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Corporate CO2 offsetting in small- and medium-seized firms in Germany

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No. 36-2021

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Andreas Ziegler**

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Firms in Germany**

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Corporate CO₂ offsetting in small- and medium-sized firms in Germany

October 2021

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Abstract

Voluntary CO₂ offsetting by individuals, firms, and organizations is increasingly considered as a direction of climate policy that is complementary to traditional approaches such as subsidies or CO₂ taxes. Based on data from a large-scale survey among corporate decision makers, this paper empirically examines corporate CO₂ offsetting and its determinants in small- and medium-sized firms in Germany. Our descriptive analysis shows both a rather limited engagement in corporate CO₂ offsetting as well as a strong lack of knowledge about its mechanism. The econometric analysis reveals that some firm-specific characteristics like the average age of the employees, firm size, and firm age matter for CO₂ offsetting. However, the main estimation results refer to the relevance of general environment-related variables like the implementation of environmental product and service innovations or the share of employees that carry out environment-related tasks and especially of climate-related factors and activities. In particular, the implementation of climate targets and the participation in the EU Emissions Trading System (EU ETS) are strongly significantly positively correlated with CO₂ offsetting. In line with similar findings at the individual level, these estimation results imply that corporate CO₂ offsetting also does not substitute or crowd out other climate protection and further pro-environmental activities, but rather complements them.

Keywords:

Corporate CO₂ offsetting, corporate climate protection and pro-environmental activities, small- and medium-sized firms

1. Introduction

According to the Paris Agreement, each country sets a target for the reduction of greenhouse gas (GHG) emissions. But even if countries are willing to achieve ambitious targets, it is not clear how they are implemented at the national level. A key challenge for national governments is the translation of targets into regulations. Previous climate policy measures such as subsidies, emission trading systems, or CO₂ taxes show that their success, among others, strongly depends on the acceptance of citizens in the respective countries (e.g. Attari et al., 2009; Lee et al., 2015; Drews and van den Bergh, 2016; Rhodes et al., 2017; Ziegler, 2019; Engler et al., 2021). However, due to the limited support and enforceability of effective and efficient climate policy measures in many countries, voluntary climate protection activities by individuals, firms, and organizations are increasingly considered as an important complementary direction of climate policy. Examples of individual or corporate activities are saving energy (e.g. by the use of energy-efficient appliances and technologies), the use of renewable energies, reducing car use and flights, or the use of climate-friendly means of transportation such as public transportation. An additional increasingly popular direction of voluntary climate protection activities is CO₂ offsetting.

CO₂ offsetting describes the financial compensation of CO₂ emissions caused by individuals or firms through, for example, vehicle use, (business) travel activities, logistics services, or energy consumption (e.g. Ziegler et al., 2012; Blasch and Farsi, 2014; Lange and Ziegler, 2017; Lange et al., 2017). There are various ways to offset CO₂ emissions. In some cases, it is possible to directly compensate CO₂ emissions, for example, when booking a flight. In this case, an additional amount must be paid depending on the CO₂ emissions incurred. Alternatively, one can seek the services of a specialized provider to offset activities that have already been carried out or will be carried out in the future. The corresponding compensation payments are typically used to financially support climate protection projects for reforestation, increasing energy efficiency, or the expansion of renewable energies in developing countries (e.g. Brouwer et al., 2008; Akter et al., 2009; MacKerron et al., 2009). Therefore, such projects can entail additional positive (local) co-benefits in terms of promoting biodiversity, reducing poverty, or enabling innovations in low-carbon sectors (e.g. MacKerron et al., 2009).

Many previous studies empirically examine CO₂ offsetting at the individual level. These studies, for example, show that many individuals are generally interested in this direction of climate protection (e.g. Schwirplies and Ziegler, 2016). However, the direct engagement in CO₂ offsetting is still rather low, which might be caused by the low level of knowledge about its

mechanism (e.g. Ziegler et al., 2012). Previous studies reveal that individual CO₂ offsetting additionally depends on several other factors such as trust in the voluntary carbon market (e.g. Akter et al., 2009), co-benefits of climate protection projects (e.g. MacKerron et al., 2009), climate change awareness (e.g. Ziegler et al., 2012), environmental values and identity (e.g. Schwirplies and Ziegler, 2016; Schwirplies et al., 2019), or further individual characteristics such as income, education, and age (e.g. Blasch and Farsi, 2014; Lange and Ziegler, 2017). Previous studies specifically suggest a complementary relationship between CO₂ offsetting and other voluntary climate protection activities (e.g. Lange et al., 2017) as well as mandatory government climate policies (e.g. Schleich et al., 2018).

In contrast to individual CO₂ offsetting, corporate CO₂ offsetting has not been extensively analyzed so far. Previous studies at the firm level instead consider, for example, general sustainability initiatives and environmental management strategies (e.g. Arimura et al., 2008; Ziegler and Seijas Nogareda, 2009; Arimura et al., 2011; Leonidou et al., 2017; Testa et al., 2018; Boiral et al., 2019) or general environmental activities like conducting environmental product and process innovations (e.g. Ziegler, 2015) without focus on climate protection. In addition, some previous studies specifically examine voluntary corporate climate protection activities beyond CO₂ offsetting (e.g. Dawkins and Fraas, 2011; Böttcher and Müller, 2016). Due to the high potential in implementing voluntary climate protection activities among firms (e.g. Fishedick et al., 2014; Kornelis et al., 2020), the analysis of the experience and motives of corporate CO₂ offsetting is certainly interesting for both small and large firms. From a policy perspective, however, the analysis of small- and medium-sized firms is especially crucial for quantifying the extent of their contribution in achieving the climate targets set in the Paris Agreement. Furthermore, the impact of small- and medium-sized firms may be multiplicative if considering the effects that corporate climate protection activities have on employees and communities around them (e.g. Norton et al., 2014; Haski-Leventhal et al., 2017; Paillé et al., 2019).

Against this background, this paper examines the extent of engagement in as well as determinants of voluntary CO₂ offsetting in small- and medium-sized firms. The contribution of our study is threefold: First, we contribute to the specific literature on CO₂ offsetting by analyzing its determinants at the firm level instead of the individual level as in many previous studies. Second, we contribute to the more general literature on corporate climate protection and other pro-environmental activities by analyzing small- and medium-sized firms instead of large firms and especially stock corporations as in previous studies. Third, our econometric analysis

is based on a unique data set from a survey among decision makers in German small- and medium-sized firms. As such, it includes a comprehensive set of explanatory factors. Besides controlling for firm-specific characteristics like firm size or firm age, we focus on climate-related variables such as the implementation of climate targets and further environment-related variables like certified environmental management systems or the implementation of environmental measures. To address a major criticism of CO₂ offsetting that it can crowd out pro-environmental activities (some critics even compare the concept of CO₂ offsetting to the old practice of buying indulgences from the Catholic Church, e.g. Kotchen, 2009; Lange and Ziegler, 2017) and can thus have a negative net impact on environmental quality (e.g. Lange et al., 2017), we specifically examine whether corporate pro-environmental activities (including climate protection activities) and corporate CO₂ offsetting are indeed substitutes or rather complements.

