// DOCUMENTATION 22-01

# ME-FINE

## MANNHEIM EUROPEAN PANEL ON FINANCIAL INDICATORS AND EMISSIONS

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Mannheim, October 2022

Leibniz Association

ZEW

# ME-FINE: Mannheim European panel on Financial Indicators and Emissions

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**Abstract**

The Mannheim European panel on Financial Indicators and Emissions (ME-FINE) is a new European company-level dataset, combining financial information from Bureau van Dijk's Orbis database with data on pollutant emissions from the European Pollutant Emission Register (EPER) and its successor, the European Pollutant Release and Transfer Register (E-PRTR). The current version of ME-FINE spans from 1998 to 2016 and focuses on companies in the manufacturing and energy supply sectors in the EU-15 plus Hungary and Norway. The dataset covers around 70 percent of observations in EPER and E-PRTR in those sectors and countries, representing about more than half of the emissions of the most common (air) pollutants.

- State of the data: 21 May 2021, sample period: 1998 – 2016
- Data sources:
  - Orbis by Bureau van Dijk
  - European Pollutant Emission Register (EPER) and European Pollutant Release and Transfer Register (E-PRTR), Database version 16

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## 1. Introduction

Since the implementation of environmental regulations in the 1970s, there has been much debate about their potential impacts on affected companies (e.g., see reviews by Brännlund and Lundgren, 2009; Ambec et al., 2013; Dechezleprêtre and Sato, 2017; Cohen and Tubb, 2018). Policy makers and company representatives fear that incomplete regulation could harm the competitiveness of domestic companies or shift pollution-intensive production processes to less stringently regulated parts of the world. There is, however, also an opposing view on the effects of environmental regulation on companies: the so-called Porter hypothesis. It argues that more stringent environmental policies can actually even have a net positive effect on the competitiveness of regulated companies because such policies may promote cost-cutting efficiency improvements and foster innovation.

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Empirical evidence on this debate is much needed. But these analyses rely on the availability of (detailed) microdata. The implementation of reporting obligations from various regulations increased the availability of data on the micro level (i.e., for generating units, facilities, plants or companies). However, these data sets are usually not combined despite the increasing efforts from researchers, other non-governmental organizations and public authorities. Thus, we aim to improve the data landscape by contributing a new dataset based on emissions data from the European Pollutant Release and Transfer Register (E-PRTR) and its predecessor European Pollutant Emission Register (EPER) and on financial data from Orbis. This newly constructed dataset allows for analyses on both environmental and economic performance of companies. Furthermore, the new data set can function as a "data hub" to connect other relevant data sets, such as the recent EU industrial emissions database that combined E-PRTR and the data from large combustion plants (LCP) or data on greenhouse gas emissions covered by the European Union Emissions Trading Scheme (EU ETS) from the European Union Transaction Log (EUTL).

## 2. Emissions data from EPER and E-PRTR

The emissions data stem from the EPER and its successor the E-PRTR. The EPER was established in 2000 (2000/479/EC) and provides data on pollution into air and water from large and medium-sized point sources (facilities). Reporting is mandatory for facilities belonging to certain economic sectors as well as exceeding capacity and pollutant-specific thresholds. The thresholds are set to cover about 90 percent of the emissions for each pollutant. Regulated facilities had to report emissions in 2001 and 2004, while those reports were published in 2004 and 2006, respectively. The E-PRTR was established by the European E-PRTR regulation in 2006 (No 166/2006) and annual reporting started in 2007 with a two-year reporting lag (first emission report published in 2009). Compared to the EPER, the E-PRTR expands number of regulated sectors (from 56 to 61) and reported pollutants (50 to 91). In particular, the E-PRTR adds reporting on emissions to the ground and disposal of waste.

The unit of observation in the EPER and the E-PRTR are facilities, which are defined in EPER as a "stationary technical unit, where one or more activities listed in Annex I to the IPPC Directive are carried out, and any other directly associated activities, which have a technical connection with the activities carried out on that site and which could have an effect on emissions and pollution" (EU Commission Decision 2000/479/EC) and in E-PRTR as "one or more installations on the same site that are operated by the same natural or legal person" (Regulation (EC) No 166/2006 of the European Parliament and the Council). Data on emissions are available according to the reporting periods, i.e., 2001 and 2004 for EPER, and annually from 2007 for E-PRTR. In this version of the dataset, our sample period ends in 2016, using database version 16 of E-PRTR from the European Environmental Agency (EEA).[5] Furthermore, we focus on facilities in the EU-15 (*Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom*), Norway and Hungary since these countries were regulated under EPER from the beginning. Furthermore, we restrict facilities to operate in the manufacturing and energy supply sectors (NACE Rev. 2: 10 – 35) to ensure sufficient overlap with companies in Orbis.[6]

[5] Downloaded from https://www.eea.europa.eu/data-and-maps/data/member-states-reporting-art-7-under-the-european-pollutant-release-and-transfer-register-e-prtr-regulation-22 in June 2019.

[6] Although Orbis is not limited to companies in the manufacturing and energy sectors, coverage in these sectors is usually better than in others (e.g., Bajgar et al., 2020).

## 3. Financial data from Orbis

The financial data on companies are based on Orbis, a private dataset provided by Bureau van Dijk. The data stem mainly from company accounts and include information on number of employees, operating revenues, profits, wage costs, book value of assets, cash flow, etc. Many researchers scrutinized the representativeness of this data set (e.g., Kalemli-Ozcan et al., 2019; Bajgar et al., 2020). Since the reporting requirements vary across countries, coverage differs across countries and sectors as well as over time. While Kalemli-Ozcan et al. (2019) describe ways to achieve nationally representative samples for some European countries, Bajgar et al. (2020) state that overall companies are rather "disproportionally large, old and productive" in their sample focusing on productivity.

The unit of observation is companies as indicated by the Bureau van Dijk identification number (BVDID). However, the financial data is often more disaggregated based on the "account level" as companies can file multiple accounts. This issue will be dealt with in Section 6. In line with the reporting period for the emissions data, we focus on the years from 1998 to 2016. We restrict the dataset to the same countries as in the emissions data (EU-15 plus Norway and Hungary). We access the BVD Orbis database through ZEW's prepared SQL database.

## 4. Methodology and merge steps

While EPER / E-PRTR provide data on facilities that belong to companies, Orbis offers data at the company level. Since a company can own multiple facilities, the two data sets can only be combined at the company level. Therefore, we aim to identify the company that owns the EPER / E-PRTR facility and aggregate emissions information on the company level.

Lacking unique company identifiers (such as VAT number, trade registry number etc.) in EPER / E-PRTR, we rely on string matching based on facility and company names as well as address information to identify the (Orbis) company possessing the EPER / E-PRTR facility as shown in Figure 1. EPER / E-PRTR provides a facility identification number (facility ID), the name of the facility and the name of its parent company. We extract Orbis identifier and company information (company name and addresses, either in national or international spelling) for each country and the selected sectors from the Orbis database.[7] Given that ownership of facilities can change over time we match facilities on an annual basis, i.e., assign a company to each EPER / E-PRTR observation. To remove duplicates, we treat observations as identical, if they display the same EPER / E-PRTR facility ID, facility name and parent company name.

[7] Initially, we extract companies with NACE Rev. 2 sectors 10 – 39.

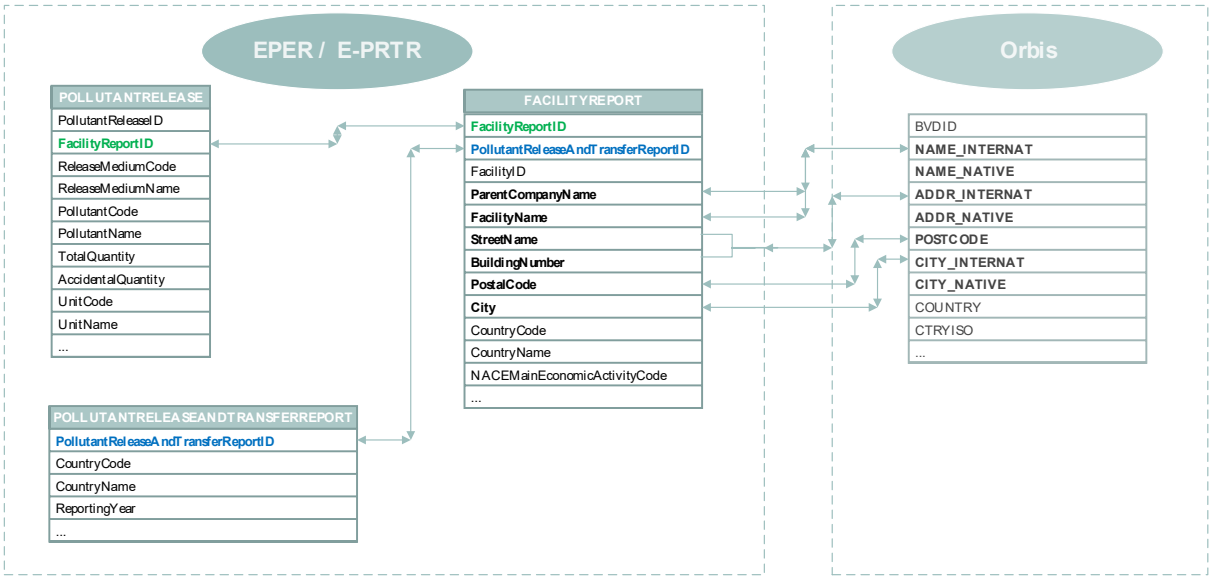


*Figure 1: Overview of merged data sets*

Our matching procedure involves several steps and involves using record linkages methods from the R package "RecordLinkage" version 0.4-11.2 (Sariyar and Borg, 2010). In particular, we restrict potential matches to have a Jarowinkler string distance of at least 0.9. We apply phonetic functions where appropriate. We harmonize address information in EPER / E-PRTR and Orbis. For each country, we check whether the information in EPER / E-PRTR is provided in national or international spelling. The name information from Orbis is chosen accordingly. Furthermore, there are differences in the availability of postcode information in the data across countries. Therefore, we check whether "reliable" and harmonized postcode information is available for the majority of companies / facilities. Given the size of (in particular the Orbis) data and to limit computational time, we use different approaches of data slices to compare names of facilities (facility name and parent company name) to company names in Orbis going from the most to least demanding in terms of information used):

1) We restrict the potential matching candidates to be located in exactly the same address defined by street name, building number, postcode (depending on the availability of reliable measures) and city.
2) The potential candidates need only to be located in the same postcode and city.
3) The names of parent company first and then facility names are directly matched to companies in Orbis (in the respective country and sectors as outlined above) with the exact same name.
4) Names of facilities are directly compared to all companies in Orbis (again in the country and sectors). Since the last step can involve a particular large amount of potential matches, we repeat this step several times adjusting for common words that are to be excluded from the comparisons.

Each step identifies a catalogue of potential matched observations and companies. After each step we check manually the potential matches (matches are checked and confirmed by two different people). Successfully identified facility observations in one step are excluded from the remaining sample before moving down the ladder to the next step. Finally, emissions of EPER / E-PRTR facilities are aggregated to the company-year level (based on BVDID) by summation.

## 5. Emissions data on the company level

The final data set combines emissions data from EPER / E-PRTR aggregated on the company level with firm-level data from Orbis. After aggregating the EPER / E-PRTR data to the company level, both datasets have a common unit of observation, namely company-year observations. The company is identified by the Bureau van Dijk company identifier (BVDID). The time period of the final data spans from 1998 to 2016, with emissions data available in 2001, 2004 and from 2007 to 2016. Those years are equivalent to the reporting years in EPER / E-PRTR.

The emissions data set includes 5,699 companies with at least one EPER / E-PRTR facility.[8] Those companies encompass 29,795 company-year observations. Thus, the average matched company that reports to EPER / E-PRTR has around five observations, for which at least one facility reports its emission. In total 7,375 facilities could be merged to a company in Orbis. However, this number is based on the facility identification number in EPER / E-PRTR, which may assign different identifier to the same facility (in particular in the transition from EPER to E-PRTR).

The emissions data set uses information from about 70 percent of observations in EPER / E-PRTR in the manufacturing and energy supply sectors. However, the geographic coverage varies across countries as can be seen in Figure 2. The figure shows the share of facility-year observations for which a company could be assigned to a facility. While some countries exhibit a fairly large coverage, such as the Netherlands (89 percent), Denmark (87 percent), Austria (86 percent), Spain and Germany (both 84 percent), the matching procedure performs rather poor for other countries (e.g. Finland with 38 percent, Greece with 39 percent and Ireland with 42 percent).

[8] Note that this and the following will only refer to the EPER / E-PRTR part of the data aggregated on the company level. Financial information from Orbis can be missing for these years.

