 2-digit level of the “NACE Rev. 2 – Statistical classification of economic activities” (Eurostat 2008) to eight industry categories (cf. Hohn et al. 2022). From 2011 to 2014, the survey only contained six industry categories.

5 Since the survey wave 2019, firms in Eastern Germany have not been oversampled anymore.

6 During their responsibility for the BIBB Training Panel the institute was called TNS Infratest Social Research.

7 Prior to 2016, the additional option for participation was a Pen and Paper Interview (PAPI).

Beginning with the second wave in 2012, the sample was split into two groups consisting of panel firms and supplemental firms. The latter compensate for panel mortality. The survey institute pre-contacts supplemental firms participating in the survey for the first time to find the appropriate contact person. The survey institute then contacts all firms in writing and announces that a new wave of the BIBB Training Panel will soon start. The letter introduces the thematic focus of the upcoming wave, provides information on the data protection policy and asks for participation. The survey institute sends out announcement letters to panel firms at an earlier juncture, at the same time when the supplemental firms are pre-contacted. Interviewers subsequently contact the firms to arrange an interview. The survey institute intends to query always the same person. However, the data set available via the BIBB-FDZ does not include any information about the interviewee. Hence, it is not possible to determine whether the interviewee stays the same over time or whether he or she has changed in a given year.

Fieldwork typically starts in February and lasts until September. Before the interviewers begin their fieldwork, they receive group training and extensive information material about the BIBB Training Panel. Interviewers without prior experience with the BIBB Training Panel get personal training. To ensure the interview quality, interviewers have to keep contact protocols and the survey institute monitors them randomly (cf. Häring et al. 2017a).

From 2011 to 2013, the target sample size was about 2,000 and increased to 3,500 in 2014 and to 4,000 in 2018 to expand the analytical potential of the data. In 2016, an additional survey of approximately 3,500 firms was conducted via Computer Assisted Telephone Interviews (CATI), focusing on technology and automation. Between 2011 and 2014, the share of non-CAPI (i.e. PAPI) interviews on all interviews was about 28%. With the change of the survey institute, the share of non-CAPI (i.e. CAWI) interviews dropped markedly to about 4% between 2015 and 2019 (cf. Table 1).⁸

Table 1 shows the response rates of the BIBB Training Panel from 2011 to 2019 separately for panel and supplemental firms. The response rate is calculated as share of responses to addresses used multiplied by 100. On average, 23% of the supplemental firms contacted participated in the survey. The lowest rate was recorded in 2018 and the highest in 2015. The response rate of panel firms is markedly higher. An average of 66% of the panel firms contacted chose to take part. Participation rates vary between a minimum of 54% (2015) and a maximum of 72% (2012). For the survey in 2017, no supplemental firms were contacted, because the additional addresses of firms who participated in the additional 2016 CATI interviews were used as new firms. This procedure resulted in an overall response rate of 59% in 2017.

8 A variable indicating the mode of the data collection is not included in the regular data set but is available upon request.

Table 1: Response rates and reasons for non-response of the BIBB Training Panel 2011 to 2019