Our descriptive analysis shows that CO₂ offsetting as a topic has only reached a small proportion of small- and medium-sized firms in Germany, which is also reflected in the limited number of firms that have conducted voluntary CO₂ offsetting so far. The econometric analysis reveals that some firm-specific characteristics such as the average age of the employees, firm size, and firm age matter for CO₂ offsetting. However, the main estimation results refer to the relevance of climate- and further environment-related factors and activities. For example, we find a significantly positive correlation of CO₂ offsetting with the implementation of climate targets and the participation in the EU Emissions Trading System (EU ETS). With respect to environmental innovations, our analysis shows a strong significantly positive correlation between environmental product and/or service innovations and CO₂ offsetting. In addition, the share of environment-related employees in the firm is also significantly positively correlated with the probability of CO₂ offsetting. Therefore, our estimation results suggest that corporate CO₂ offsetting does not substitute or crowd out corporate climate protection and further pro-environmental activities, but rather complements them.

The remainder of the paper is organized as follows: Section 2 presents the data used in our empirical analysis. Section 3 reports the results of our descriptive and econometric analysis. Section 4 concludes and provides some policy implications.

2. Data

Our empirical analysis is based on data collected in a large-scale web survey among decision makers in small- and medium-sized firms in Germany, which were founded before 2019. The

survey was carried out in cooperation with the German market research company Psyma+Consultic GmbH (Psyma) in February and March 2021. The respondents were recruited from an online panel of decision makers in firms with headquarters in Germany. On the basis of information available to the online panel provider, invitations to participate in the survey were sent to decision makers from firms that meet the criteria for small- and medium-sized firms as defined by the European Commission (2021), i.e. less than 250 employees and a turnover between two and 50 million euros. Due to the focus of the survey on CO₂ offsetting, only decision makers informed about important environmental or sustainability-related measures in their firm (e.g. the development of environmental and sustainability strategies, general energy efficiency measures, or environmental management) were interviewed. A total of 991 people participated in the survey, with 700 interviews completed and a median interview time of about 28 minutes. For our empirical analysis, we exclude 120 of these 700 interviews because the corresponding firms are too large in terms of turnover or the number of employees according to the aforementioned definition.¹ Accordingly, we only include firms between ten and 249 employees² and a turnover of less or equal to 50 million euros in 2020.³ In addition, three other firms are excluded due to invalid answers, where, for example, decision makers did not make realistic numerical entries when asked for the number of women in the firm or reported a total number of employees engaged in environment-related jobs that exceed the total number of employees in the firm. As a result, our empirical analysis is based on data from 577 firms.

3. Empirical analysis

3.1 Descriptive analysis of corporate CO₂ offsetting

We first consider the awareness and knowledge of CO₂ offsetting. Table 1 shows that 57.71% of the surveyed decision makers have already heard of CO₂ offsetting prior to the survey.⁴ Of these 333 respondents, 34.84% rate their knowledge of CO₂ offsetting as rather high or very high, 32.73% as rather low or very low, and 32.43% are undecided (see Table 2). Thus, about

¹ Although only firms with less than 250 employees and a turnover between two and 50 million euros according to the information of the online panel provider were invited, this information is outdated for some firms, which now exceed at least one of the size thresholds for small- and medium-sized firms.

² Micro-sized firms with less than ten employees are not considered in this study since we assume that these firms compensate CO₂ emissions to a significantly lower extent due to limited financial and staff capacities.

³ Among the firms included, 42 reported turnovers of zero euros for 2020. One possible reason for this response behavior is that the respondents did not want to disclose this information. To not further reduce the sample size, we do not exclude these firms at this point, but address this point in the econometric analysis to avoid any selection bias.

⁴ All survey questions analyzed in this study are reported in the online appendix.

61.18%⁵ of all respondents have no or only little knowledge of CO₂ offsetting. These results suggest that so far the topic of CO₂ offsetting has only reached a rather small share of decision makers in small- and medium-sized firms in Germany. The observed low level of knowledge about CO₂ offsetting is also reflected in the past CO₂ offsetting activities: According to Table 3, only 14.90% of the firms have already compensated CO₂ emissions before 2018, while 22.01% have conducted offsetting activities between 2018 and 2020. In total, only 139 firms, and thus less than one quarter (24.09%), have started conducting CO₂ offsetting by 2020, although we observe a slight increase in the number of firms conducting CO₂ offsetting within the last few years.

Decision makers of firms with CO₂ offsetting activities in the last three years from 2018 to 2020 were also asked which types of self-generated CO₂ emissions their firm has previously offset (the selection of multiple types was possible).⁶ Accordingly, most of these firms have compensated emissions from their energy consumption (48.03%), followed by emissions from car travel for business trips (45.67%), logistics services for the firm (45.67%), flights for business trips (38.58%), stays in hotels or other overnight accommodation during business trips (37.01%), and long-distance bus travel for business trips (31.50%). 10.24% have compensated all emissions from the firm within a given time period and only 2.36% have compensated further emissions not listed before. The vast majority of firms (70.08%) has used a provider for CO₂ offsets (e.g. atmosfair, myclimate) to conduct their offsetting activities. A smaller share of firms has conducted direct payments to a climate protection project (41.73%) and 31.50% have compensated emissions by directly paying extra when booking a specific activity (e.g. when booking a flight).⁷

We also asked all respondents about their firm's future willingness to conduct CO₂ offsetting. Table 4 shows that a clear majority (89.93%) of the 139 firms that have already conducted CO₂ offsetting in the past is also willing to offset CO₂ emissions in the future. Only 6.47% are no longer willing to carry out CO₂ offsetting in the future and the remaining 3.60% are unsure. Considering firms that have not conducted any CO₂ offsetting so far, 32.02% are willing to offset CO₂ emissions in the future, while 30.06% are not willing to do so and the largest share

⁵ Here, we consider all respondents that have never heard of CO₂ offsetting before and those with rather or very low knowledge: $(244+94+15)/577 = 0.6118$ (or 61.18%).

⁶ The categories presented to the respondents were as follows: 1) emissions from flights for business trips, 2) emissions from stays in hotels or other overnight accommodation during business trips, 3) emissions from car travel (incl. rental car travel) for business trips, 4) emissions from long-distance bus travel for business trips, 5) emissions from logistics services (shipping) for your firm, 6) emissions from the energy consumption of your firm, 7) all emissions from your firm within a period of time, and 8) other.