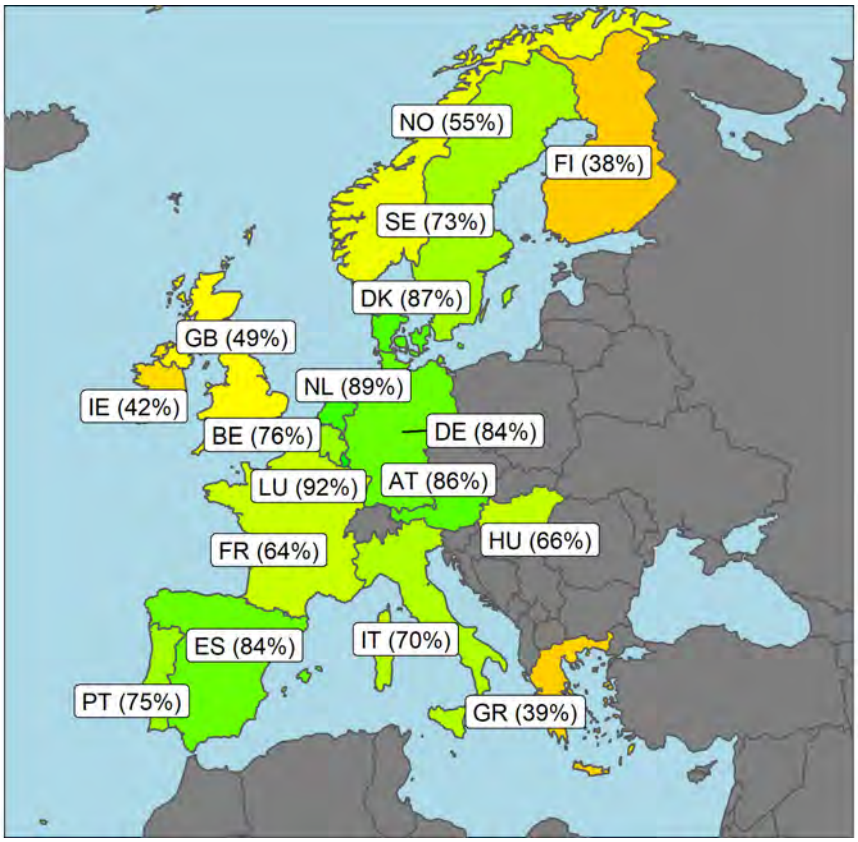


*Figure 2: Geographical coverage of emissions data*

In addition to the geographical variation in coverage, the share of matched facility-year observations varies also across sectors as can be seen in Figure 3. The value in each cell displays the share of matched facility-year observations, except for the cells in the last column. The final column in this figure provides information on the total number of facility-year observations for each country. While we are able to assign a company from Orbis to 92 percent of EPER / E-PRTR observations in Luxembourg, there are only 133 (unique) observations to be matched. In contrast, only 49 percent of observations in the United Kingdom could be merged. But these 49 percent out of a total of 5,686 observations corresponds to 2,786 matched observations.

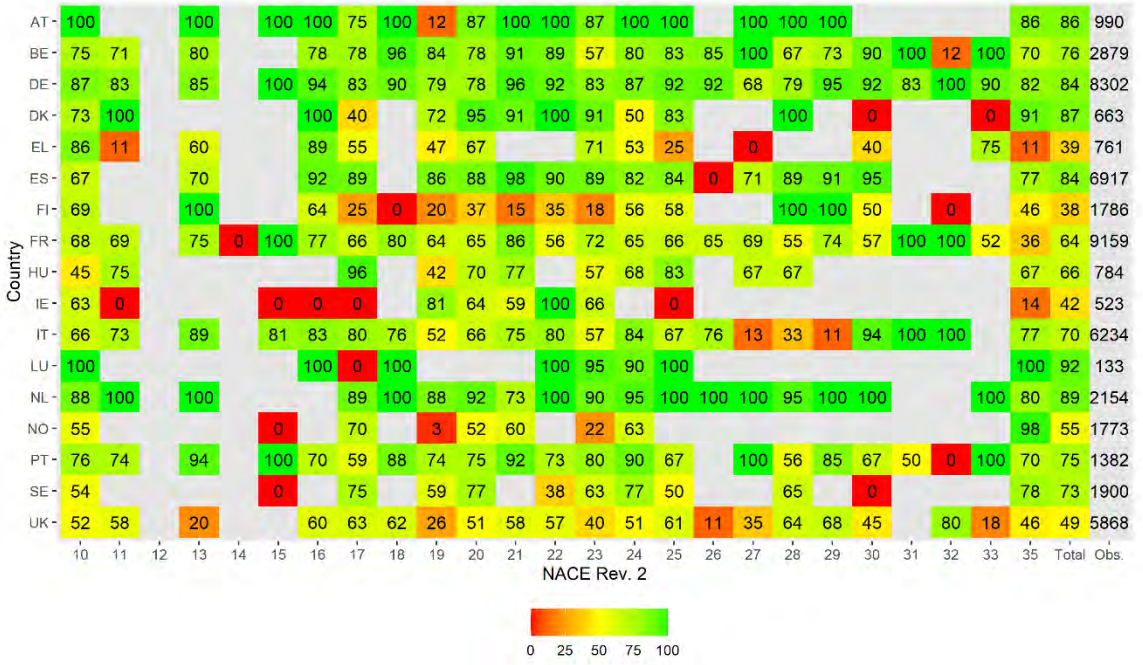


*Figure 3: Sectoral coverage of emissions data*

Figure 4 shows the twenty most common pollutants and release medium in the matched emissions data and the number of their emission reports. The top four pollutants refer to releases in the air, i.e., nitrogen oxides (NOx), carbon dioxide (CO2), non-methane volatile organic compounds (NMVOC) and sulphur oxides (SOx). While the releases of NOx are observed during the complete sample period, there has been a change in the definition of carbon dioxide from EPER to E-PRTR rendering it incomparable across the two regulations.[9] Therefore, the CO2 emission reports in Figure 4 refer only to the E-PRTR sample period from 2007 to 2016.

[9] EPER excludes CO2 emissions from biomass, which are included under E-PRTR. CO2 emissions without biomass is also reported in E-PRTR but the coverage is limited as can be seen in the figure (line 19).

| | Medium - Pollutant | Observations |
|---|---|---|
| 1 | NOX - AIR | 11003 |
| 2 | CO2 - AIR | 8038 |
| 3 | NMVOC - AIR | 5539 |
| 4 | SOX - AIR | 5395 |
| 5 | TOTAL ORGANIC CARBON (TOC) - WATER | 3371 |
| 6 | ZN AND COMPOUNDS - WATER | 3122 |
| 7 | NI AND COMPOUNDS - WATER | 3030 |
| 8 | CO - AIR | 2754 |
| 9 | ZN AND COMPOUNDS - AIR | 2633 |
| 10 | NI AND COMPOUNDS - AIR | 2536 |
| 11 | N2O - AIR | 2451 |
| 12 | PM10 - AIR | 2291 |
| 13 | HG AND COMPOUNDS - AIR | 2197 |
| 14 | CHLORINE AND INORGANIC COMPOUNDS - AIR | 2094 |
| 15 | NH3 - AIR | 1910 |
| 16 | HCFCS - AIR | 1884 |
| 17 | CU AND COMPOUNDS - WATER | 1825 |
| 18 | BENZENE - AIR | 1809 |
| 19 | CO2 EXCL BIOMASS - AIR | 1788 |
| 20 | FLUORINE AND INORGANIC COMPOUNDS - AIR | 1749 |

*Figure 4: Emission reports of companies by main pollutants (top 20)*

Turning to emissions covered instead of observations covered in the company data set, Figure 5 illustrates the emissions covered relative to overall emissions in the EPER / E-PRTR of selected pollutants in EU15 plus Hungary and Norway in manufacturing and energy supply. Overall, the emission shares of the five most common air pollutants in the sample are larger than 50 percent (except for NMVOC in some years). The shares are rather stable, with increases in coverage over time in particular for NOx.

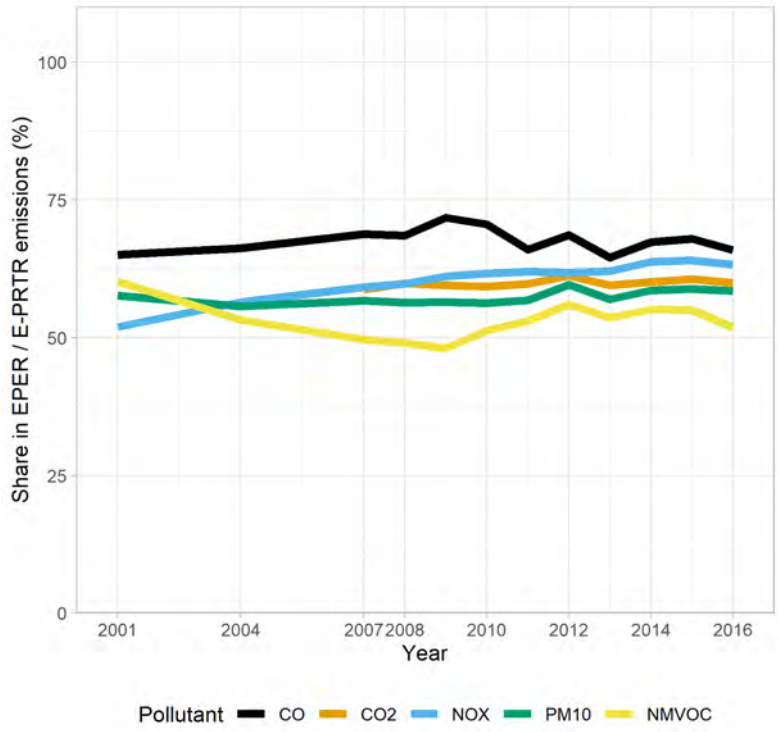


*Figure 5: Covered emissions in EU15 plus Hungary and Norway in manufacturing and energy supply*

A more detailed look at emissions coverage by countries in Figure 6 reveals that there is large variation across countries. Since there could be differences in emissions intensity of matched facilities across countries, this variation does not necessarily reflect the coverage in terms of number of observations. For example, the level of coverage of emissions data in the United Kingdom is comparable with the coverage in Italy, in spite of the fact that the data for UK contains only about 49 percent of observations matched compared to 70 percent in Italy. While for several countries the shares are rather stable over time, the large variation in some countries may point to the need of further data cleaning procedures when working with the emissions data in these countries.

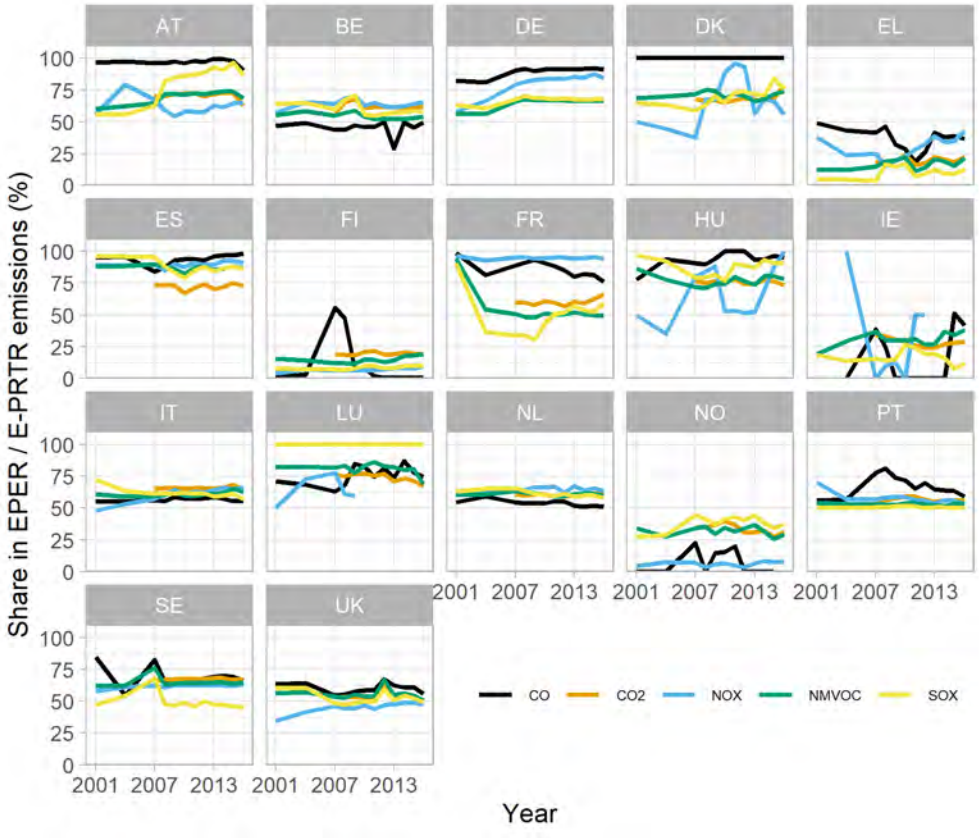


*Figure 6: Share of total emissions covered in the matched data set by country*

## 6. Preparing the final combined emissions and financial data

The previous section describes only the emissions part of the dataset, i.e. aggregated EPER / E-PRTR data for which a company could be identified in Orbis. However, this parts neglects the reporting coverage and quality of Orbis, which demand additional data cleaning procedures as suggested e.g. by Bajgar et al. (2020) and Kalemli-Ozcan et al. (2019). First, we consolidate duplicates of company-year observations in financial data, stemming from different consolidation codes. Financial information in Orbis is reported in different accounts. One major difference is whether this report refers to the unconsolidated or consolidated statements. While the latter includes the financials of the company's headquarter together with all its subsidiaries and affiliates (domestic or even abroad), the former would only include financials of the headquarter or its subsidiaries individually (Kalemli-Ozcan et al., 2019).

| Consolidation code | Definition |
|---|---|
| C1 | Consolidated account, when there is no recorded unconsolidated companion |
| C2 | Consolidated account, when there is an unconsolidated companion |
| U1 | Unconsolidated account, when there is no recorded consolidated companion |
| U2 | Unconsolidated account, when there is a recorded consolidated companion |
| LF | Limited number of financial item |
| NF | No financial items at all |

*Figure 7: Overview of consolidation codes in Orbis (source: Orbis Internet User Guide)*

Since unconsolidated accounts are more in line with standard definitions of the firm (Bajgar et al., 2020), we use unconsolidated accounts whenever those are available (codes U1 and U2 in Orbis). If there is no unconsolidated account available in a year, we refer to the consolidated account (code C1: there is no unconsolidated account), and then to accounts with limited financials (code LF). Finally, we drop consolidated accounts when there is an unconsolidated account (code C2).