Firm	2011	2012	2013	2014	2015	2016	2016	2017	2018	2019							
	Panel	Supple- mental	Panel	Supple- mental	Panel	Supple- mental	CATI	Panel	Supple- mental	Panel							
Addresses used	8,355	1,617	3,429	1,895	3,849	1,985	13,434	2,192	7,616	3,288	5,992	26,866	6,300	5,254	6,848	4,400	10,841
Non-Response																	
Firm not part of the target group	96	2	27	4	67	6	149	13	71	13	84	268	21	20	95	9	150
Firm does not exist anymore ⁹	1.1%	0.1%	0.8%	0.2%	1.7%	0.3%	1.1%	0.6%	0.9%	0.4%	1.4%	1%	0.3%	0.4%	1.4%	0.2%	1.4%
Firm not found under given address ⁹	131	9	71	20	54	28	254	21	157	20	244	559	28	45	71	35	202
Contact person refuses	1.6%	0.6%	2.1%	1.1%	1.4%	1.4%	1.9%	1%	2.1%	0.6%	4.1%	2.1%	0.4%	0.9%	1%	0.8%	1.9%
Contact person not available	168	-	58	-	75	13	301	1	25	8	73	481	15	13	118	23	515
Other reasons	2.0%	1.7%	-	-	1.9%	0.7%	2.2%	0%	0.3%	0.2%	1.2%	1.8%	0.2%	0.2%	1.7%	0.5%	4.8%
	3,260	94	700	404	1,674	278	5,449	463	2,577	678	2,221	9,711	1,993	1,804	4,231	1,443	7,485
	39%	5.8%	20.4%	21.3%	43.5%	14%	40.6%	21.1%	33.8%	20.6%	37.1%	36.1%	31.6%	34.3%	61.8%	32.8%	69%
	358	11	100	14	121	93	1,230	250	2,291	255	1,269	3,981	49	33	190	85	700
	4.3%	0.7%	2.9%	0.7%	3.1%	4.7%	9.2%	11.4%	30.1%	7.8%	21.2%	14.8%	0.8%	0.6%	2.8%	1.9%	6.5%
	1,606	109	619	89	549	204	2,799	115	757	108	813	9,128	428	396	1,358	173	1,255
	19.2%	6.7%	18.1%	4.7%	14.3%	10.3%	20.8%	5.2%	9.9%	3.3%	13.6%	34%	6.7%	7.5%	19.8%	3.9%	11.6%
Response	2,004	1,168	838	1,321	705	1,352	2,114	1,187	2,411	2,197	1,419	3,521	3,727	3,004	1,076	2,676	1,370
Thereof PAPI/ CAWI	534	198	267	240	210	404	815	78	18	11	167	-	152	79	78	157	87
Response rate in %	24.0	72.2	24.4	69.7	18.3	68.1	15.7	54.2	31.7	66.8	23.7	13.1	59.2	56.3	15.1	59.9	11.7

Note: The frequencies in brackets are the proportion of non-response to the addresses used.
Source: Hohn et al. 2022; Friedrich/Gerhards 2018; Häring et al. 2017a, 2017b, 2017c, 2018, 2019; Schiel et al. 2016; TNS Infratest Sozialforschung 2012, 2013, 2015; TNS Infratest 2011.

For panel analyses, participation in more than one wave is crucial. As Table 2 shows, about 6,800 firms participated in more than one wave of the BIBB Training Panel, but only 87 were involved in all nine waves. There were, however, three reasons why not all of the 15,918 firms were afforded the opportunity to participate in nine waves. Firstly, the number of firms surveyed was raised. Secondly, supplemental firms were recruited each year. And thirdly, from 2014 to 2016, about 900 firms did not allow their information to be merged with that from previous years.¹⁰

Table 2: Participations in the BIBB Training Panel 2011 to 2019

Sum of participations	Frequencies	Percentage
1	9,150	57.48
2	2,366	14.86
3	1,565	9.83
4	1,660	10.43
5	684	4.30
6	227	1.43
7	79	0.50
8	100	0.63
9	87	0.55
Total	15,918	100.00

Source: BIBB Training Panel 2011 to 2019 long.

2.3 Bias due to non-response

Non-response could bias the analytical results if it is not missing completely at random (MCAR, cf. Rubin 1976). This condition is hardly achieved in empirical studies. However, if the data is missing at random (MAR), i.e. missing, but depending on other observed variables in the data, the resulting bias could be adjusted (ibid.). Missing data becomes problematic, when it is not missing at random (NMAR), i.e. it is dependent on the missing values themselves. In that case correcting for missing values is rather challenging.

The best way to avoid bias due to non-response is to avoid non-response. High-quality data collection is the most important and promising approach in terms of preventing non-response. For the BIBB Training Panel, the survey institute implemented several measures to avoid non-response during the fieldwork. The most important measure is the choice of the survey method. Using CAPI allows plausibility checks and filtering during the interview itself. Moreover, the survey institute can carry out more complex questionnaire controls and the interviewer is able to

9 The categories 'Firm does not exist anymore' and 'Firm not found under given address' comprise firms whose location is unknown even after an intense search.