⁷ Again, respondents could indicate multiple categories.

of 37.92% is not sure about this point. Thus, we find a moderate willingness for CO₂ offsetting among firms that have not yet carried out such activities. However, these figures also imply a considerable potential for future corporate CO₂ offsetting, as the vast majority (i.e. 32.02% + 37.92% = 69.94%) of all firms that have not yet carried out any CO₂ compensations do not categorically rule out such activities in the future.

3.2 Econometric analysis

3.2.1 Dependent variables

To analyze the determinants of corporate CO₂ offsetting, we consider two of the answers respondents gave in the survey about their firm's CO₂ compensations in the past (see Table 3). The dummy variable 'CO₂ offsetting in the past' takes the value one if the respondents indicated that their firm has conducted CO₂ offsetting either before 2018 and/or between 2018 and 2020. The variable takes the value zero if the respondent answered "no" both times, "no" and "don't know," or "don't know" and "no," respectively. As treating "don't know" answers in the same way as "no" answers could influence the results of our econometric analysis, we also construct a second dummy variable 'CO₂ offsetting in the past (without don't know answers).' This variable is identical to the previous variable except that those respondents who did not know whether their firm has conducted CO₂ offsetting in the past are treated as missing data.⁸ The upper part of Table 5 reports selected descriptive statistics for these two dependent variables. In line with our description in the previous section, the mean of 'CO₂ offsetting in the past' is 0.2409, which indicates that less than one quarter of all firms in the sample has offset some CO₂ emissions yet. The mean of 'CO₂ offsetting in the past (without don't know answers)' is calculated with only 495 observations and therefore slightly higher (0.2808) than for the previous case, where all observations are considered.

3.2.2 Explanatory variables

Our selection of potential explanatory factors for corporate CO₂ offsetting is based on previous empirical findings in the field of corporate environmental management, but also on studies

⁸ The dummy variable 'CO₂ offsetting in the past (without don't know answers)' takes the value one if the firm has ever conducted CO₂ offsetting before 2018 and/or between 2018 and 2020, and the value zero if CO₂ offsetting has not been carried out in either of the two periods. Cases in which respondents indicated either "don't know" both times, "no" and "don't know," or "don't know" and "no" are treated as missing values.

analyzing CO₂ offsetting among individuals. For a better overview, we distinguish in the following between a) climate-related variables, b) further environment-related variables, and c) firm-specific characteristics.

Climate-related variables

We first aim to capture the vulnerability of firms due to climate change. We thereby address findings showing that an exposure to climate change affects corporate climate activities (e.g. Chrischilles and Mahammadzadeh, 2014). To this end, we asked the respondents to indicate the extent to which their firm's business has been affected by climate change over the last ten years since 2010. The five ordered response categories were 'not at all affected,' 'rather little affected,' 'undecided,' 'rather strongly affected,' and 'very strongly affected.' The dummy variable 'affected by climate change' takes the value one if the decision makers selected 'rather strongly affected' or 'very strongly affected,' and zero otherwise. We further take into account results showing that (some) corporate climate change targets are correlated with reductions in GHG emissions (e.g. Dahlmann et al., 2019) or that the commitment to climate change action is positively related to corporate GHG performance (e.g. Littlewood et al., 2018). The corresponding dummy variable 'climate targets' takes the value one if the firm has formulated specific goals for its own climate protection activities, and zero otherwise. Finally, we also consider the role of climate-related regulatory measures by constructing the dummy variable 'EU ETS' that takes the value one if the firm participates in the EU ETS, and zero otherwise. The second part of Table 5 shows that almost 17% of the decisions makers indicated that their firm has been rather or very strongly affected by climate change over the last ten years. More than 28% of the firms have formulated specific targets for climate protection activities and about one eighth of firms participates in the EU ETS.

Further environment-related variables

In addition to variables specifically related to climate change, we also consider further environment-related variables. Previous studies show that organizational environmental measures and specifically the implementation of environmental management systems (e.g. ISO 14001) are positively related to a firm's commitment to reduce their GHG emissions (e.g. Böttcher and Müller, 2016), to reduce other environmental impacts (e.g. Arimura et al., 2008), or to conduct voluntary environmental activities (e.g. Arimura et al., 2011). We consider three different variables to capture organizational environmental measures: The dummy variable 'EMAS or ISO 14001' takes the value one if the firm or (at least) one site of the firm has implemented a certified environmental management system according to EMAS or ISO

14001, and zero otherwise. The dummy variable ‘uncertified environmental management system’ takes the value one if the firm or (at least) one site of the firm has implemented an environmental management system that has not been certified according to EMAS or ISO 14001, and zero otherwise. We additionally asked the decision makers to indicate those of the following five types of environment-related non-financial matters on which their firm regularly collects information: a) emissions of CO₂, b) emissions of other pollutants (e.g. nitrogen oxides), c) share of renewable energies in the total energy consumption, d) total water consumption, and e) amount of waste. The variable ‘number registered environmental indicators’ indicates how many of these different indicators are registered in each firm and thus can range between zero and five.

Previous studies also suggest a positive correlation between corporate environmental and social motivations and the commitment to reduce GHG emissions (e.g. Boiral et al., 2012) or between corporate environmental performance and voluntary climate change disclosure (e.g. Dawkins and Fraas, 2011). Likewise, at the individual level, environmental awareness and identity (e.g. Schwirplies and Ziegler, 2016; Schwirplies et al., 2019) and some pro-environmental activities (e.g. Lange et al., 2017) tend to be positively correlated with individual CO₂ offsetting. Therefore, we additionally take specific voluntary corporate environmental activities into account. To this end, we asked the decision makers to indicate which of the following environmental protection measures are regularly carried out in their firm: a) environmental audits, b) reporting of emissions (e.g. CO₂), c) environmental training for employees, d) use of renewable energies, e) use of environmentally friendly office materials (e.g. use of recycled paper), e) supporting the use of environmentally friendly means of transportation by employees (e.g. promoting the use of public transport and rail via job tickets or for business trips), and f) other measures. The variable ‘number environmental measures’ indicates the total number of different voluntary environmental protection measures regularly carried out in the firm and can thus range between zero and six.

Additionally, we refer to previous studies finding a positive relationship between environmental innovations and other corporate environmental activities (e.g. Rehfeld et al., 2007; Ziegler and Seijas Nogareda, 2009; Ziegler, 2015) and include two corresponding variables in our econometric analysis. The dummy variable ‘environmental product and service innovations’ takes the value one if the firm has carried out at least one environmental product and/or service innovation in the last three years between 2018 and 2020, and zero otherwise. In the same manner, the dummy variable ‘environmental process and procedure innovations’ takes the

value one if the firm has implemented at least one environmental process and/or procedure innovation in the past, and zero otherwise. Finally, we also include the variable ‘share environment-related employees,’ which measures the ratio between the number of employees that deals directly with information, technologies, or materials that maintain or restore environmental quality and the total number of employees in the firm. We thereby address empirical evidence of a positive relationship between employees’ awareness of environmental issues and corporate climate protection activities (e.g. Damert and Baumgartner, 2018a).