Second, we drop the entire company if the financial statements show negative values for total assets, employment, sales or tangible fixed assets in any given year. Furthermore, we exclude observations with simultaneously missing information on total assets, operating revenues, sales and employment (as in Kalemli-Ozcan et al., 2019). Since larger companies are better represented in Orbis (according to Bajgar et al. 2020), we drop observations with less than 10 employees or less than 10,000 Euro in operating revenues or in total assets as well less than 1,000 Euro in tangible fixed assets. We restrict companies to have positive operating expenditures. We further set observations of financial variables to missing when there was 100-fold increase or 100-fold decrease in those values on a year-by-year level as suggested by Gal and Hijzen (2016).[10] This applies to fixed assets, tangible fixed assets, total assets, number of employees, operating revenues, sales, cost of goods sold, gross revenue, financial revenue, financial expenditures, material expenditures, wage costs and value added.

Third, we construct additional variables. We impute value added by the sum of profits (EBITDA) and wage cost following Gal (2013), generating a new variable in addition to the original variable for value added. We construct operating expenditures by subtracting operating profits from operating revenues as well as investments following Sorbe and Johannson (2017), where investment is defined as the difference in fixed assets to the previous year plus the amount of depreciation as reported in Orbis. Furthermore, we generate a variable capturing overall emissions per company and year across the different pollutants by summing up all emissions divided by their pollutant-specific threshold. Finally, we create a year variable based on convention proposed by Kalemli-Ozcan et al. (2019): if the closing date of the account is earlier or on the 31st May, we assign this observation to the previous year; from the 1st June onwards, this observation belongs to the current year. This approach addresses the issue of different accounting periods. Furthermore, we only include data with a reporting period of 12 months to exclude sub-annual reporting, such as quarterly reports. Overall, these procedures reduce the potential number of company-year observations in the matched data set by about 9 percent from 68,746 to 62,731 company-year observations.

## 7. Descriptive statistics of the final data set

Several researchers have pointed out that coverage of Orbis differs across countries and changes over time. By including only companies that own at least one EPER / E-PRTR facility in at least one year, we create a special sample that is difficult to contrast with the universe of companies in the selected countries and sectors. To investigate how coverage of financial information differs across countries and evolves over time, we investigate how many companies "enter Orbis", i.e., start reporting financial information, later than their establishment date. Therefore, we compare in our matched data set for each year the number of companies actually reporting financial information relative to the number of companies of our matched data set that we could potentially observe in Orbis (after the data preparation described in the preceding paragraphs). The two numbers could differ, if a company does

[10] Mathematically expressed: the values x are restricted to be within $100 > \frac{x_t}{x_{t-1}} > 0.01$ with t indicating years.

indeed already exist but only starts reporting financial information in Orbis in later years. We construct this number of potential companies based on their establishment year, i.e., the reporting year needs to be later than the year of establishment, and compare this number to the number of companies actually reporting financial information in Orbis. Naturally, this only includes companies that report in Orbis at least once during our sample period. Given that Orbis is known for having a wider coverage for large companies, we differentiate reporting share by the provided company size categories in Orbis in Figure 8. The figure displays stark differences in coverage[11] both across countries and over time within a country and company category. While for some countries coverage in particular for larger companies appears rather stable over time (such as for Belgium, Spain, France and UK), other countries experience an upward trend in coverage (e.g., Austria, Germany, Portugal). With the exceptions of some countries (e.g., UK), coverage of small and medium sized companies is lower than for larger companies and even deteriorating over time for some countries (e.g., Belgium Luxembourg, Norway, Hungary).

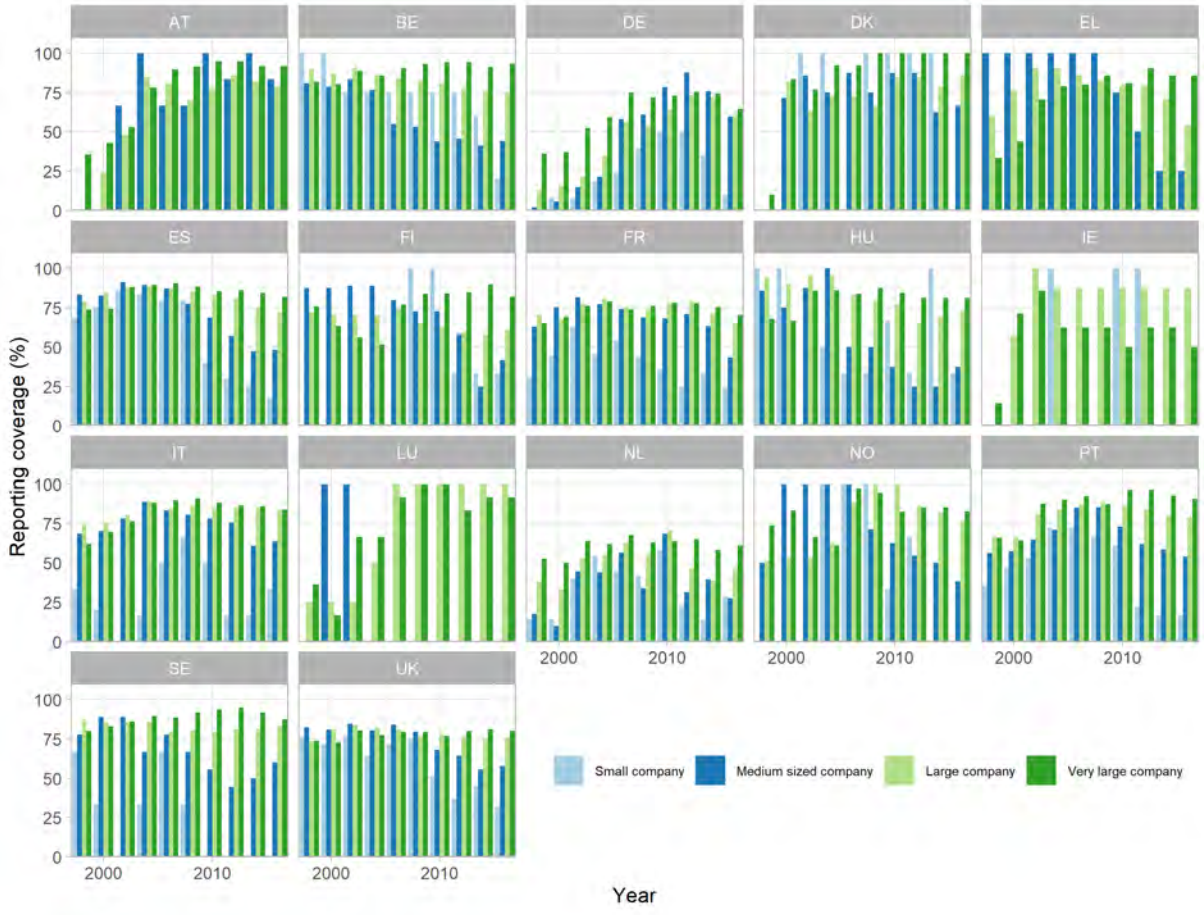


*Figure 8: Reporting coverage in Orbis over time by company size and country*

The distribution of the different consolidation codes in the sample can be seen in Figure 9. The figure shows the different shares of consolidation codes by country. The majority of observations display information from unconsolidated accounts (U1 and U2), in particular when there is no consolidated account (U1). Since the EPER / E-PRTR targets mainly large facilities, the low share of observations from

[11] Coverage is defined as number of companies actually reporting divided by number of potentially observed companies multiplied by 100.

accounts with limited financial information (LF) is not surprising. These accounts refer mostly to rather small companies with limited reporting duties. These codes have sizeable shares only in the Netherlands and in Germany.

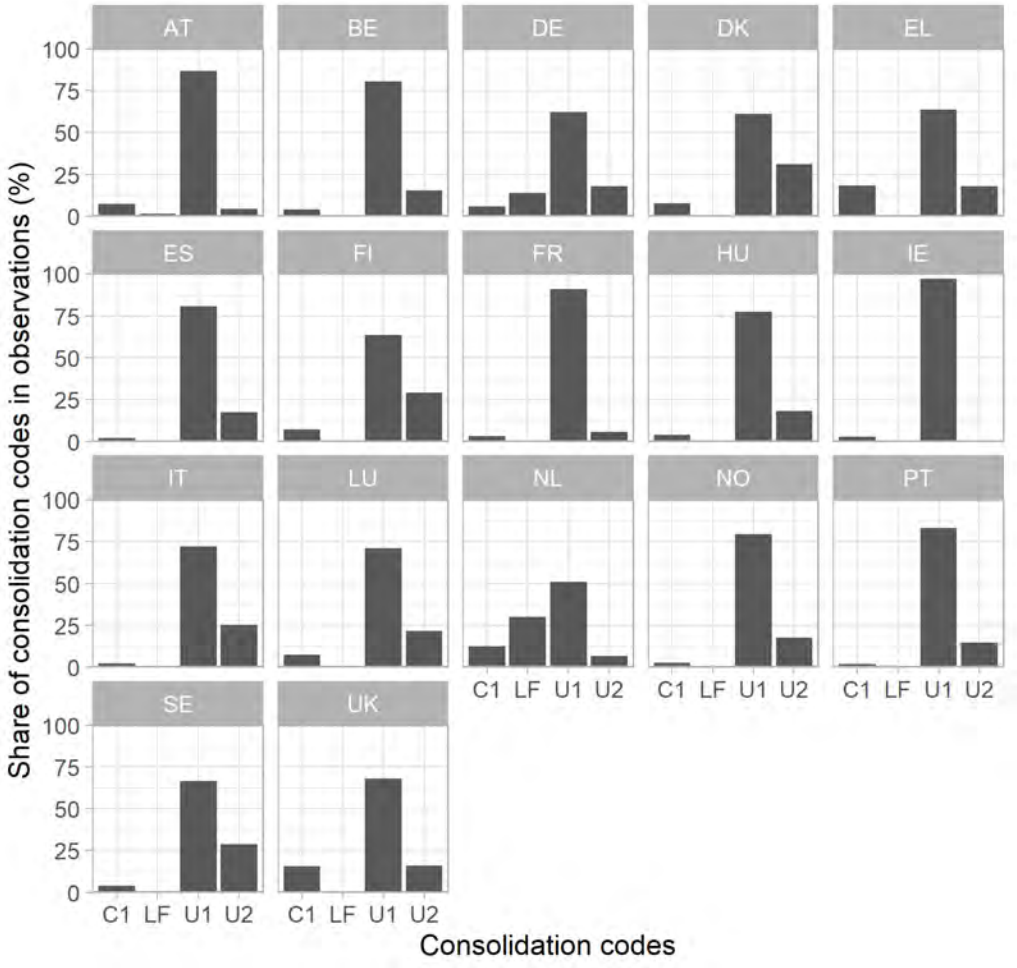


*Figure 9: Distribution of consolidation codes by country*

Figure 10 displays the distribution of all observations across two-digit NACE Rev. 2 sectors. The sample has an emphasis on companies in the sectors “Manufacture of chemicals and chemical products" (sector 20), “Manufacture of other non-metallic mineral products” (23) and “Manufacture of basic metals” (24) followed by “Electricity, gas, steam and air conditioning supply” (35), “Manufacture of food products” (10), “Manufacture of paper and paper products” (17) and “Manufacture of fabricated metal products, except machinery and equipment” (25).