10 The firms were asked about the permission to link the data to previous waves at the end of the interview. Firms that did not allow their information to be merged are treated as new firms in the respective wave. After 2017, firms were asked about the permission to link the data to forthcoming waves and were not contacted again if they denied it.

answer questions from the respondents. Further measures are interviewer training, providing extensive information material about the survey, and the pre-contact of firms.

In a survey, a distinction is drawn between two kinds of non-response – item non-response and unit non-response. Item non-response means that the respondent did not answer one or more questions or items. In firm surveys, especially sensitive firm characteristics such as business volume often suffer from item non-response. The team of the BIBB Training Panel imputes missing values for metric variables with more than 10% item non-response.¹¹ The data set contains both the original and the imputed variables, implying the advantage that users decide for themselves which variable best suits their analytical strategy.

Unit non-response occurs when an intended target firm does not participate in the survey. Table 1 gives an overview of the reasons for unit non-response in each survey wave. A contact person refusing to participate in the survey is the main reason for unit non-response. In all waves, refusals are significantly lower for panel firms compared to supplemental firms (cf. Table 1).

The survey institute provides failure models for each survey wave illustrating structural differences in unit non-response with respect to firm attributes (cf. Häring et al. 2017a, 2017b, 2017c, 2018, 2019; Schiel et al. 2016). Firms belonging to public services and education have a significantly lower unit non-response. The same holds true for firms in medical services and firms offering VET. Large firms with 200 and more employees have a significantly higher unit non-response.

2.4 Weighting

Usually, surveys rely on a specific sampling procedure giving elements in the population different selection probabilities. Hence, the means of variables of interest in the sample deviate from the means in the population (cf. Gabler et al. 2016; Gabler/Ganninger 2010). To account for different selection probabilities, researchers apply weights.

The BIBB Training Panel 2011 to 2019 long comprises different weights, namely

- cross-sectional adjusted design weights (calibrated for firms according to the stratification characteristics, for employees and for industries),
- cross-sectional adjusted design extrapolation weights (also calibrated for firms according to the stratification characteristics, for employees and for industries),
- longitudinal adjusted design weights and
- longitudinal adjusted design extrapolation weights.

11 For a more detailed description of the imputation, see Gerhards et al. 2012.

All weights adjust for firms in Germany with at least one employee subject to social insurance contribution. The additional cross-sectional weights calibrate for employees and for industries to enable representative results on the employee and industry level, respectively. Friedrich and Ord (2020) give an overview, which weight suits for which research interest.

Due to the before mentioned change of the survey institute the weighting procedure slightly changed in 2015. In the following, we scrutinise the weighting procedure used since 2015 (for details see the reports of the survey institute e.g. Häring et al. 2017a). The former weighting procedure can be found in TNS Infratest Sozialforschung (2015).

Based on the stratification characteristics, a Horvitz-Thompson (cf. Gabler et al. 2016; Gabler/Ganninger 2010) estimator calculates the inverse selection probability, the reciprocal of which forms the design weight. Moreover, failure models with stratification characteristics as independent variables estimate the participation probability where multiplication by the design weight results in the adjusted design weight. The calculation is performed separately for panel and new firms. A next step combines both weights. Finally, an iterative proportional fitting (IPF) of the stratification characteristics (and additionally for employees and industries) calibrates the cross-sectional weights. The base for the calibration is the establishment database of the BA.

For the longitudinal weighting, the estimated failure model uses the retention probability instead of the selection probability. Apart from this difference, the cross-sectional and longitudinal design weights are estimated analogously.

Especially descriptive findings should always be weighted. Otherwise they will be biased and not representative for the target population. Further, all stratification variables are included in the data set and can be used for analyses.