The third part of Table 5 shows that 31.02% of the firms have a certified environmental management system, while 6.41% have an uncertified environmental management system. On average, firms register about 1.8 of the five environmental indicators⁹ and conduct about 2.2 of the six environmental measures¹⁰ listed above. Moreover, almost one third has conducted environmental product and/or service innovations in the last three years from 2018 to 2020, and a slightly lower share (29.46%) has conducted environmental process and/or procedure innovations. The average share of environment-related employees among all employees is 15.93%.

Firm-specific characteristics

We also consider a variety of firm-specific characteristics. Previous studies consider the share of women and younger employees in firms with respect to corporate climate issues (e.g. Ciocirlan and Pettersson, 2012). We thus include the variable ‘share female employees,’ which is the ratio between the number of female employees and the total number of employees. The dummy variable ‘average age employees up to 34 years’ takes the value one if the average age of employees in the firm does not exceed 34 years.¹¹ Previous findings further suggest that firm size is correlated with the engagement in environmental management practices (e.g. Uhlaner et al., 2012) and the implementation of low-carbon practices and climate change strategies (e.g. Böttcher and Müller, 2015; Damert and Baumgartner, 2018b). This is attributed to the availability of resources, including knowledge and financial funds, which tend to increase not only with firm size, but also with the years of existence in the market.

⁹ Most firms collect information on their total water consumption and amount of waste (53.25% and 53.90% respectively), followed by information on the share of renewable energies, emissions of CO₂, and emissions of other pollutants (e.g. nitrogen oxides), which are collected by 31.02%, 25.65%, and 17.50% of the firms, respectively.

¹⁰ Most firms (62.91%) use environmentally friendly office materials, followed by the use of renewable energies (48.53%), the support of environmentally friendly means of transportation by employees (35.36%), and the provision of environmental training for employees (31.20%). The other measures are negligible.

¹¹ We use the threshold of 34 years of age for differentiating between young and old employees. This approach is in line with a report on this topic from the German Statistical Agency (e.g. Günther und Gawronski, 2018).

Against this background, the dummy variable ‘number employees over 49’ takes the value one if the firm has more than 49 employees, which corresponds to the threshold of small- to medium-sized firms. In addition, the dummy variable ‘average turnover over ten million euros’ takes the value one if the average annual turnover for the years between 2018 and 2020 exceeds 10 million euros (again, in line with the threshold of small- to medium-sized firms), and the variable ‘log firm age’ is the natural logarithm of the years of activity.¹²

Finally, we aim to capture regional and sector-specific differences. The dummy variable ‘Eastern Germany’ takes the value one if the headquarter or head office of the firm is located in one of the Eastern German federal states. We also asked the decision makers to indicate to which sector¹³ their firm belongs. We construct dummy variables for the four sectors with the highest number of firms in our sample, namely “manufacturing or production of goods,” “constructions,” “health and social care,” and “information and communication.” Accordingly, the dummy variables ‘manufacturing sector,’ ‘construction sector,’ ‘health sector,’ and ‘information communication sector’ take the value one if the firm belongs to the corresponding sector, and zero otherwise, respectively. The bottom part of Table 5 shows that on average 41.82% of the employees are female and that in 16.12% of the firms the average age of employees does not exceed 34 years. Moreover, almost 56% of the firms have more than 49 employees, while 32.41% have an average annual turnover of over 10 million euros for the years between 2018 and 2020. The average firm age is about 35 years. In addition, about one quarter of the firms is based in Eastern Germany and 14.38%, 9.18%, 8.66%, and 8.32% are active in the manufacturing, construction, health, and information and communication sectors, respectively.

3.3 Results

To address the binary nature of our two dependent variables, we use binary probit models in our econometric analysis.¹⁴ Table 6 reports the estimates of average marginal and discrete probability effects¹⁵ in binary probit models based on two different model and sample specifications for both dependent variables.¹⁶ The estimation results for models (1) and (2) are

¹² Firms founded after 2018 are excluded from our analysis since they cannot provide information on CO₂ offsetting conducted before 2018, which is a crucial component for constructing our dependent variables.

¹³ According to the classification of the German Federal Statistical Office (Statistisches Bundesamt, 2008).

¹⁴ We use the statistical software package Stata 15 for our econometric analysis.

¹⁵ We use the term “effect” as it is common in econometric analyses. However, some relationships between the dependent and explanatory variables should rather be interpreted as correlations instead of causal effects.

¹⁶ ‘CO₂ offsetting in the past’ is the dependent variable in models (1) and (3), while ‘CO₂ offsetting in the past (without don’t know answers)’ is the dependent variable in models (2) and (4).

based on the same (full) sample as considered in the descriptive analysis.¹⁷ In both specifications, we include all previously mentioned explanatory variables, except ‘average turnover over ten million euros’ since this sample comprises firms indicating no turnover for 2020. To test the robustness of the estimation results, we omit the firms with indicated zero turnover in 2020 (see Section 2) in models (3) and (4), reducing the sample sizes to 535 and 459, respectively. In these models we consider the explanatory variable ‘average turnover over ten million euros’ as alternative indicator for firm size (and exclude ‘number employees over 49’).¹⁸ Overall, comparing the estimation results across the different model specifications reveals that most of the estimated average marginal and discrete probability effects are very similar in terms of their direction and statistical significance. Differences in the estimation results between the model specifications are discussed in the following.

Climate-related variables

Concerning our climate-related variables, we find no evidence that the vulnerability of firms by climate change in the past is correlated with CO₂ offsetting. Instead, we find that both the implementation of climate targets and the participation in the EU ETS are significantly positively correlated with CO₂ offsetting. In terms of economic significance, the estimation results in model (1) imply that firms having formulated specific goals for their own climate protection activities are on average 13.37 percentage points more likely to conduct CO₂ offsetting than their counterparts. This finding is in line with previous studies revealing a positive correlation between (some) corporate climate change targets or the commitment to climate change action (which includes specific goals and targeted measures to reduce GHG emissions) and corporate GHG performance (e.g. Littlewood et al., 2018; Dahlmann et al., 2019). Remarkably, the estimated probability effect of ‘EU ETS’ is even higher: The estimation results in model (1) imply that firms participating in the EU ETS are on average 26.80 percentage points more likely to conduct CO₂ offsetting than non-EU ETS firms.¹⁹ In sum, the estimation results thus suggest that corporate CO₂ offsetting does not substitute corporate climate protection activities, but rather complements them.