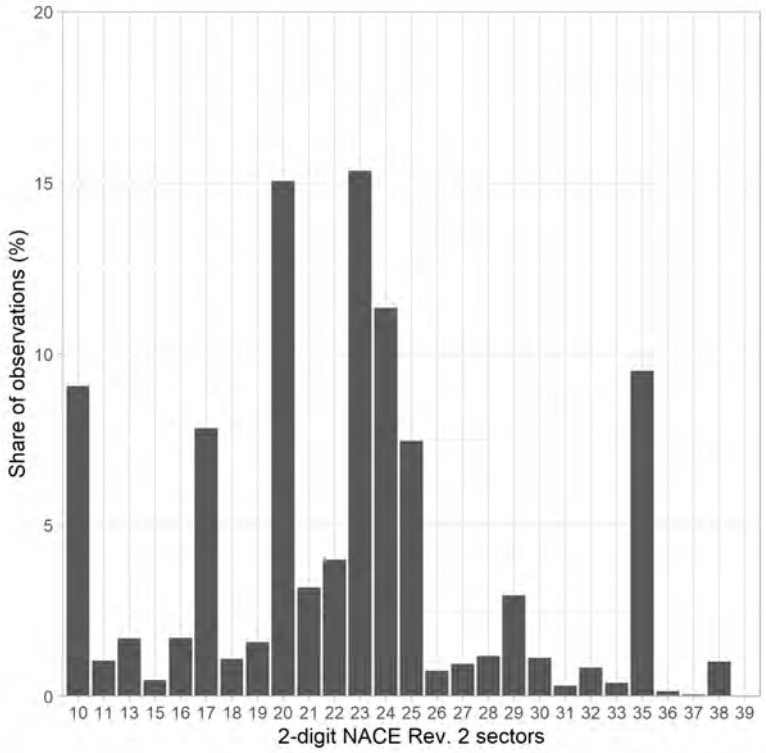


*Figure 10: Distribution of observations by sector*

In line with the statistics on the consolidation codes, the majority of the sample consists of rather large companies as shown in Figure 11, while the specific distribution differs by country.

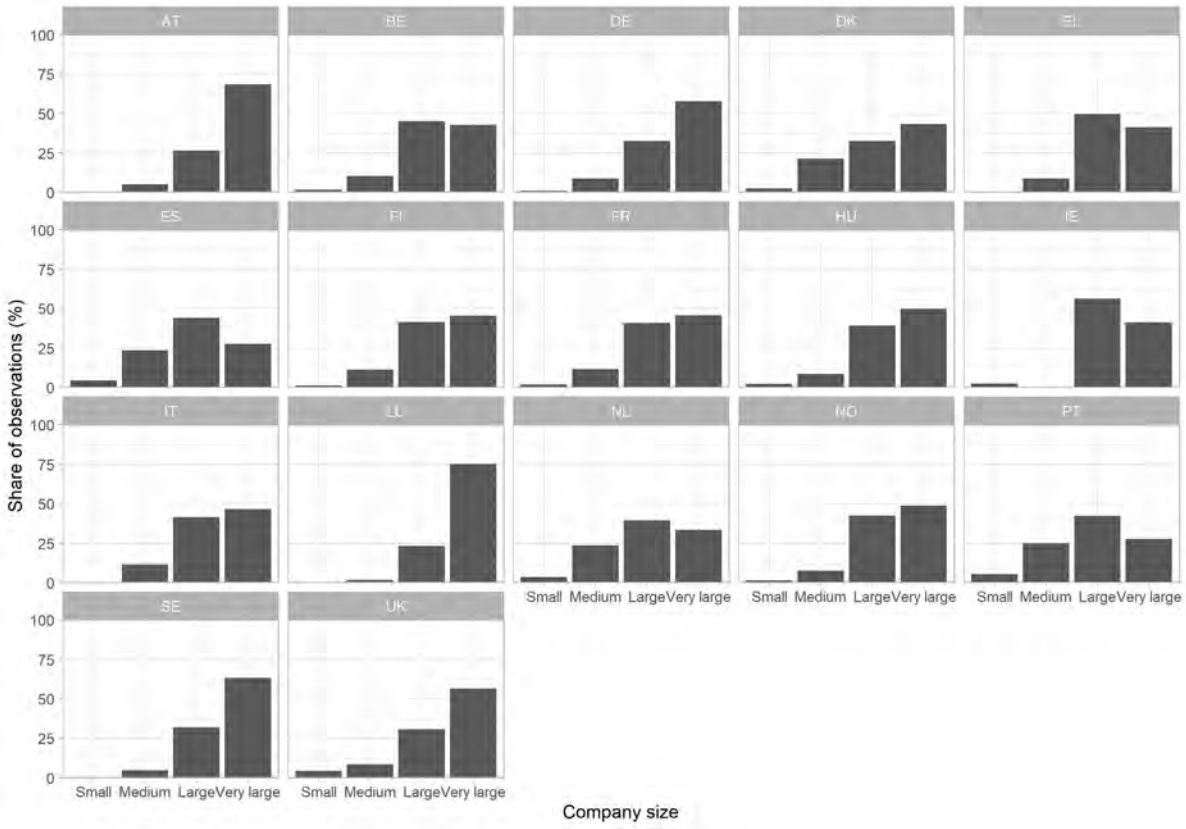


*Figure 11: Distribution by company size and country*

Table 1 contains summary statistics of EPER / E-PRTR companies in Orbis (in the manufacturing and energy supply sectors in the EU-15 plus Hungary and Norway) for operating revenues, operating expenditures, operating profits, number of employees, tangible fixed assets, materials, after-tax profits, R&D expenses and exports. The sample shows large variability since the standard deviation is larger than the mean for each of the variables. The minima for operating revenues, number of employees and tangible fixed assets reflect the values chosen in the data cleaning procedures described earlier.

*Table 1: Summary statistics on selected financial variables for the pooled sample of companies reporting to EPER/E-PRTR*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 58,210 | 4,521 | 825,608,820 | 6,416,653,468 | 10,000 | 751,904 | 69,739,158 | 14,011,809,792 | 291,699,880,724 |
| Operating expenditures (EUR) | 58,160 | 4,571 | 779,335,687 | 6,100,723,472 | 209 | 801,273 | 65,226,438 | 12,980,935,740 | 287,692,799,266 |
| Operating profits (EUR) | 59,296 | 3,435 | 49,791,086 | 497,549,091 | -8,195,095,543 | -88,219,051 | 1,905,801 | 981,433,900 | 28,162,989,000 |
| Number of employees | 52,762 | 9,969 | 2,035 | 16,041 | 10 | 12 | 220 | 35,587 | 626,715 |
| Tangible fixed assets (EUR) | 58,912 | 3,819 | 311,481,761 | 3,046,663,550 | 1,000 | 79,239 | 18,859,893 | 5,297,695,740 | 131,253,000,000 |
| Material expenses (EUR) | 44,902 | 17,829 | 314,190,264 | 3,220,423,191 | -8,661,000 | 76,404 | 28,241,416 | 4,097,018,042 | 232,194,103,326 |
| After-tax profits (EUR) | 58,810 | 3,921 | 35,451,658 | 397,800,731 | -12,420,111,000 | -101,716,365 | 1,033,000 | 756,645,157 | 21,884,000,000 |
| R&D expenses (EUR) | 3,392 | 59,339 | 208,233,390 | 745,900,023 | 0 | 0 | 2,108,668 | 4,241,354,176 | 8,591,000,000 |
| Export revenues (EUR) | 15,150 | 47,581 | 165,047,703 | 1,904,092,619 | 0 | 0 | 16,523,000 | 2,143,789,480 | 159,916,417,000 |

We now turn to trends in financial and emission indicators over time and normalize the sum of these variables across all companies in a given year with the sum in 2007 (the first reporting year of E-PRTR). For operating revenues, expenditures and profits in the different countries, Figure 12 shows large variation over time. This variation, however, is not only derived from changes within companies over time but reflects also changes in coverage and composition of the sample. Given the data cleaning procedures outlined above, there may be issues with coverage in some countries (e.g. Greece, Ireland, Luxembourg).

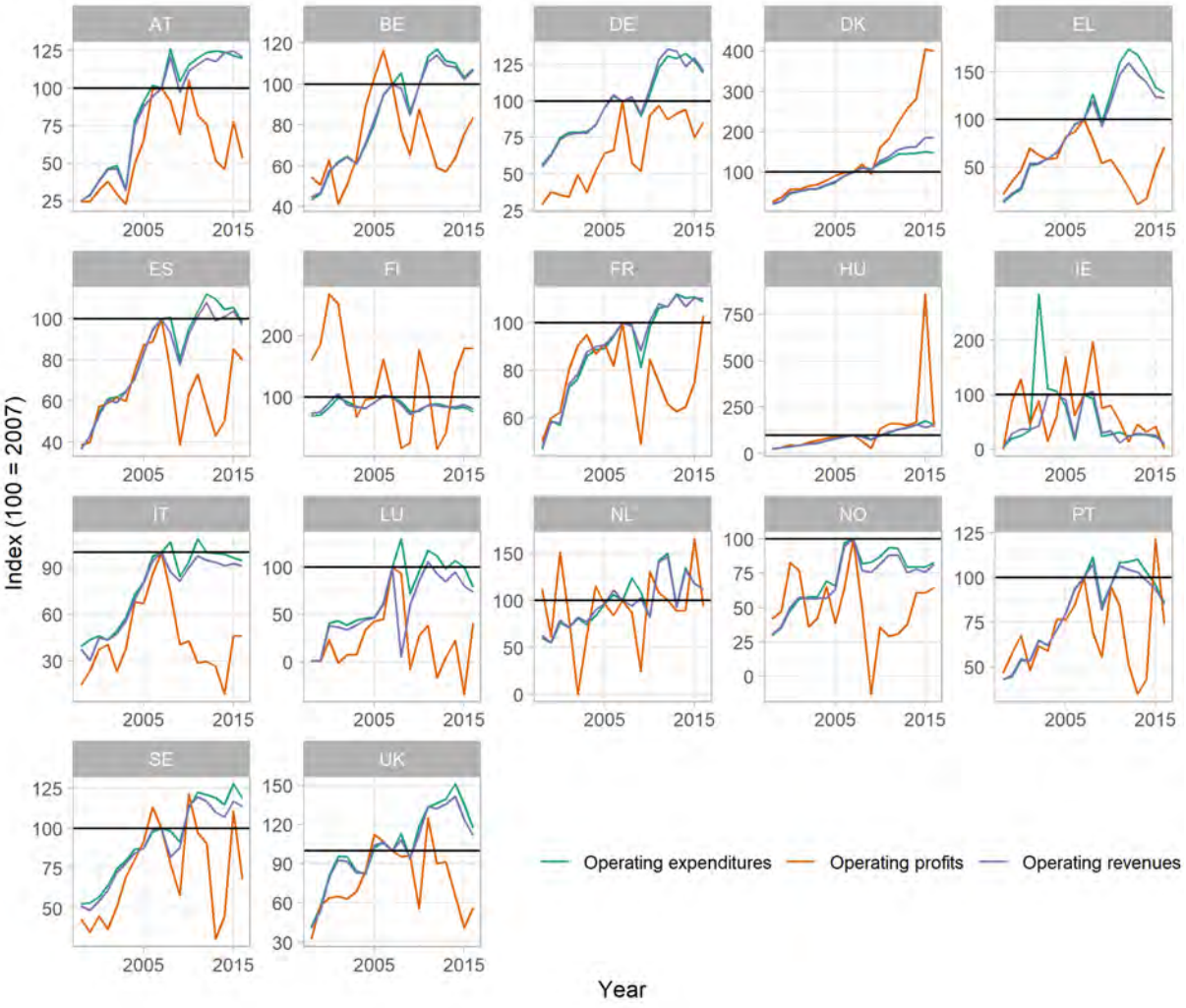


*Figure 12: Trends in total operating revenues, total expenditures and total profits compared to 2007 over all reporting companies by country*

Next, we investigate value added and the two inputs commonly used in value added production functions, namely labor (number of employees) and capital (tangible fixed assets). However, several researchers have pointed out the rather low coverage of value added in the Orbis data and have suggested ways to impute these information (as described earlier). And indeed, Figure 13 illustrates some differences in the original values and the imputed values for value added for some countries. For example, the imputed values of value added in Finland are lower the original values. Given the lower variance within a country over time and in particular outliers in some countries (e.g., Hungary, Sweden or Norway), we use the original values for value added in the following.


*Figure 13: Trends of imputed and original value added compared to 2007 by country*

Figure 14 shows trends in value added (imputed), number of employees and tangible fixed assets over time by country. Again, the variability in some countries is rather high, in particular in Spain in the beginning of the sample period, in Ireland before 2005 (tangible fixed assets) and in Norway (number of employees) in the beginning and end of the sample period.


*Figure 14: Trends in value added, number of employees and tangible fixed assets compared to 2007 by country*


*Figure 15: Trends in exports, after-tax profits and R&D expenses compared to 2007 by country*

Trends in exports, after-tax profits as well as research and development (R&D) expenses display large variability over time and across countries as can be seen in Figure 15. In particular, export revenues are only reported for a small number of countries (similar for R&D expenses).[12] Values in Ireland show once again huge variation over time, in particular in the beginning of the sample period.

[12] For example, values for exporting are reported only from 2007 onwards for companies in Ireland and from 2009 on for companies in Germany.