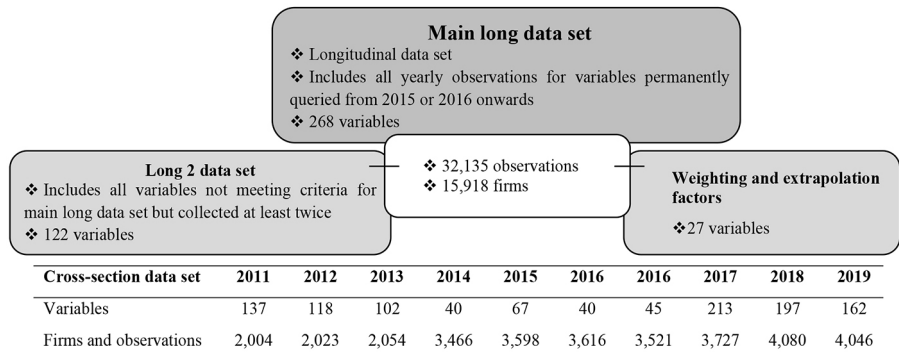
3 The BIBB Training Panel long

The Research Data Centre at BIBB (BIBB-FDZ) has combined the yearly data sets from 2011 to 2019 in order to permit straightforward usage of the BIBB Training Panel. The data consist of three data sets in the long format containing all variables collected more than once (main long data set, long 2 data set, weighting and extrapolation factors) and ten yearly data sets (2011 to 2019, two data sets for 2016, see below) containing all variables just collected once (cf. Friedrich/Ord 2020). Figure 1 gives an overview of all data sets comprising their number of variables, observations and firms.

The research data has been divided into individual data sets to simplify data usage. The full data set encompassing nearly 1,200 variables would be very complex and include many missing values for all the questions merely investigated once or twice. Obtaining an overview of panel and non-panel variables would be rather time-con-

suming. Having different data sets for panel and non-panel variables makes initial access to the data easier. The main long data set of the BIBB Training Panel 2011 to 2019 includes all variables permanently queried from 2015 or 2016 onwards,¹² i.e. the main panel variables. The data set is stored in the long format, and thus each firm is included in the data set as often as it has participated in the survey. To document the variables of the BIBB Training Panel main long data set, the BIBB-FDZ has created a comprehensive questionnaire and makes it available on its website. The main long data set includes 268 variables and 32,135 observations from 15,918 different firms. Researchers interested in long-term panel analyses could focus on this data set.

Figure 1: Overview of sub-data sets



Note: The observations in the cross-sectional data sets comprise some cases of firms not having employees subject to social insurance contributions in this particular year and consequently are not part of the statistical population of the study for the year in question. They therefore drop out of the sample when cross-sectional weights are used.
Source: BIBB Training Panel 2011 to 2019 long.

The additional long 2 data set comprises all variables that were surveyed more than once, but not regularly, such as questions on employees’ tasks, hence the irregular panel variables. 122 variables and 24,075 observations from 13,473 different firms belong to the data set. Researchers interested in analysing timely differences in these variables can easily merge the variables of interest to the main long data set.

The last long data set includes additional weighting and extrapolation weights (27). The extrapolation factor for cross-sections and the extrapolation factor for longitudinal section are included in the main data set. The number of observations and firms equals those in the other two long data sets. These additional weighting and extrapolation weights are not included in the main data set, because they are not

12 When creating the main long data set, the BIBB-FDZ already considered the inclusion of upcoming survey waves. The selection criterion for variables to be included in the main long data set is to be permanently queried from 2015 or 2016 onwards. The data set contains the respective panel variables for all survey years.

relevant for most research projects. However, they are also available to give researchers an additional option for weighting and to make the weighting transparent. The additional variables allow researchers to inspect the retention probability or the unadjusted design weights.

To ensure easy handling of the data set the BIBB-FDZ has carried out a large number of harmonisations documented in Friedrich and Ord (2020). One major harmonisation is the consistent naming of the variables in the long data set. Before 2016, the naming of the variables followed the numbering of questions from each questionnaire in the corresponding year. A stable variable naming system was introduced in the 2016 survey. In the long data set, all variables are named according to the 2016 scheme. To facilitate an easier initial exploration of the data, questions or items that were not queried or imputed in a given year are coded as not queried and not imputed.

4 Subject areas and survey instruments

4.1 Subject areas

The BIBB Training Panel covers three core topics in each year – VET, HRM and continuing training. Basic firm characteristics are also included. Additionally, the survey encompasses varying thematic focuses. In the following, we present the content of the three core topics and two recurring thematic focusses frequently used by researchers, technological change and tasks.