¹⁷ That is, we consider all firms with less than or equal to 50 million euros turnover in 2020.

¹⁸ To test the robustness of our econometric results, we have also considered a model specification with both explanatory variables ‘number employees over 49’ and ‘average turnover over ten million euros’ besides all other explanatory variables. While the corresponding estimation results (which are available upon request) are qualitatively very similar to the case of exclusively including one variable for firm size, it should be noted that ‘number employees over 49’ and ‘average turnover over ten million euros’ are highly correlated with a correlation coefficient of 0.54 so that multicollinearity problems occur in this case.

¹⁹ Further estimations reveal that EU ETS firms which have formulated climate targets are on average even about 47 percentage points more likely to conduct CO₂ offsetting than non-EU ETS firms without climate targets.

Further environment-related variables

With respect to organizational environmental measures, we find no significant correlation between ‘number registered environmental indicators’ or ‘uncertified environmental management system’ and CO₂ offsetting. Instead, the estimated probability of CO₂ offsetting is slightly higher for firms with a certified environmental management system (i.e. EMAS or ISO 14001) compared to firms without any environmental management system. However, the corresponding parameter is only different from zero at the 10% significance level when we consider ‘CO₂ offsetting in the past’ as dependent variable. Thus, these results do not unequivocally support previous studies showing a positive correlation between the implementation of environmental management systems and corporate GHG reduction or environmental activities (e.g. Arimura et al., 2008; Ziegler and Seijas Nogareda, 2009; Arimura et al., 2011; Ziegler, 2015; Böttcher and Müller, 2016). However, in no model organizational environmental measures are negatively correlated with the estimated probability of CO₂ offsetting.

Concerning environmental activities beyond organizational measures, only environmental process and/or procedure innovations are negatively correlated with the estimated probability of CO₂ offsetting. However, the correlation is only weakly significant in model (3). In contrast, the implementation of environmental product and/or service innovations is significantly positively correlated with the probability of CO₂ offsetting in all four models. In terms of economic significance, the estimated average discrete probability effects vary between 8.35 percentage points in model (3) and 14.71 percentage points in model (2), which are not negligible. Furthermore, the number of environmental measures is weakly significantly positively correlated with CO₂ offsetting in models (3) and (4). Finally, and in line with evidence of a positive correlation between employees’ awareness of environmental issues and corporate climate activities (e.g. Damert and Baumgartner, 2018a), we find a significantly positive correlation between the share of environment-related employees and CO₂ offsetting. An increase of the share by 0.01 (i.e. one percentage point) is associated with an increase of the estimated average probability of CO₂ offsetting by values between 0.12 and 0.18 percentage points. Therefore, with the exception of environmental process and/or procedure innovations, our estimation results suggest that corporate CO₂ offsetting also seems to be a complement rather than a substitute to our other environment-related variables.

In sum, the estimation results for the climate- and further environment-related variables are strongly in line with findings of previous studies at the individual level. For example, Schwirplies and Ziegler (2016) and Schwirplies et al. (2019) reveal a positive correlation between

environmental values (measured by a scale according to the New Ecological Paradigm, see e.g. Ziegler, 2021) or environmental identity and individual CO₂ offsetting. In particular, Lange et al. (2017) show a complementary relationship between individual CO₂ offsetting and other pro-environmental activities including climate protection activities in Germany and the USA. Therefore, it seems that neither individual nor corporate CO₂ offsetting crowd out individual or corporate pro-environmental activities including climate protection activities.

Firm-specific characteristics

Concerning further firm-specific characteristics, we find a significantly positive correlation between corporate CO₂ offsetting and firm size in terms of employees, younger firms, and younger employees in the firm, respectively. The estimation result for firm size suggests that larger firms have more resources for financing CO₂ offsetting. Furthermore, it might be speculated that younger firms and firms with more young employees may have a corporate culture with a stronger focus on environmental issues. In contrast, we find no significant correlation between any of the remaining firm-specific characteristics such as the share of females in the firm and the probability of CO₂ offsetting. The only exception refers to the estimated effect for our regional dummy variable ‘Eastern Germany,’ which is significant in models (3) and (4), albeit only at the 10% significance level.

4. Conclusions and climate policy implications

Based on data from a large-scale survey among corporate decision makers in small- and medium-sized firms in Germany, this paper empirically examines corporate CO₂ offsetting and its determinants. Our descriptive analysis shows a limited number of firms in our sample that have conducted voluntary CO₂ offsetting so far. Concerning future CO₂ offsetting, most firms that have already conducted CO₂ offsetting in the past are also willing to compensate CO₂ emissions in the future. In contrast, we only find a moderate willingness to offset CO₂ emissions among firms that have not yet carried out such activities. Importantly, the limited engagement in corporate CO₂ offsetting is associated with a strong lack of knowledge about its mechanism. An important direction for climate policy to increase the extent of corporate CO₂ offsetting is therefore the promotion of systematic information campaigns on this topic. It can be expected that the provision of fundamental knowledge may reduce uncertainties and eliminate possible reservations towards CO₂ offsetting. The results of our econometric analysis, especially with respect to firm-specific characteristics like firm size, average age of the employees, and years of activity provide a good basis for targeted information allocation.

The main estimation results of our econometric analysis refer to the relevance of climate- and further environment-related factors and activities. In particular, the implementation of climate targets and the participation in the EU ETS are strongly significantly positively correlated with CO₂ offsetting. Furthermore, our econometric analysis reveals a strong positive correlation between CO₂ offsetting and environmental product and/or service innovations as well as the share of environment-related employees in the firm. In line with similar findings at the individual level, these estimation results thus imply that corporate CO₂ offsetting also does not substitute or crowd out other climate protection and further pro-environmental activities, but rather complements them. Therefore, our empirical findings do not support concerns that the availability of CO₂ offsetting has a negative net impact on environmental quality. With respect to climate policy, these estimation results suggest combined public campaigns addressing both voluntary direct corporate climate protection and further pro-environmental activities as well as corporate CO₂ offsetting to increase general corporate environmental and climate performance.

While our empirical study is, to the best of our knowledge, the first systematic empirical analysis of corporate CO₂ offsetting and its determinants based on a unique data set, we cannot clearly establish causal effects between climate protection and further pro-environmental activities on the one hand and CO₂ offsetting on the other hand. An important direction for further research is therefore to analyze the causality of this relationship based on panel data, which are not available so far, as well as on the basis of revealed instead of stated activities.

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Tables

Table 1: Awareness of CO₂ offsetting

| | Yes | No |
|--|-----------------|-----------------|
| Have you ever heard anything of CO ₂ compensations (or CO ₂ offsetting)? | 333 (57.71%) | 244 (42.29%) |

Table 2: Self-assessed knowledge of CO₂ offsetting

| | Very high | Rather high | Undecided | Rather low | Very low |
|---|---------------|----------------|-----------------|----------------|---------------|
| According to your assessment, how high is your knowledge of how CO ₂ compensations work? | 21 (6.31%) | 95 (28.53%) | 108 (32.43%) | 94 (28.23%) | 15 (4.50%) |

Note: The table only contains answers of the 333 decision makers who have already heard anything of CO₂ compensations.