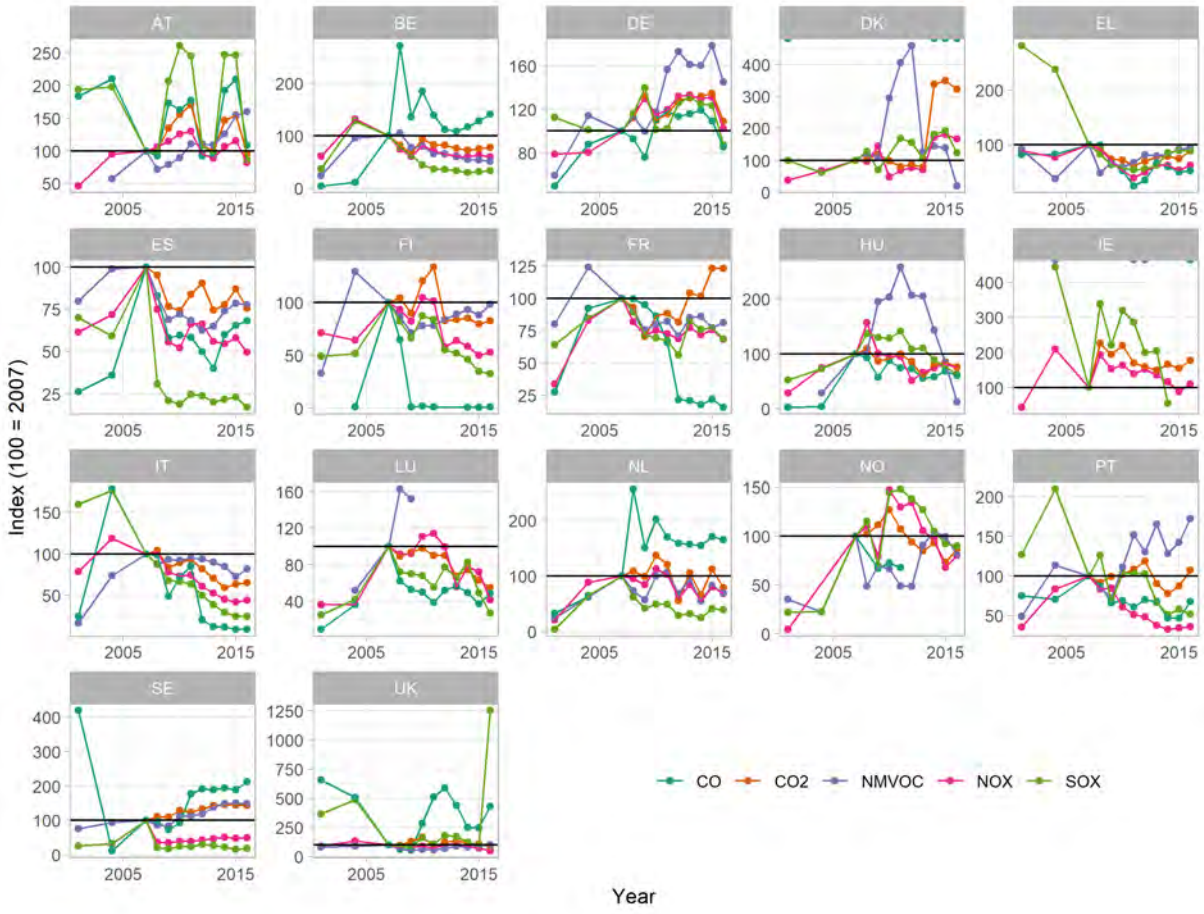


*Figure 16: Trends in the top five releases to the air by country*

The trends in the top five releases to the air are mixed across countries and pollutant as shown in Figure 16. Emissions relative to 2007 are zero in non-reporting years of EPER (2002, 2003, 2005, and 2006). While pollutants in some countries seem to decrease over time, there are also some instances in which pollutant emissions are higher than in 2007.

*Table 2: Distribution of normalized emissions over time*

| year | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| 2001 | 867 | 1,907 | 111 | 491 | 1 | 1 | 9 | 1,974 | 7,669 |
| 2004 | 1,343 | 1,967 | 80 | 360 | 1 | 1 | 7 | 1,502 | 8,478 |
| 2007 | 1,758 | 1,821 | 447 | 7,994 | 1 | 1 | 7 | 3,934 | 307,581 |
| 2008 | 1,774 | 1,822 | 274 | 3,670 | 1 | 1 | 7 | 3,131 | 112,964 |
| 2009 | 1,674 | 1,935 | 231 | 2,315 | 1 | 1 | 7 | 2,831 | 60,494 |
| 2010 | 1,790 | 1,900 | 162 | 1,787 | 1 | 1 | 7 | 1,891 | 56,365 |
| 2011 | 1,829 | 1,917 | 157 | 1,469 | 1 | 1 | 7 | 2,491 | 52,345 |
| 2012 | 1,755 | 1,928 | 193 | 3,286 | 1 | 1 | 7 | 1,753 | 129,398 |
| 2013 | 1,773 | 1,905 | 203 | 2,806 | 1 | 1 | 7 | 2,064 | 99,959 |
| 2014 | 1,743 | 1,835 | 183 | 2,326 | 1 | 1 | 6 | 1,805 | 77,798 |
| 2015 | 1,740 | 1,833 | 171 | 2,589 | 1 | 1 | 6 | 1,164 | 88,668 |
| 2016 | 1,691 | 1,706 | 174 | 2,712 | 1 | 1 | 6 | 1,014 | 93,944 |

Summary statistics on the annual distribution of normalized emissions across all countries are shown in Table 2. Normalized emissions is the variable that captures the sum of all pollutant releases

normalized by their respective threshold value in EPER / E-PRTR. Furthermore, the total number of companies with at least one emission release reported in EPER / E-PRTR is shown in column 2, while column 3 contains the number of companies that do not report any emissions in a given year. Given the normalization procedure the minimum value is limited to one, stating that no emission report is below the threshold. The range in emission reports is huge, ranging from 1 to more than 300,000. Comparing the values over time also suggests that changes from EPER to E-PRTR may be important, given the large increase in mean values from 2007 on. This could reflect the extended reporting duties, capturing more sectors and pollutants in E-PRTR compared to EPER.[13]

## 8. Evolution and decomposition of normalized emissions in ME-FINE from 2007 to 2016

As a first application and to learn more about the emission trends over time for the firms included in the ME-FINE dataset, the following section presents an index decomposition of normalized emissions from 2007 to 2016.[14] Figure 17 and Figure 18 show the evolution and drivers of normalized emissions in the ME-FINE data set for the total sample and a balanced subsample of firms, i.e., only for the firms that report emissions and output[15] for all years from 2007 to 2016.

By 2016, normalized emissions of firms fell by almost 50 percent compared to 2007 for a balanced sample of firms (see the purple line in Figure 18). For the unbalanced sample, normalized emissions decrease even more drastically by almost 60 percent (see the purple line in Figure 17). There is a steep drop in emissions in 2008 and slight downward trend afterwards (with the exception of an increase again in 2016). In this sample, however, the composition of firms is not stable over time, resulting in large shifts due to potential entry and exit of firms (or start and end of emissions reporting, respectively). For the balanced sample, we do not see this steep reduction in normalized emissions in 2008 (but rather a small temporary increase), emphasizing the point that the reductions observed in the unbalanced sample may be attributed to firms exiting the market or at least stop emissions reporting by falling below the E-PRTR reporting thresholds.[16] The coincidence with the beginning of the financial crisis may further underline this potential explanation. In the balanced sample, we observe a continuous downward trend starting in 2008 with one major reduction in 2011. In contrast to the unbalanced sample, this trend is not driven by entry and exit of firms but is reflected only by changes in emissions from a fixed set of (always reporting) firms.[17]

[13] This phenomenon could also relate to increases in reporting coverage in Orbis over time in some countries. The same development, however, can be observed for the emissions part only (ignoring availability of financial information in Orbis).

[14] This time period includes only reporting under the E-PRTR to have a stable coverage of pollutants for the computation of the normalized emissions measure and to rely on a greater coverage of firms in Orbis.

[15] Output refers to deflated operating revenues.

[16] Note again that firms need to report both emissions in E-PRTR and output in Orbis to be included in the balanced sample.

[17] Even within these firms, however, normalized emissions could be impacted by changes in reporting obligations for the individual pollutants.

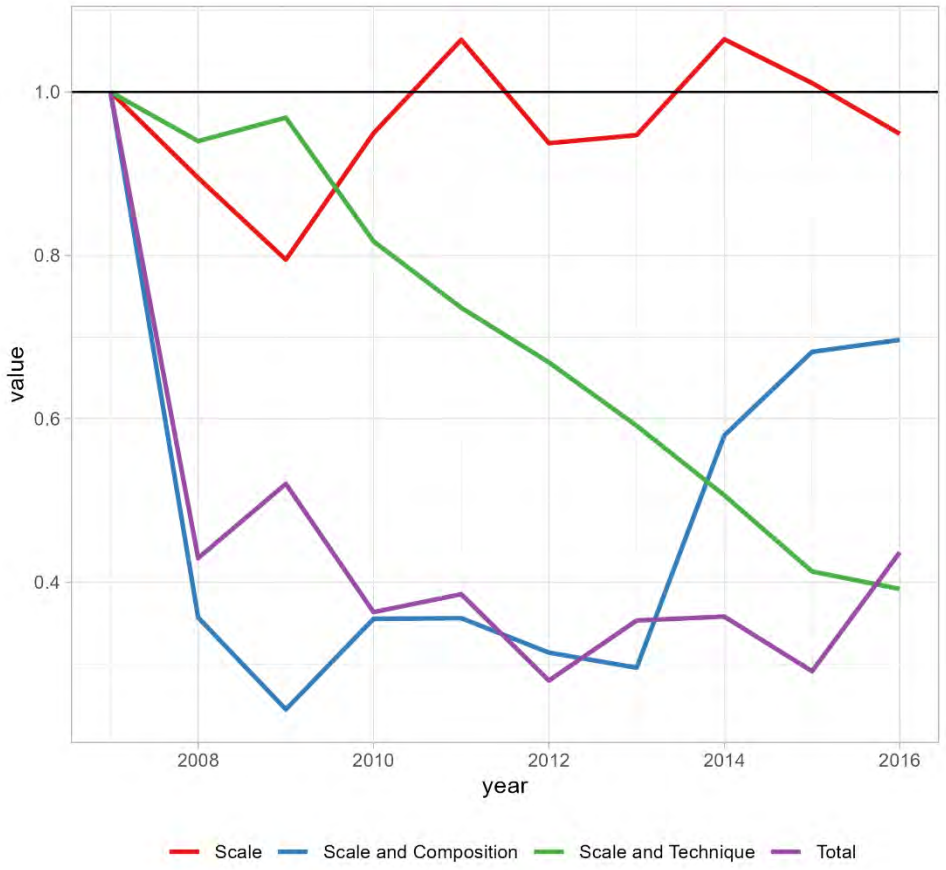


*Figure 17: Index decomposition of normalized emissions for the total sample*

But what are the main drivers of these emission developments? To answer this question, we use an index decomposition approach which divides the change in emissions into three different components: scale, composition, and technique effect (see e.g., Levinson, 2009; Brunel, 2017). First, the scale effect illustrates the change in emissions from growth in output, while holding market shares of firms in total output and firms' emission intensity constant. Second, the decomposition effect shows the part of change in emissions that is driven by reallocation of output across firms (with potentially different emissions intensities), while keeping their output and emissions intensity fixed. Third, the technique effect describes the change in emissions that results only from changes in the emissions intensity of individual firms.

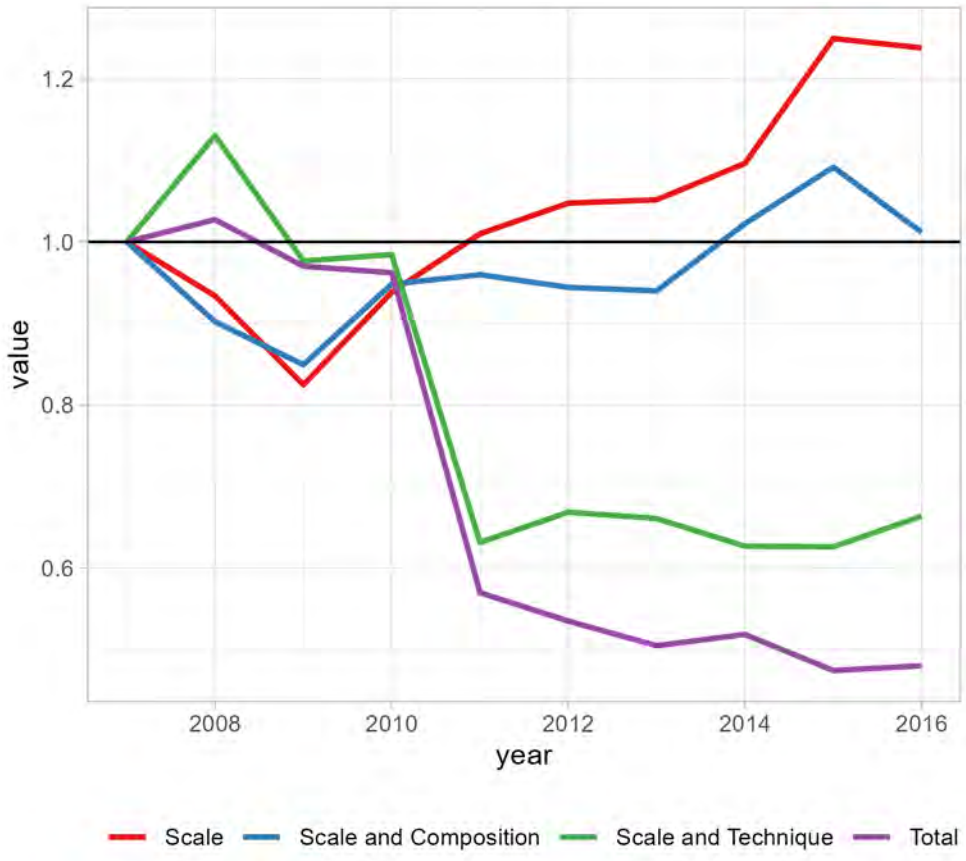


*Figure 18: Index decomposition of normalized emissions for the balanced sample*

The decomposition approach reveals that changes in firms' emission intensity (emissions divided by output) drive most of these reductions (see Figure 18). The difference between the scale effect (the red line in Figure 18) and the scale plus technique effect (the green line in Figure 18) indicates the size of the technique effect. Similarly, the difference between the red and blue line in Figure 18 shows the magnitude of the composition effect. Interestingly, the scale effect decreases until 2009 and increases afterwards, consistent with the evolution of the financial crisis. The finding of a dominant technique effect is broadly consistent with previous decomposition studies. Levinson (2009) as well as Brunel (2017) identify improvements in production technique on the industry level as main driver for emission reductions in US and EU manufacturing, respectively. Rottner and von Graevenitz (2021), however, do not find a negative technique effect for CO2 emissions in German manufacturing, but only a negative composition effect.