Vocational education and training

The survey evaluates firms' employment of apprentices recognised under the Vocational Training Act (BBiG) or the Crafts Code (HwO) in detail. Despite the overall number of apprentices, the survey elicits the five occupations in which most apprentices are trained together with the number of apprentices in the respective occupation. The information on VET ranges from firms' motives for offering VET to hiring and unfilled vacancies and also extends to include premature termination of contracts and retention after completion of VET. Since 2016, the survey has also contained information on refugees and their participation in VET.

Human resources management

This topic provides information on staff fluctuations (additions, departures and unfilled vacancies) as well as on the overall staff structure by type of contract (marginal, part-time, temporary), gender and qualification. In addition, employees are categorised into three employment groups depending on their actual job requirements.

- Employees performing unskilled tasks, which usually do not require VET.
- Employees performing qualified tasks, which usually require VET or equivalent professional experience.
- Employees performing highly qualified tasks, which usually require a university (of applied sciences) degree or formal, advanced training (e.g. master craftsman, technician).

This recurring distinction of employees applies in several topics and questions. The survey also queries the number of refugees working at the firm.

Continuing training

The survey elicits employees' participation in employer-funded training and distinguishes between formal, advanced training leading to a higher qualification (e.g. master craftsman or technician),¹³ non-formal course-based training and other forms of training (e.g. learning at the workplace and self-directed learning). This definition corresponds to the standard European classification according to the Continuing Vocational Training Survey (cf. Eurostat Statistics Explained n.d.). For advanced and course-based training the BIBB Training Panel captures the number of participants. Moreover, for course-based training, the survey queries the participation numbers differentiated by groups of employees (employees performing unskilled/qualified/highly qualified tasks).

Technological change

Since 2016, firms have provided detailed information on the use of digital technologies for their business activities. The BIBB Training Panel includes questions on computerised work equipment (e.g. computer-aided design), networking with customers (e.g. firm website and online ordering) and networking with suppliers (e.g. supply chain management software). In 2017, the survey also contains information on problems related to new technologies such as higher costs and lower benefits than initially expected. A further object of query was the degree to which firms commission external service providers for digital services. Firms indicate their use of digital work tools and the intensity of using digital technologies separately for the three employment groups (employees performing unskilled/qualified/highly qualified tasks). Additionally, firms give an assessment of structural disruptions they have already experienced and expect due to technological change.

13 Advanced training corresponds to the German term "Aufstiegsfortbildungen" comprising degrees such as "Meister/-in", "Techniker/-in", "Fachwirt/-in" or "Fachkaufmann/Fachkauffrau".

Tasks

The firms indicate how often employees perform certain tasks. For the three employment groups, the BIBB Training Panel evaluates employees' tasks via eight items reflecting the dimensions of routine, manual, interactive and cognitive tasks following the approach of Autor et al. (2003). These questions have so far occurred in the 2012, 2015, 2016 and 2019 survey waves.

4.2 Survey instruments

As already mentioned, the BIBB Training Panel is conducted as CAPI and CAWI respectively, which offers several advantages. The most important benefit compared to paper and pencil interviews is that such instruments allow the implementation of elaborated filters in the interview to avoid inconsistencies in response behaviour. Most numerical answers with a reference later in the survey are subject to consistency checks. Those checks prevent implausible response behaviour and ensure higher data quality. In addition, skipping irrelevant questions reduces the length of the survey. The survey institute pre-tests the survey instrument every year before starting the fieldwork. Around 30 firms take part in the pre-test and give feedback on the questions. Subsequently, survey questions are revised and the study enters the field. If possible, the same interviewer visits the same firm each year. This procedure intends to increase bonding and motivation to take part in the study.

Firms receive some of the questions beforehand to prepare and collect certain information. To facilitate the interviewing procedure, interviewers carry a list book with written questions and examples or illustrations.

5 Potential

The BIBB Training Panel is the most comprehensive study on firms' qualification structure and qualification processes in Germany. The survey allows in-depth analyses of firms' training activities, and its panel design facilitates causal inference. The varying thematic focusses enable users to address economic and social developments such as the ongoing digital transformation of the labour market or the integration of refugees. The following section outlines the potential for users and presents some of the previous work based on the survey.