Table 3: CO₂ offsetting in the past

| | | Has your firm conducted CO ₂ compensations for self-generated emissions before 2018? | | | |
|---|------------|---|-----------------|----------------|------------------|
| | | Yes | No | Don't know | Total |
| Has your firm conducted CO ₂ compensations for self-generated emissions in the last three years from 2018 to 2020? | Yes | 74 (12.82%) | 50 (8.67%) | 3 (0.52%) | 127 (22.01%) |
| | No | 9 (1.56%) | 356 (61.70%) | 11 (1.91%) | 376 (65.16%) |
| | Don't know | 3 (0.52%) | 18 (3.12%) | 53 (9.19%) | 74 (12.82%) |
| | Total | 86 (14.90%) | 424 (73.48%) | 67 (11.61%) | 577 (100.00%) |

Table 4: Willingness to conduct CO₂ offsetting in the future

| | Yes | No | Don't know | Number of firms |
|---|-----------------|-----------------|-----------------|-----------------|
| In the future, is your firm still willing to conduct CO ₂ compensations? | 125 (89.93%) | 9 (6.47%) | 5 (3.60%) | 139 |
| In the future, would your firm be willing to conduct CO ₂ compensations? | 114 (32.02%) | 107 (30.06%) | 135 (37.92%) | 356 |

Table 5: Descriptive statistics of the dependent and explanatory variables in the econometric analysis

| Variables | Number of firms | Mean | Standard deviation | Minimum | Maximum |
|---|-----------------|---------|--------------------|---------|---------|
| Dependent variables | | | | | |
| CO ₂ offsetting in the past | 577 | 0.2409 | 0.4280 | 0 | 1 |
| CO ₂ offsetting in the past (without don't know answers) | 495 | 0.2808 | 0.4498 | 0 | 1 |
| Climate-related variables | | | | | |
| Affected by climate change | 577 | 0.1698 | 0.3758 | 0 | 1 |
| Climate targets | 577 | 0.2825 | 0.4506 | 0 | 1 |
| EU ETS | 577 | 0.1265 | 0.3327 | 0 | 1 |
| Further environment-related variables | | | | | |
| EMAS or ISO 14001 | 577 | 0.3102 | 0.4630 | 0 | 1 |
| Uncertified environmental management system | 577 | 0.0641 | 0.2452 | 0 | 1 |
| Number registered environmental indicators | 577 | 1.8232 | 1.4482 | 0 | 5 |
| Number environmental measures | 577 | 2.2114 | 1.5059 | 1 | 6 |
| Environmental product and service innovations | 577 | 0.3137 | 0.4644 | 0 | 1 |
| Environmental process and procedure innovations | 577 | 0.2946 | 0.4563 | 0 | 1 |
| Share environment-related employees | 577 | 0.1593 | 0.2629 | 0 | 1 |
| Firm-specific characteristics | | | | | |
| Share female employees | 577 | 0.4182 | 0.2329 | 0 | 1 |
| Average age employees up to 34 years | 577 | 0.1612 | 0.3680 | 0 | 1 |
| Number employees over 49 | 577 | 0.5581 | 0.4970 | 0 | 1 |
| Average turnover over ten million euros | 577 | 0.3241 | 0.4684 | 0 | 1 |
| Firm age | 577 | 35.0208 | 29.1934 | 3 | 171 |
| Eastern Germany | 577 | 0.2582 | 0.4380 | 0 | 1 |
| Manufacturing sector | 577 | 0.1438 | 0.3512 | 0 | 1 |
| Construction sector | 577 | 0.0919 | 0.2891 | 0 | 1 |
| Health sector | 577 | 0.0867 | 0.2816 | 0 | 1 |
| Information communication sector | 577 | 0.0832 | 0.2764 | 0 | 1 |

Table 6: Estimates (robust z-statistics) of average marginal and discrete probability effects in binary probit models

| | All firms with less than or equal to 50 million euros turnover in the year 2020 | | All firms with less than or equal to 50 million euros turnover in the year 2020 (excluding firms indicating no turnover for 2020) | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Explanatory variables | CO ₂ offsetting in the past | CO ₂ offsetting in the past (without don't know answers) | CO ₂ offsetting in the past | CO ₂ offsetting in the past (without don't know answers) |
| Climate-related variables | | | | |
| Affected by climate change | 0.0270 (0.69) | -0.0022 (-0.05) | 0.0370 (0.93) | 0.0068 (0.16) |
| Climate targets | 0.1337*** (3.00) | 0.1841*** (3.40) | 0.1407*** (2.89) | 0.1889*** (3.13) |
| EU ETS | 0.2680*** (3.74) | 0.3413*** (3.81) | 0.2810*** (3.81) | 0.3525*** (3.79) |
| Further environment-related variables | | | | |
| Number registered environmental indicators | 0.0127 (1.05) | 0.0058 (0.43) | 0.0113 (0.89) | 0.0052 (0.36) |
| EMAS or ISO 14001 | 0.0773* (1.83) | 0.0680 (1.54) | 0.0744* (1.69) | 0.0715 (1.52) |
| Uncertified environmental management system | 0.0742 (1.23) | 0.0470 (0.80) | 0.0719 (1.13) | 0.0494 (0.79) |
| Number environmental measures | 0.0169 (1.34) | 0.0146 (1.09) | 0.0246* (1.87) | 0.0235* (1.67) |
| Environmental product and service innovations | 0.1121** (2.46) | 0.1471*** (2.90) | 0.0835* (1.88) | 0.1172** (2.34) |
| Environmental process and procedure innovations | -0.0513 (-1.61) | -0.0362 (-1.07) | -0.0614* (-1.90) | -0.0472 (-1.38) |
| Share environment-related employees | 0.1535*** (3.32) | 0.1755*** (3.53) | 0.1199*** (2.81) | 0.1267*** (2.76) |
| Firm-specific characteristics | | | | |
| Share female employees | -0.0191 (-0.30) | -0.0597 (-0.86) | -0.0755 (-1.15) | -0.1132 (-1.56) |
| Average age employees up to 34 years | 0.0939** (2.41) | 0.1040** (2.35) | 0.1003** (2.48) | 0.1083** (2.33) |
| Number employees over 49 | 0.0621** (2.25) | 0.0867*** (2.94) | - | - |
| Average turnover over ten million euros | - | - | 0.0220 (0.71) | 0.0101 (0.31) |
| Log firm age | -0.0540*** (-2.85) | -0.0422** (-2.10) | -0.0520*** (-2.70) | -0.0339 (-1.63) |
| Eastern Germany | 0.0291 (0.92) | 0.0306 (0.94) | 0.0560* (1.69) | 0.0610* (1.77) |
| Manufacturing sector | -0.0418 (-1.26) | -0.0344 (-1.00) | -0.0335 (-0.95) | -0.0185 (-0.49) |
| Construction sector | -0.0320 (-0.72) | -0.0233 (-0.50) | -0.0353 (-0.85) | -0.0382 (-0.88) |
| Health sector | -0.0241 (-0.53) | -0.0314 (-0.65) | -0.0067 (-0.13) | -0.0147 (-0.27) |
| Information communication sector | 0.0058 (0.12) | -0.0007 (-0.01) | 0.0155 (0.31) | 0.0082 (0.15) |
| Number of firms | 577 | 495 | 535 | 459 |

Notes: * (**, ***) means that the appropriate effect is different from zero at the 10% (5%, 1%) significance level, respectively.