One advantage of an index decomposition approach at the firm level compared to a higher aggregation level, such as sectors, is the possibility to relate those trends to different characteristics of firms. Hence, we divide the balanced sample into different sub-samples based on firm characteristics. First, we can investigate emission developments and the different drivers along the productivity of firms. Therefore, we categorize firms of being on average either above or below the median of certain productivity measures. Figure 19 and Figure 20 illustrate the results for the scale and technique effect in relationship to the total effect for subsamples according to the following productivity measures: Labor productivity (as defined as output divided by number of employees), capital productivity (output divided by deflated total fixed assets), and total factor productivity (residual of a value-added

production function following Wooldridge, 2009)[18] as well as the emissions intensity (normalized emissions divided by output).

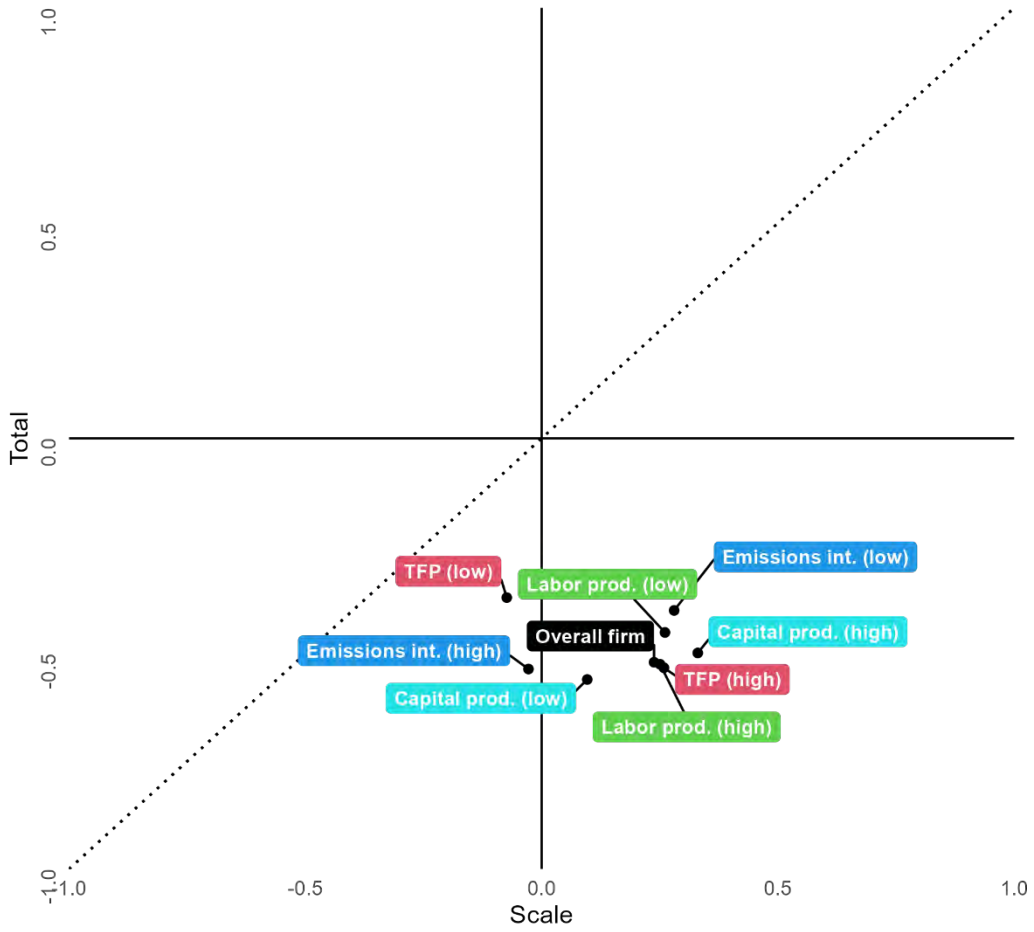


*Figure 19: Total and scale effect of normalized emissions across productivity characteristics*

Figure 19 and Figure 20 show the total and scale as well as the total and technique effect, respectively. The values shown in the figures are the values for the effect estimates in 2016 relative to 2007 minus one. This means that a value of zero indicates no change in emissions, a negative value a decrease, and a positive value an increase in emissions (either in total or for the different channels). Figure 19 shows that firms with higher total factor and capital productivity as well as lower emissions intensity have larger scale effect, i.e., they experience higher growth in output. Comparing the scale effect for different samples based on labor productivity does not reveal large differences along this productivity measure, although firms with higher labor productivity have a lower total effect (i.e., larger decrease in normalized emissions).

Since the scale effects (on the x-axis) are not equal to the total effects (on the y-axis) for the different samples, the composition and technique effects may play an important role in driving the total effects. Figure 20 illustrates the technique effects next to the total effects along the productivity measures.[19]

[18] The estimated values are highly correlated with values estimated following similar approaches (Olley and Pakes, 1996; Ackerberg et al., 2015).

[19] We do not investigate the composition effect since it only shows reallocation of output within each sample (e.g., the highly productive firms), which may be difficult to interpret.

The technique effects are closer to the total effects as indicated by their closeness to the dotted 45-degree line. Firms with higher total factor and capital productivity experience a larger decrease in emissions due to the technique effect, while for labor productivity and emissions intensity the technique effects are closer to each other.

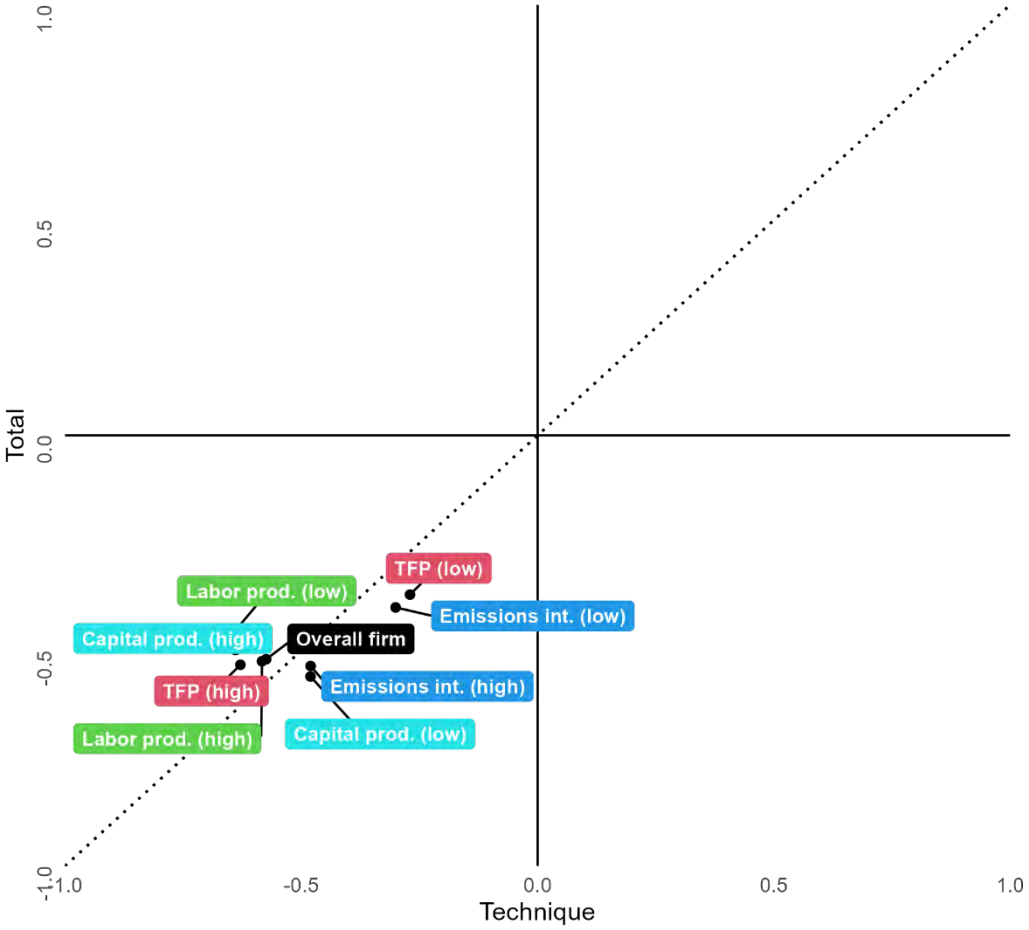


*Figure 20: Total and technique effect of normalized emissions across productivity characteristics*

There is a large literature on the relationship between trade and the environment (see e.g., Copeland and Taylor, 2004; Cherniwchan et al., 2017, for overviews). Trade can increase economic activity and thereby increase emissions through the scale effect. At the same time trade can affect real income which increases demand for environmental quality and stricter environmental policies. This process could lead to emission decreases through the technique effect. Finally, trade can impact sectoral composition and market shares of firms and thereby influence emissions through the composition effect. Unfortunately, there is only limited data on exports and trade statistics in Orbis. Therefore, we investigate the potential relationship of trade with pollutant emissions based on the trade intensity of the sectors in which the firms are mainly operating. Trade intensity of the sector within a country is defined by the country-sector's share in the country's overall trade relative to the world-sector's share in world trade:[20] $\frac{\left(\frac{Country-sector\ trade}{Country\ trade}\right)}{\left(\frac{World-sector\ trade}{World\ trade}\right)}$. We calculate these measures separately for imports, exports and

[20] We find relatively similar results when we relate the sector trade to the country and world gross domestic product, respectively.

total trade (imports plus exports) and we divide firms in different samples whether their main sectors are above or below the median trade intensity of the sectors in the sample.

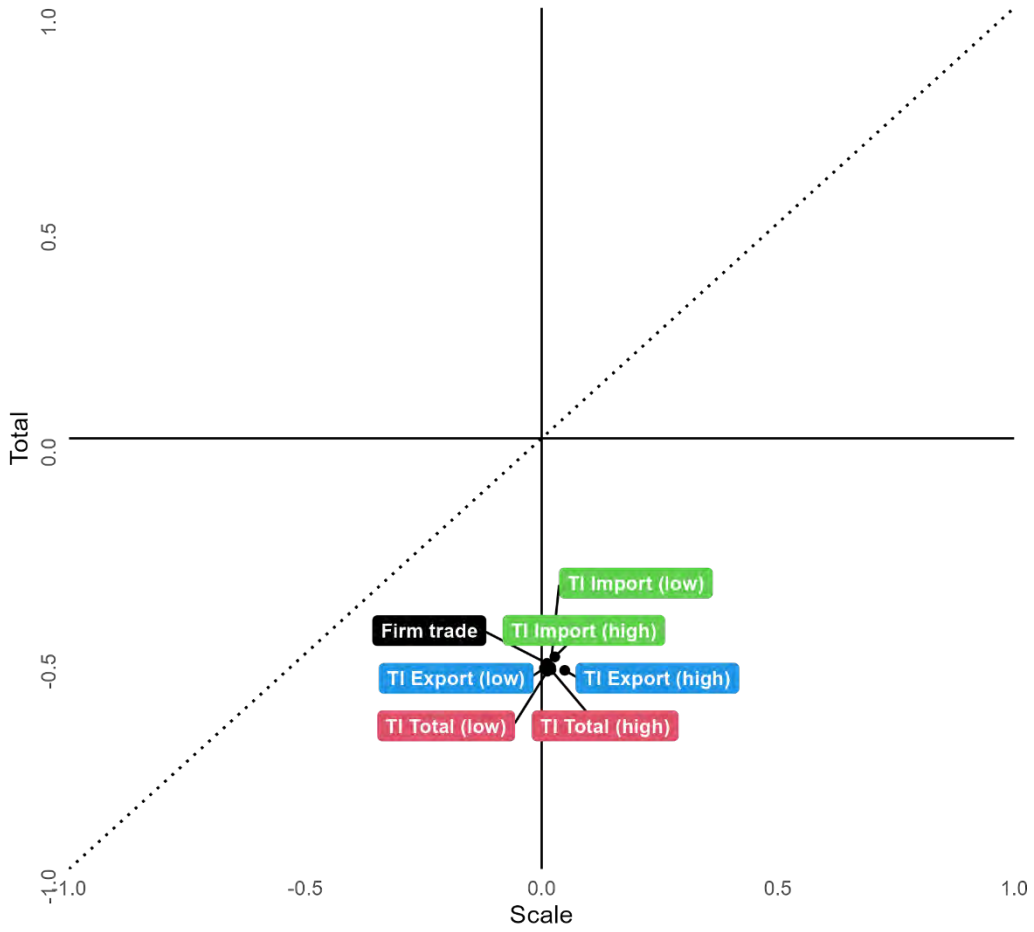


*Figure 21: Total and scale effect of normalized emissions across trade intensity of main sector*

Figure 21 and Figure 22 show the results for the scale and technique effect, respectively, jointly with the total effect. The results indicate that the different effects are quite similar irrespective of the categories of trade intensity.