Vocational education and training (VET)

One of the main advantages of the survey is its differentiated view on the German VET system offering detailed information on firms' training occupations using the German Classification of Occupations 2010. Hence, researchers are able to match occupational characteristics from other data sources such as the VET statistics. For

example, Mohr and Weis (2019) used the VET statistics to identify occupations with a high share of apprentices with a lower secondary school-leaving certificate. They merged this information to the BIBB Training Panel and have shown that a higher technology level and higher cognitive demands correlate with a decline in hiring lower secondary school leavers as apprentices. Complementing the survey with apprenticeship market data including the supply-demand ratio (BIBB n.d.) (i.e. the number of apprenticeships offered by firms divided by the number of apprenticeship seekers multiplied by 100) provides a comprehensive picture of firms' VET environment and enables researchers to address questions on how occupational and firms' VET decisions are interwoven. Future research might deal with the question if a decreasing supply-demand ratio induces firms to withdraw from training or to put more effort in the recruitment of apprentices. Another possibility is to combine the BIBB Training Panel with information on apprenticeship wages to determine if rising wages come along with less training activities.

The BIBB Training Panel comprises the school-leaving certificates of newly hired apprentices and enables users to observe and explain changes over time. Firms provide information on the hiring process of apprentices outlining the number of applicants, unfilled training positions and incentives firms offer for new apprentices. This information can be combined with other subject areas such as Friedrich (2021) who related firms' task composition to their decision to provide VET showing that the school-leaving certificates of newly hired apprentices are associated with the firms' task share. New research might combine the items on technological change with the number of applicants to investigate whether highly digitalised firms are more attractive for youngsters. But also further analyses of the impact of technological change on firms' training strategies inherits a huge research potential of the BIBB Training Panel.

The survey captures the failure and success of apprenticeships eliciting the number of prematurely terminated contracts and the number of apprentices with successful completion of their VET programme. Unfilled training positions are one of the reasons why premature termination of contracts poses a problem for firms offering VET. Rohrbach-Schmidt and Uhly (2016) have found that an investment orientation of a firm's VET activities is associated with a lower rate of premature terminations of contracts. In addition, the authors state that a more direct recruitment of apprentices (e.g. through internships and career fairs) helps to increase the fit between firm and apprentices. However, the debate of how firms' tasks composition or level of technology affects failure and success of apprenticeships is still ongoing.

The sample allows analysing small- and medium-sized enterprises (SMEs) with respect to their VET activities. Pahnke et al. (2020) have illustrated the decrease of apprentices in microenterprises and analysed their struggle to find suitable applicants. Further analyses focusing on large firms or different industries could further expand our understanding of the VET system.

Continuing Training

Facing competition, continuing training is an important instrument for firms to update their employees' knowledge and skills to ensure productivity. Especially in the wake of technological change, continuing training has increasingly gained attention. New technologies alter tasks and require new skills. Lukowski et al. (2020) present a good example for the relationship between employer-provided training and employees' task profiles as well as digital technology usage. The authors show that a high share of complex tasks and digital technology usage collates with more training, even though employees who spend more time using digital technologies participate less in training. Further research potential lies in the analysis of different forms of training and their evolvement over time in the light of technological change. The BIBB Training Panel offers the possibility to relate technologies to advanced training courses or other, non-course training measures. Mohr et al. (2016) have already demonstrated the explanatory power of aggregated task measures at the firm-level for the training participation of low-skilled employees. However, also other firm characteristics such as the qualification structure or staff fluctuation could influence the training participation of low-skilled employees. Using the temporal heterogeneity within a firm to obtain causal insights on reasons for employer-provided training could be implemented with BIBB Training Panel.

6 Strengths and weaknesses

A major strength of the BIBB Training Panel is the extensive set of panel questions covering VET. Additionally, the data set includes detailed information on continuing training according to the international standards of the Continuing Vocational Training Survey (CVTS). Both topics can be analysed over time and combined with staff structure and firm characteristics. Moreover, starting in 2016, the survey has implemented questions on current developments such as technological change as well as employment and VET of refugees.

Covering a wide range of topics, the BIBB Training Panel includes many metric variables. For example, the data not only includes whether firms offer VET or continuing training but also the number of apprentices and participants in continuing training. The metric variables extend the analytical options of researchers tremendously since these variables imply much more information than categorical variables and allow linear regressions.