Online appendix: Survey questions used in the empirical analysis (translated into English)

Have you ever heard anything of CO₂ compensations (or CO₂ offsetting)?

| | |
|-----|--------------------------|
| No | <input type="checkbox"/> |
| Yes | <input type="checkbox"/> |

According to your assessment, how high is your knowledge of how CO₂ compensations work?

| | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Very low | Rather low | Undecided | Rather high | Very high |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

The following two questions were used to construct the variables 'CO₂ offsetting in the past' and 'CO₂ offsetting in the past (without don't know answers)':

Has your firm conducted CO₂ compensations for self-generated emissions in the last three years from 2018 to 2020?

| | |
|------------|--------------------------|
| No | <input type="checkbox"/> |
| Yes | <input type="checkbox"/> |
| Don't know | <input type="checkbox"/> |

Has your firm conducted CO₂ compensations for self-generated emissions before 2018?

| | |
|------------|--------------------------|
| No | <input type="checkbox"/> |
| Yes | <input type="checkbox"/> |
| Don't know | <input type="checkbox"/> |

In the future, is your firm still willing to conduct CO₂ compensations?

| | |
|------------|--------------------------|
| No | <input type="checkbox"/> |
| Yes | <input type="checkbox"/> |
| Don't know | <input type="checkbox"/> |

In the future, would your firm be willing to conduct CO₂ compensations?

| | |
|------------|--------------------------|
| No | <input type="checkbox"/> |
| Yes | <input type="checkbox"/> |
| Don't know | <input type="checkbox"/> |

The first item of the following question was used to construct the variable 'affected by climate change':

In your opinion, to what extent was or is your firm's business affected by climate change during the following periods?

| Period | Not at all affected | Rather little affected | Undecided | Rather strongly affected | Very strongly affected |
|------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Over the last ten years since 2010 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| In the next ten years until 2030 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| In the time period after 2030 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

The following question was used to construct the variable 'climate targets':

Has your firm formulated concrete goals for its own climate protection measures?

Info: Such targets can include, for example, reduction targets for greenhouse gas emissions or targeted shares of renewable energy in the firm's total energy consumption.

| | |
|-----|--------------------------|
| No | <input type="checkbox"/> |
| Yes | <input type="checkbox"/> |

The following question was used to construct the variable 'EU ETS':

Does your firm participate in the European Emissions Trading Scheme (EU ETS)?

Info: In the European Union, the EU ETS sets a certain amount of greenhouse gas emissions that firms from the energy and other industry sectors are allowed to emit in total for a certain period of time. From this amount, the firms receive or purchase emission rights that they can trade among themselves on a market. After the purchase, these rights are no longer available to other firms.

| | |
|-----|--------------------------|
| No | <input type="checkbox"/> |
| Yes | <input type="checkbox"/> |

The following questions were used to construct the variables 'EMAS or ISO 14001' and 'un-certified environmental management system':

Decision makers from firms with one site:

Do you currently have an environmental management system implemented in your firm?

| | |
|-----|--------------------------|
| No | <input type="checkbox"/> |
| Yes | <input type="checkbox"/> |

Is this environmental management system certified according to EMAS or ISO 14001? (Multiple selection possible)

| | |
|--|--------------------------|
| No | <input type="checkbox"/> |
| Yes, according to EMAS (Eco-Management and Audit Scheme) | <input type="checkbox"/> |
| Yes, according to ISO 14001 | <input type="checkbox"/> |

Decision makers from firms with more than one site:

Do you currently have (at least) one environmental management system implemented in your firm or in one of your firm's sites?

| | |
|-----|--------------------------|
| No | <input type="checkbox"/> |
| Yes | <input type="checkbox"/> |

Is (at least) one environmental management system certified according to EMAS or ISO 14001? (Multiple selection possible)

| | |
|--|--------------------------|
| No | <input type="checkbox"/> |
| Yes, according to EMAS (Eco-Management and Audit Scheme) | <input type="checkbox"/> |
| Yes, according to ISO 14001 | <input type="checkbox"/> |

The following question was used to construct the variable 'number registered environmental indicators':

About which of the following non-financial matters does your firm regularly collect information? (Multiple selection possible)

| | |
|---|--------------------------|
| Emissions of carbon dioxide (CO ₂) | <input type="checkbox"/> |
| Emissions of other pollutants (e.g. nitrogen oxides) | <input type="checkbox"/> |
| Share of renewable energies in total energy consumption | <input type="checkbox"/> |
| Total water consumption | <input type="checkbox"/> |
| Amount of waste | <input type="checkbox"/> |

The following question was used to construct the variable 'number environmental measures':

Which of the following environmental protection measures does your firm regularly carry out voluntarily (i.e. not required by law)? (Multiple selection possible)

| | |
|---|--------------------------|
| Environmental audits | <input type="checkbox"/> |
| Reporting on emissions, e.g. of CO ₂ | <input type="checkbox"/> |
| Environmental training for employees | <input type="checkbox"/> |
| Use of renewable energies | <input type="checkbox"/> |
| Use of environmentally friendly office materials (e.g. use of recycled paper) | <input type="checkbox"/> |
| Supporting the use of environmentally friendly means of transportation by employees (e.g. promoting the use of public transport and rail via job tickets or for business trips) | <input type="checkbox"/> |
| None of these measures | <input type="checkbox"/> |
| Other measures, namely _____ | <input type="checkbox"/> |

The following questions were used to construct the variables ‘environmental product and service innovations’ and ‘environmental process and procedure innovations’:

Decisions makers indicating that their firm conducted product and service and/or process and procedure innovations in the last three years from 2018 to 2020 were asked the following questions. Product and service innovations were defined as follows: Product and service innovations are new or improved products or services whose components or basic characteristics (technical features, integrated software, application properties, user-friendliness, availability, customer benefits, design) differ noticeably from the products and services previously offered by your firm. The innovation must be new for your firm, but it does not necessarily have to be a market novelty. It is irrelevant who developed the innovation. The mere sale of innovations produced by other firms is not a product innovation. Moreover, we defined process and procedure innovations as follows: Process and procedure innovations are new or improved procedures and methods that have a noticeably positive effect on costs or quality. Process and method innovations can relate to manufacturing or process technologies, service delivery methods, logistics and distribution methods, information technology, support activities (e.g. office technology, administrative procedures), organizational and management methods and marketing methods. The innovation must be new to your firm, but it does not necessarily have to have been introduced by your firm first. It does not matter who developed the innovation.