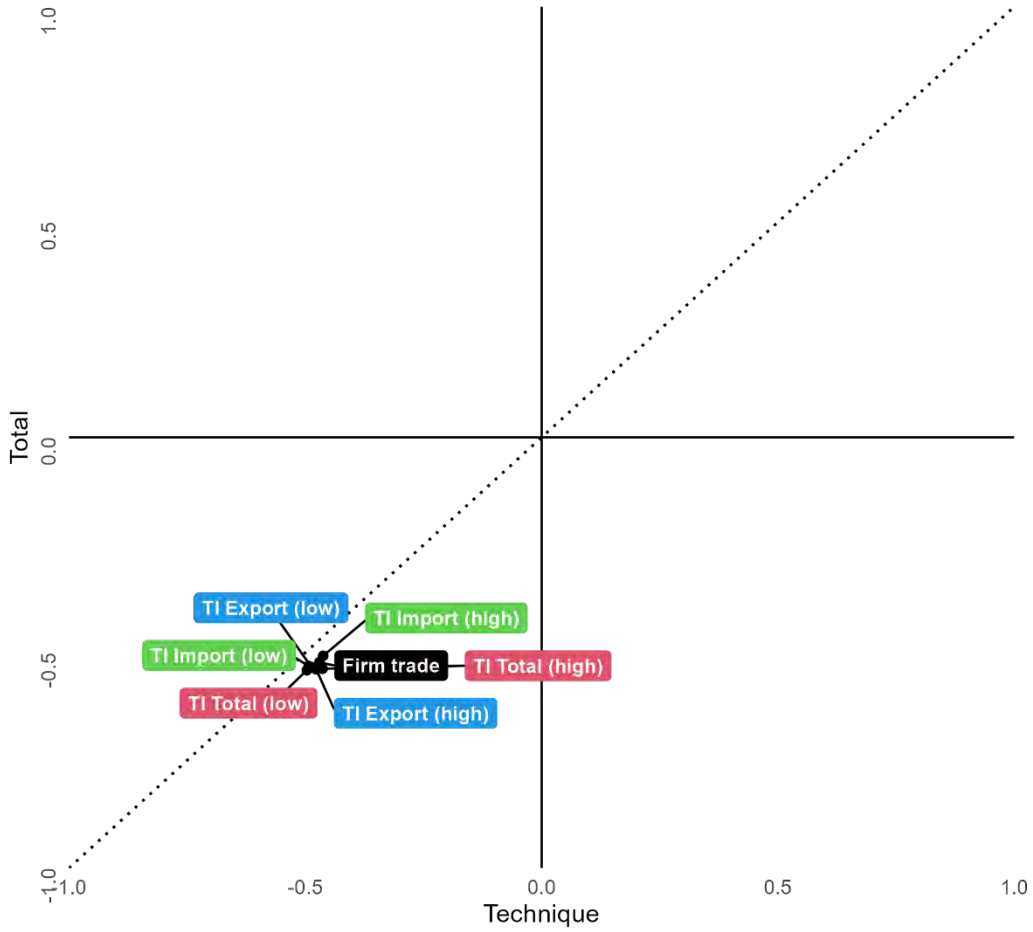


*Figure 22: Total and technique effect of normalized emissions across trade intensity of main sector*

However, trade of goods and services is only on part of international trade. Foreign direct investment is another dimension. So, are there differences in the evolution of emissions and their drivers by firm ownership characteristics, in particular related to (foreign) ownership? We run the decomposition analyses for different sub-samples defined by ownership characteristics, i.e., whether it is a domestic or foreign parent company, whether the firm is a subsidiary or not; or whether the firm experienced an ownership change within our sample period. Figure 23 and Figure 24 present the scale and technique effect in 2016 as percentage differences from their values in 2007 for the different sub-samples.

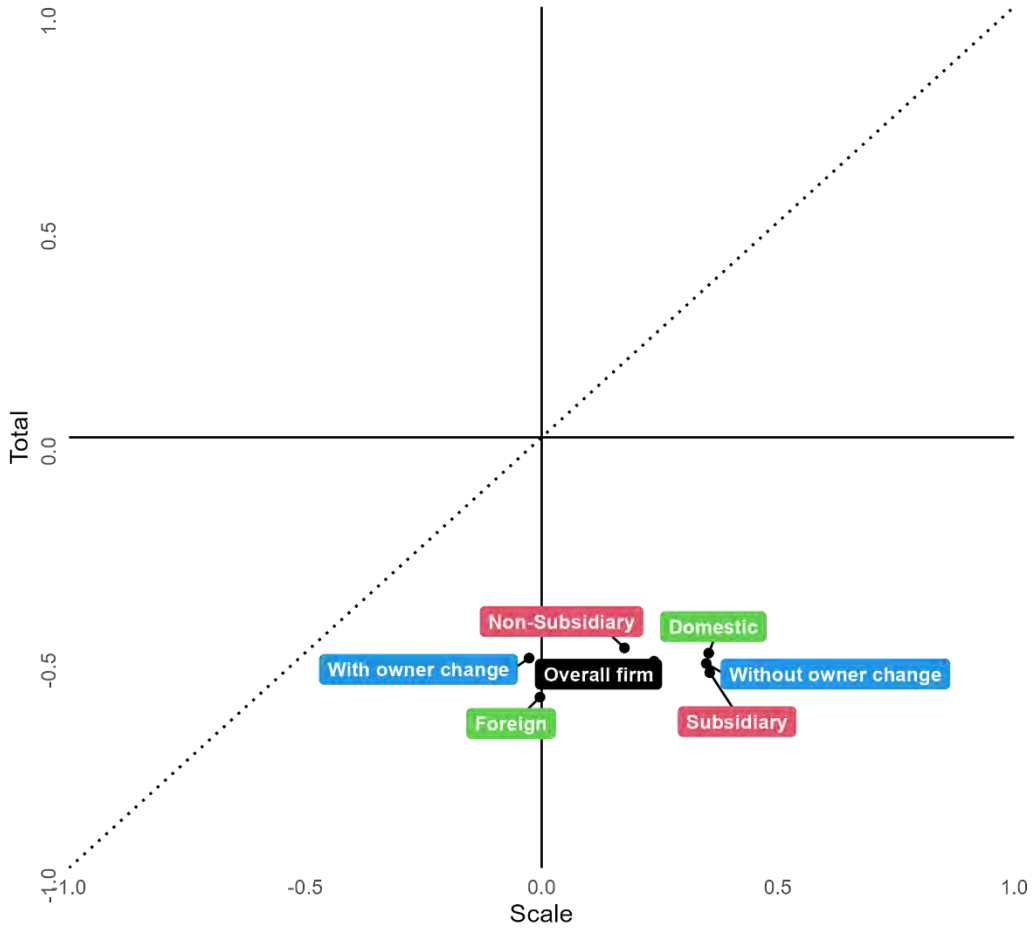


*Figure 23: Total and scale effect of normalized emissions across ownership characteristics*

With respect to the scale effect, firms that have the same parent company during our sample period, a domestic owner or are subsidiaries experience a larger growth in output than firms that do not display these characteristics. The total effect on emissions, however, is rather similar across ownership characteristics (see Figure 23). Consistently, the former mentioned characteristics are also associated with a larger (negative) technique effect, i.e., a steeper reduction in emissions intensity (see Figure 24).

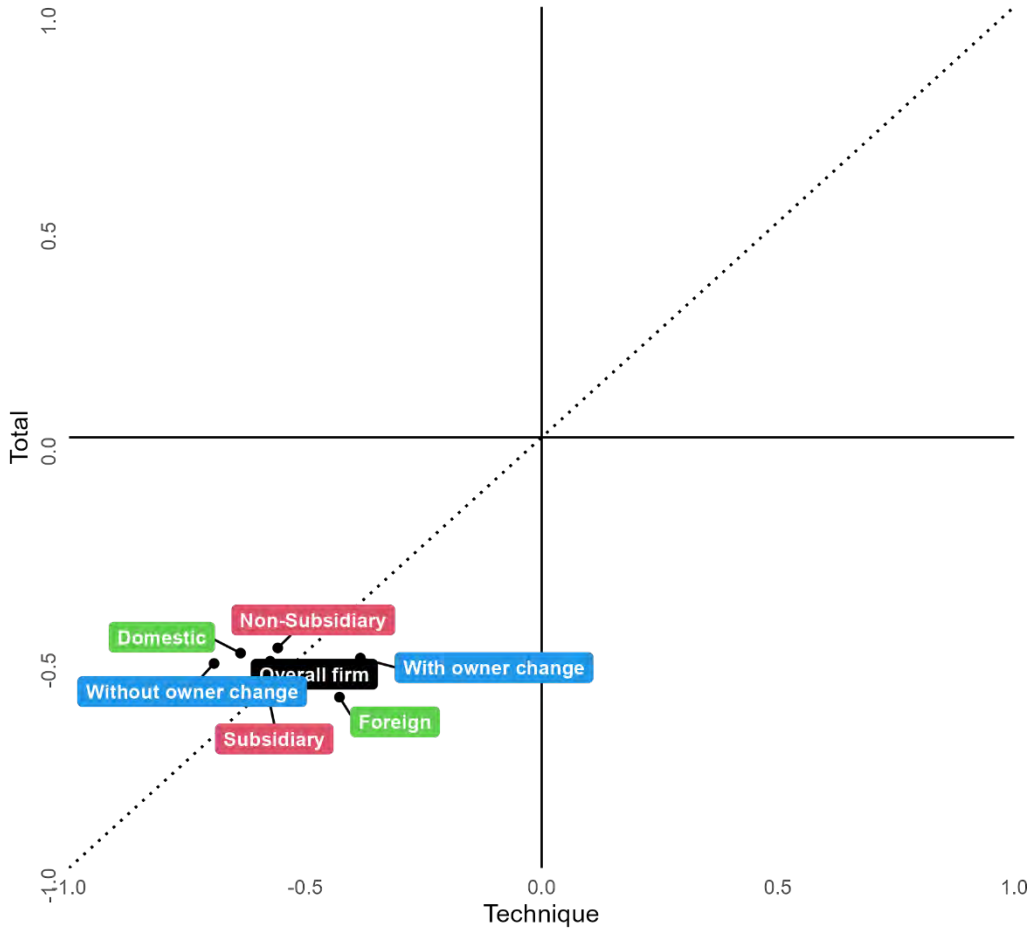


*Figure 24: Total and technique effect of normalized emissions across ownership characteristics*

While the decomposition analyses highlight differences in emissions over time across different ownership types, these analyses do not identify the causal effect of ownership (characteristics) on emissions and output. Ownership characteristics are most likely associated with other factors impacting production and investment decisions, such as e.g., the quality of the existing workforce, production facilities, and management. To disentangle these effects and to obtain more credible estimates on the effect of ownership on emissions is left for future research.

## 9. Conclusion and outlook

The ME-FINE combines data on pollutant emissions with financial information on firms. The dataset currently covers the EU-15 plus Hungary and Norway and focuses on the manufacturing and energy supply sectors from 1998 to 2016. Around 70 percent of facility-year observations from EPER / E-PRTR can be assigned to a company, representing more than half of the most common (air) pollutants.

The construction of this new data set allows for combined analyses on environmental and financial performance of companies. First applications include decomposition analyses of the development of pollution emissions as well as impacts of the introduction of the EPER/E-PRTR as a regulation on

financial indicators (Earnhart et al., 2022).[21] Further research will explore more generally the relationship between economic activity, regulation and the environmental impact of companies.

Currently, with respect to data access, the ME-FINE is a central part of several ZEW projects and is in general not available to the public. However, interested researchers are invited to contact us. Furthermore, we currently evaluate whether we will be able to provide access to the data set through the ZEW Research Data Centre (ZEW-FDZ).

## 10. Acknowledgements

We thank Philipp Massier, Ulrich Wagner, and Bastian Zeiger as well as the audience at the SEEK Workshop 2021 for valuable comments and suggestions. We thank Chiara Gesmundo, Lea Helms, Anna Lena Lesch, Anna Ruffert, Marina Schwab, Kathrin Schwörer, Aayushi Singh, Anna Thomas, Dorian Vester, and Johanna Zürcher for excellent research assistance. Funding by the international research program "Strengthening Efficiency and Competitiveness in the European Knowledge Economies" (SEEK) at ZEW by the State of Baden-Württemberg and by the German Ministry for Education and Research (BMBF) through the INTEGRATE project (FKZ: 01LP1928B) is gratefully acknowledged.