The main advantages of the research data of the BIBB Training Panel 2011 to 2019 are its long format and its harmonisation (e.g. consistent naming of variables). These aspects diminish the effort necessary for data preparation. Due to the fact that the panel variables which are regularly surveyed between 2011 and 2019 are bundled in the main long data set, handling this panel data set is relatively comfort-

table. The data and methodological report (Friedrich/Ord 2020) gives exemplifying codes for Stata and SPSS and includes further suggested codes e.g. to declare all missing values as system missing values. The availability of all labels and documentation in English (available on the BIBB Training Panel website of the BIBB-FDZ) is another advantage of the dataset. For Stata, the English labels are already included in the data set.¹⁴ For SPSS, researchers can download syntaxes for translating the data.

Allowing causal inference is an advantage of all panel data sets and thus also of the BIBB Training Panel. Social research faces a considerable challenge when it seeks to embrace causality to explore how one factor affects another rather than merely show correlation between two factors. Researchers choose between a variety of models to estimate causal effects (e.g. Legewie 2012) such as fixed-effect models (e.g. Brüderl/Ludwig 2015; Collischon/Eberl 2020), hybrid models (e.g. Schunck 2013) or difference-in-differences estimators (e.g. Angrist/Pischke 2008).

Nevertheless, the data set also faces some limitations. Firstly, the data allows no detailed investigations at regional level. Only the differentiation of Eastern and Western firms is possible, but not the differentiation of the 16 German federal states. This missing regional differentiation is a shortcoming because e.g. regional labour markets shape youngsters occupational aspirations (Flohr et al. 2020), induce the changes of youngsters to enter VET (cf. Weßling et al. 2015), differ in their population, unemployment shares and other conditions (cf. Blien/Hirschenauer 2018).

Secondly, analyses over more than four years for sub-groups (e.g. firms offering VET or firms in the craft trade sector) may suffer from small number of cases. In addition, longitudinal analyses with small samples are more prone to bias. One possible way to partly account for the problem of small numbers lies in diminishing the item non-response. For this purpose, the BIBB-FDZ recommends using the imputed variables already included in the data set (cf. Section 2.3). Furthermore, the increased number of firms interviewed since 2014 (+1,500) and 2018 (+500) has minimised the problem for recent waves.

Thirdly, so far no studies have investigated the data quality of the BIBB Training Panel. Apart from the information of field reports no systematic analyses on the measurement error, non-response error, interviewer and mode effects exist.

In summary, besides the missing regional differentiation and possibly low case numbers in early waves, the BIBB Training Panel provides a broad thematic spectrum. Additionally, the long data set enables an easy and straightforward handling of the data. The long data set of the BIBB Training Panel is a suitable database for research concerning VET, continuing training, and technological change.

14 The language of the labels can be replaced with the Stata command `label language en`.

7 Data access

Access to the research data of the BIBB-FDZ “BIBB Establishment Panel on Qualification and Competence Development – the longitudinal data set” is exclusively subject to the principle of data economy and compliance with the applicable data protection regulations. Users can analyse the long data set of the BIBB Training Panel 2011 to 2019 via remote data access (RDA) and an on-site visit at the BIBB-FDZ in Bonn.

For remote data access, the BIBB-FDZ has launched an automated remote data processing system so that data users can submit their own syntax programs to the original data. The on-site visits at an isolated PC in a separate guest room at the BIBB-FDZ will be linked with the remote access system on a project-related basis.

The use of the data requires a formal application for all data access routes described here. The corresponding applications are available for download at the BIBB-FDZ website.

The BIBB-FDZ will update and newly publish the longitudinal data set of the BIBB Training Panel regularly. The update does not imply a separate documentation or updating of the data and methodological report on the longitudinal data set for every forthcoming wave.