By environmental innovations, we mean product and service innovations or process and procedure innovations that lead to a noticeable reduction in environmental impact. The positive environmental effects can be both an explicit goal or a side effect of the innovation. The positive environmental effects can occur either in your firm (including in sales) or in the use of the products or services by your customers or end users.

Was at least one of the product or service innovations carried out by your firm in the last three years from 2018 to 2020 an environmental innovation?

| | |
|-----|--------------------------|
| No | <input type="checkbox"/> |
| Yes | <input type="checkbox"/> |

Was at least one of the process or procedure innovations carried out by your firm in the last three years from 2018 to 2020 an environmental innovation?

| | |
|-----|--------------------------|
| No | <input type="checkbox"/> |
| Yes | <input type="checkbox"/> |

The following questions were used to construct the variables ‘number employees over 49,’ ‘share environment-related employees,’ and ‘share female employees’:

Please indicate how many people (including yourself) are currently employed in your firm (if you are not sure, please estimate):

Info: Full-time, part-time, temporary and seasonal employees are included here. Apprentices or students who are in vocational formation and have an apprenticeship or training contract, as well as employees on maternity or parental leave are not counted as employees.

| |
|---------------|
| Number: _____ |
|---------------|

Please indicate how many employees (including yourself) are currently engaged in environment-related jobs in your firm, either partially or fully (if you are not sure, please estimate):

Info: An environment-related job is one that deals directly with information, technologies, or materials that maintain or restore environmental quality. This requires specific skills, knowledge, training, or experience (e.g. checking compliance with environmental legislation, monitoring resource efficiency within the firm, promoting and selling green products and services).

Number: _____

Please indicate how many women [if the respondent is a woman, we added “including yourself”] are currently employed in your firm. You can refer here to the absolute number of women or to their share of all employees. Which value would you like to indicate?

| | |
|---------------------------------|--------------------------|
| Absolute number of women | <input type="checkbox"/> |
| Share of women in all employees | <input type="checkbox"/> |

If decision maker selected “absolute number of women”:

Please now indicate the current absolute number of women in your firm (if you are not sure, please estimate):

Info: Again, full-time, part-time, temporary and seasonal staff are included. Apprentices or students who are in vocational training and have an apprenticeship or training contract, as well as employees on maternity or parental leave are not counted as employees.

Number: _____

If decision maker selected “share of women in all employees”:

Please now indicate the current share of women in all employees in your firm (if you are not sure, please estimate):

Info: Again, full-time, part-time, temporary and seasonal staff are included. Apprentices or students who are in vocational training and have an apprenticeship or training contract, as well as employees on maternity or parental leave are not counted as employees.

Share in %: _____

The following question was used to construct the variable ‘average age employees up to 34 years’:

Please indicate the average age of all employees in your firm. Please use the following age groups for a rough estimate:

| | |
|------------------------------|--------------------------|
| Up to 34 years | <input type="checkbox"/> |
| Over 34 years up to 49 years | <input type="checkbox"/> |
| Over 49 years | <input type="checkbox"/> |

The following question was used to construct the variable 'log firm age':

Please indicate when your firm was founded?

| |
|--------------------|
| In the year: _____ |
|--------------------|

The following question was used to construct the variable 'average turnover over ten million euros':

Please indicate the annual turnover (in million euros) of your firm for the last three years from 2018 to 2020 (if you are not sure, please estimate):

| |
|--|
| Annual turnover 2018 in million euros: _____ |
|--|

| |
|--|
| Annual turnover 2019 in million euros: _____ |
|--|

| |
|--|
| Annual turnover 2020 in million euros: _____ |
|--|

The following question was used to construct the variable 'Eastern Germany':

In which federal state is your firm's headquarters or head office located?

| | |
|-------------------------------|--------------------------|
| Baden-Wuerttemberg | <input type="checkbox"/> |
| Bavaria | <input type="checkbox"/> |
| Berlin | <input type="checkbox"/> |
| Brandenburg | <input type="checkbox"/> |
| Bremen | <input type="checkbox"/> |
| Hamburg | <input type="checkbox"/> |
| Hesse | <input type="checkbox"/> |
| Mecklenburg-Western Pomerania | <input type="checkbox"/> |
| Lower Saxony | <input type="checkbox"/> |
| North Rhine-Westphalia | <input type="checkbox"/> |
| Rhineland-Palatinate | <input type="checkbox"/> |
| Saarland | <input type="checkbox"/> |
| Saxony | <input type="checkbox"/> |
| Saxony-Anhalt | <input type="checkbox"/> |
| Schleswig-Holstein | <input type="checkbox"/> |
| Thuringia | <input type="checkbox"/> |

The following question was used to construct the variables 'manufacturing sector,' 'construction sector,' 'information communication sector,' and 'health sector':

To which sector does your firm belong?

| | |
|--|--------------------------|
| Agriculture, forestry and fishing | <input type="checkbox"/> |
| Mining and quarrying | <input type="checkbox"/> |
| Manufacturing or production of goods | <input type="checkbox"/> |
| Energy supply | <input type="checkbox"/> |
| Water supply, sewerage, waste management and remediation activities | <input type="checkbox"/> |
| Construction | <input type="checkbox"/> |
| Wholesale and retail trade, repair of motor vehicles and motorcycles | <input type="checkbox"/> |
| Transport and storage | <input type="checkbox"/> |
| Accommodation and food service activities | <input type="checkbox"/> |
| Information and communication | <input type="checkbox"/> |
| Financial and insurance activities | <input type="checkbox"/> |
| Real estate activities | <input type="checkbox"/> |
| Professional, scientific and technical activities | <input type="checkbox"/> |
| Other business services | <input type="checkbox"/> |
| Public administration and defense, compulsory social security (public service) | <input type="checkbox"/> |
| Education | <input type="checkbox"/> |
| Health and social work activities | <input type="checkbox"/> |
| Arts, entertainment and recreation | <input type="checkbox"/> |
| Other service activities | <input type="checkbox"/> |
| Extraterritorial organizations and bodies | <input type="checkbox"/> |
| Other sector, namely: _____ | <input type="checkbox"/> |