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Anhang

Table A1: Distribution of stratification variables in the population and in the BIBB Training panel; Shares in percent

	2011		2012		2013		2014		2015	
	Popu- lation	Data	Popu- lation	Data	Popu- lation	Data	Popu- lation	Data	Popu- lation	Data
<i>Firm Size</i>										
1 to19	89.2	32.3	89.0	31.2	88.9	30.1	88.7	29.9	88.5	19.7
20 to 99	8.7	26.0	8.8	27.7	9.0	28.0	9.1	29.1	9.3	25.0
100 to 199	1.2	11.5	1.2	12.2	1.2	13.7	1.3	12.1	1.3	12.5
200 or more	0.9	30.2	0.9	29.0	0.9	28.3	1.0	29.0	1.0	42.7
<i>Industry*</i>										
Agriculture/ mining and energy	14.0	9.0	14.1	10.5	14.2	9.5	3.4	3.6	3.5	3.4
Manufactu- ring	9.3	19.7	9.1	21.4	9.0	20.0	8.8	22.7	8.7	20.4
Construction							10.8	6.0	10.8	4.0
Trade and repair	20.9	14.0	20.7	14.0	20.5	14.0	20.2	12.4	20.0	11.1
Business ser- vices	20.2	16.3	20.4	15.4	20.8	17.8	20.9	15.2	21.1	16.1
Other	29.1	14.6	29.1	18.7	29.1	17.2				
Personal ser- vices							18.7	13.6	18.8	11.0
Medical ser- vices							10.7	12.6	10.8	19.0
Public ser- vices and education	6.6	26.4	6.6	20.0	6.5	21.6	6.4	14.3	6.4	15.0
<i>Region</i>										
West	79.1	70.6	79.2	68.4	79.2	67.4	79.3	67.7	79.4	71.70
East	20.9	29.4	20.8	31.6	20.8	32.6	20.7	32.3	20.6	28.30
<i>VET</i>										
Yes	23.6	66.0	22.1	63.1	21.0	60.9	21.1	60.4	20.7	65.8
No	76.4	34.1	77.9	36.9	79.0	39.1	78.9	39.6	79.3	34.2
<i>Overall</i>	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Continuation Table A1: Distribution of stratification variables in the population and in the BIBB Training panel; Shares in percent

	2016		2016 CATI		2017		2018		2019	
	Popu- lation	Data	Popu- lation	Data	Popu- lation	Data	Popu- lation	Data	Popu- lation	Data
<i>Firm Size</i>										
1 to19	88.2	25.7	88.2	33.4	88.0	27.1	87.7	26.5	87.5	32.2
20 to 99	9.5	28.1	9.5	29.9	9.7	30.3	9.9	29.0	10.1	26.3
100 to 199	1.3	14.0	1.3	12.7	1.3	14.1	1.4	13.0	1.4	18.8
200 or more	1.0	32.2	1.0	24.0	1.0	28.5	1.0	31.5	1.1	22.8
<i>Industry*</i>										
Agriculture/ mining and energy	3.5	3.1	3.5	3.2	3.5	3.6	3.5	3.6	3.5	4.0
Manufactu- ring	8.5	20.4	8.5	17.1	8.4	18.5	8.3	18.2	8.1	20.2
Construction	10.8	4.9	10.8	5.6	10.8	4.4	10.8	4.1	10.9	5.5
Trade and repair	19.9	11.0	19.9	12.0	19.7	10.3	19.5	10.2	19.3	12.8
Business ser- vices	21.3	15.3	21.3	17.2	21.4	15.6	21.6	14.6	21.7	16.1
Other										
Personal ser- vices	19.0	12.1	19.0	11.8	19.1	11.5	19.2	12.0	19.4	13.2
Medical ser- vices	10.8	16.0	10.8	15.7	10.8	16.6	10.8	17.4	10.7	12.4
Public ser- vices and education	6.3	17.3	6.3	17.4	6.4	19.5	6.3	19.9	6.3	15.9
<i>Region</i>										
West	79.5	72.6	79.5	71.5	79.6	71.0	79.6	70.5	79.7	73.6
East	20.5	27.4	20.5	28.5	20.4	29.0	20.4	29.5	20.3	26.5
<i>VET</i>										
Yes	20.4	60.0	20.4	53.5	20.2	57.3	20.2	55.6	20.1	53.4
No	79.6	40.0	79.6	46.5	79.8	42.7	79.8	44.4	79.9	46.6
<i>Overall</i>	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: *In 2015, the industry classification has been changed from six to eight categories.

Source: Hohn et al. 2022; Häring et al. 2017c.