[21] For the latter analysis, we add financial information on non-EPER/E-PRTR companies from Orbis to the data set.

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## Appendix

The following tables provide summary statistics on selected financial variables separately for all countries in the ME-FINE dataset.

*Table 3: Summary statistics on selected financial variables for companies in Austria (AT)*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 1,026 | 187 | 586,095,015 | 1,346,770,548 | 46,300 | 2,486,297 | 189,966,000 | 7,245,840,750 | 12,338,974,000 |
| Operating expenditures (EUR) | 1,029 | 184 | 533,838,792 | 1,235,283,294 | 20,189 | 1,097,760 | 172,576,647 | 6,307,816,920 | 11,638,185,000 |
| Operating profits (EUR) | 1,050 | 163 | 47,105,309 | 141,566,909 | -653,025,471 | -47,760,358 | 8,675,500 | 862,381,700 | 1,103,377,000 |
| Number of employees | 633 | 580 | 2,357 | 6,198 | 18 | 20 | 500 | 42,499 | 47,186 |
| Tangible fixed assets (EUR) | 1,028 | 185 | 347,703,156 | 1,026,365,241 | 1,700 | 236,389 | 51,646,281 | 5,184,341,630 | 9,436,551,000 |
| Material expenses (EUR) | 748 | 465 | 255,659,031 | 424,998,944 | 13,600 | 6,350,470 | 105,218,679 | 2,073,102,483 | 3,304,867,000 |
| After-tax profits (EUR) | 1,052 | 161 | 42,144,475 | 137,146,745 | -744,912,629 | -60,553,950 | 7,522,698 | 650,384,070 | 2,578,106,833 |
| R&D expenses (EUR) | 67 | 1,146 | 23,926,418 | 43,142,356 | 0 | 0 | 1,600,000 | 134,690,000 | 140,300,000 |
| Export revenues (EUR) | 0 | 1,213 | NaN | NA | Inf | NA | NA | NA | -Inf |

*Table 4: Summary statistics on selected financial variables for companies in Belgium (BE)*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 3,108 | 238 | 568,795,804 | 2,193,333,175 | 34,300 | 2,746,360 | 65,144,500 | 10,325,794,690 | 33,148,223,000 |
| Operating expenditures (EUR) | 3,149 | 197 | 537,577,624 | 2,091,155,385 | 1,200 | 2,695,160 | 63,883,434 | 9,446,945,160 | 32,638,223,000 |
| Operating profits (EUR) | 3,342 | 4 | 27,776,577 | 137,156,083 | -922,820,000 | -36,298,060 | 1,639,359 | 742,919,720 | 2,262,436,000 |
| Number of employees | 3,252 | 94 | 923 | 3,110 | 10 | 14 | 181 | 17,198 | 33,104 |
| Tangible fixed assets (EUR) | 3,305 | 41 | 109,136,753 | 469,029,338 | 1,653 | 99,387 | 13,036,000 | 1,917,274,360 | 6,946,000,000 |
| Material expenses (EUR) | 2,921 | 425 | 337,176,751 | 1,803,042,152 | 3 | 486,592 | 28,823,030 | 5,976,377,800 | 30,870,704,000 |
| After-tax profits (EUR) | 3,344 | 2 | 28,483,300 | 213,387,426 | -1,044,299,000 | -55,549,553 | 932,140 | 672,835,990 | 5,045,538,000 |
| R&D expenses (EUR) | 118 | 3,228 | 80,567,283 | 134,129,430 | 0 | 0 | 17,378,000 | 561,810,000 | 564,000,000 |
| Export revenues (EUR) | 0 | 3,346 | NaN | NA | Inf | NA | NA | NA | -Inf |

*Table 5: : Summary statistics on selected financial variables for companies in Denmark (DK)*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 340 | 148 | 704,709,539 | 1,858,039,211 | 369,000 | 6,988,947 | 139,902,500 | 11,009,536,511 | 15,136,488,371 |
| Operating expenditures (EUR) | 345 | 143 | 551,915,834 | 1,197,554,994 | 468,000 | 5,253,294 | 136,937,000 | 6,872,497,437 | 8,621,866,450 |
| Operating profits (EUR) | 487 | 1 | 103,316,069 | 589,258,808 | -350,730,000 | -113,722,720 | 1,267,000 | 3,140,890,102 | 6,649,434,023 |
| Number of employees | 423 | 65 | 1,783 | 5,786 | 10 | 10 | 320 | 33,813 | 41,971 |
| Tangible fixed assets (EUR) | 470 | 18 | 184,087,172 | 539,365,499 | 3,351 | 43,830 | 27,054,000 | 2,836,946,963 | 4,059,398,228 |
| Material expenses (EUR) | 0 | 488 | NaN | NA | Inf | NA | NA | NA | -Inf |
| After-tax profits (EUR) | 487 | 1 | 86,801,071 | 448,484,551 | -429,473,000 | -90,065,590 | 640,000 | 2,379,652,434 | 5,101,318,062 |
| R&D expenses (EUR) | 47 | 441 | 405,692,191 | 557,140,401 | 0 | 5,506 | 145,915,296 | 1,844,090,192 | 1,851,723,463 |
| Export revenues (EUR) | 0 | 488 | NaN | NA | Inf | NA | NA | NA | -Inf |

*Table 6: : Summary statistics on selected financial variables for companies in Finland (FI)*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 1,089 | 39 | 644,645,087 | 2,043,480,433 | 32,000 | 274,120 | 66,804,000 | 10,847,936,000 | 14,758,200,000 |
| Operating expenditures (EUR) | 1,113 | 15 | 597,674,194 | 1,913,693,581 | 47,000 | 282,596 | 66,000,000 | 10,400,772,000 | 14,247,600,000 |
| Operating profits (EUR) | 1,126 | 2 | 39,368,403 | 177,753,741 | -1,406,000,000 | -104,305,319 | 1,763,666 | 951,475,000 | 1,867,100,000 |
| Number of employees | 906 | 222 | 2,130 | 6,782 | 10 | 11 | 239 | 39,092 | 46,166 |
| Tangible fixed assets (EUR) | 1,093 | 35 | 396,781,053 | 1,467,562,102 | 1,000 | 3,920 | 36,844,000 | 8,135,240,000 | 12,785,500,000 |
| Material expenses (EUR) | 833 | 295 | 382,995,611 | 1,167,432,001 | -4,000 | 42,640 | 29,379,703 | 6,517,016,000 | 8,214,300,000 |
| After-tax profits (EUR) | 1,127 | 1 | 26,915,439 | 151,337,648 | -1,122,000,000 | -168,522,940 | 567,767 | 812,910,885 | 1,448,700,000 |
| R&D expenses (EUR) | 66 | 1,062 | 39,640,909 | 27,928,496 | 0 | 0 | 42,350,000 | 89,780,000 | 91,600,000 |
| Export revenues (EUR) | 0 | 1,128 | NaN | NA | Inf | NA | NA | NA | -Inf |

*Table 7: Summary statistics on selected financial variables for companies in France (FR)*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 10,625 | 131 | 794,491,223 | 4,830,607,537 | 10,000 | 694,835 | 73,846,000 | 16,492,607,307 | 82,112,000,000 |
| Operating expenditures (EUR) | 10,481 | 275 | 760,800,234 | 4,611,963,500 | 14,000 | 694,291 | 72,140,291 | 14,635,000,000 | 77,591,000,000 |
| Operating profits (EUR) | 10,485 | 271 | 41,626,664 | 394,833,186 | -1,864,942,000 | -77,376,859 | 1,473,196 | 1,049,442,680 | 10,992,000,000 |
| Number of employees | 8,115 | 2,641 | 2,747 | 15,365 | 10 | 14 | 280 | 82,720 | 211,800 |
| Tangible fixed assets (EUR) | 10,324 | 432 | 351,346,788 | 4,703,872,365 | 1,153 | 34,046 | 15,799,273 | 3,695,266,220 | 131,253,000,000 |
| Material expenses (EUR) | 9,898 | 858 | 288,691,338 | 2,424,198,517 | -8,661,000 | 57,194 | 28,844,000 | 2,512,478,000 | 53,380,581,000 |
| After-tax profits (EUR) | 10,486 | 270 | 21,694,413 | 213,580,483 | -5,888,000,000 | -85,613,250 | 997,252 | 592,675,172 | 5,616,000,000 |
| R&D expenses (EUR) | 279 | 10,477 | 302,605,371 | 576,385,702 | 0 | 0 | 36,730,000 | 3,033,120,000 | 3,481,000,000 |
| Export revenues (EUR) | 10,098 | 658 | 87,651,080 | 519,087,828 | 0 | 0 | 8,759,597 | 1,253,645,193 | 20,127,000,000 |

*Table 8: Summary statistics on selected financial variables for companies in Germany (DE)*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 6,686 | 1,275 | 2,493,148,238 | 13,001,062,258 | 37,579 | 3,373,215 | 171,110,229 | 72,187,971,550 | 225,372,000,000 |
| Operating expenditures (EUR) | 6,124 | 1,837 | 2,561,498,041 | 12,993,548,292 | 32,106 | 3,593,120 | 170,703,500 | 68,306,080,000 | 221,818,000,000 |
| Operating profits (EUR) | 6,465 | 1,496 | 126,302,918 | 811,807,824 | -7,164,200,000 | -216,732,880 | 5,419,999 | 4,033,120,000 | 14,359,000,000 |
| Number of employees | 6,714 | 1,247 | 6,170 | 38,333 | 10 | 16 | 408 | 184,101 | 626,715 |
| Tangible fixed assets (EUR) | 6,594 | 1,367 | 656,805,306 | 3,900,013,250 | 2,000 | 57,820 | 42,623,617 | 14,910,635,000 | 73,323,000,000 |
| Material expenses (EUR) | 5,216 | 2,745 | 788,093,224 | 4,459,445,635 | 4,710 | 514,946 | 83,040,786 | 17,279,995,000 | 111,703,000,000 |
| After-tax profits (EUR) | 6,459 | 1,502 | 94,964,894 | 683,591,120 | -7,099,300,000 | -279,042,829 | 3,596,046 | 2,860,705,500 | 21,884,000,000 |
| R&D expenses (EUR) | 600 | 7,361 | 603,718,880 | 1,343,267,757 | 0 | 0 | 25,858,976 | 5,662,130,000 | 8,591,000,000 |
| Export revenues (EUR) | 967 | 6,994 | 239,266,254 | 747,912,035 | 1,000 | 43,118 | 66,451,642 | 4,501,830,976 | 7,433,133,287 |

*Table 9: Summary statistics on selected financial variables for companies in Greece (EL)*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 657 | 15 | 252,230,228 | 941,663,711 | 75,719 | 768,459 | 37,004,000 | 5,923,785,960 | 9,734,920,000 |
| Operating expenditures (EUR) | 671 | 1 | 233,331,371 | 899,263,033 | 99,253 | 913,863 | 36,973,000 | 5,657,072,000 | 9,552,665,000 |
| Operating profits (EUR) | 672 | 0 | 14,952,474 | 53,442,051 | -161,355,000 | -40,091,844 | 1,181,822 | 262,087,630 | 473,832,000 |
| Number of employees | 636 | 36 | 523 | 983 | 12 | 15 | 180 | 5,589 | 6,505 |
| Tangible fixed assets (EUR) | 669 | 3 | 116,065,551 | 271,855,922 | 26,000 | 437,686 | 22,293,000 | 1,605,163,000 | 1,963,439,000 |
| Material expenses (EUR) | 0 | 672 | NaN | NA | Inf | NA | NA | NA | -Inf |
| After-tax profits (EUR) | 672 | 0 | 5,818,831 | 35,402,988 | -136,278,000 | -58,965,953 | 311,130 | 169,016,230 | 297,845,000 |
| R&D expenses (EUR) | 116 | 556 | 50,630 | 186,344 | 0 | 0 | 0 | 933,050 | 1,137,000 |
| Export revenues (EUR) | 512 | 160 | 24,014,593 | 57,065,360 | 0 | 0 | 5,943,310 | 334,987,349 | 585,969,786 |

*Table 10: Summary statistics on selected financial variables for companies in Ireland (IE)*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 168 | 36 | 1,163,326,261 | 3,133,194,273 | 7,726,104 | 8,926,041 | 112,178,500 | 17,661,338,946 | 18,660,478,128 |
| Operating expenditures (EUR) | 170 | 34 | 1,259,512,530 | 4,604,823,866 | 7,669,980 | 8,749,379 | 98,678,236 | 16,567,903,771 | 49,561,695,176 |
| Operating profits (EUR) | 195 | 9 | 184,320,938 | 609,464,472 | -245,274,172 | -174,148,519 | 2,182,391 | 2,475,294,902 | 4,590,369,617 |
| Number of employees | 121 | 83 | 283 | 388 | 10 | 10 | 222 | 2,483 | 2,556 |
| Tangible fixed assets (EUR) | 176 | 28 | 623,057,829 | 2,217,695,786 | 7,000 | 7,750 | 94,613,583 | 12,453,026,526 | 13,641,745,147 |
| Material expenses (EUR) | 0 | 204 | NaN | NA | Inf | NA | NA | NA | -Inf |
| After-tax profits (EUR) | 186 | 18 | 290,165,951 | 971,947,842 | -251,059,847 | -159,638,377 | 1,717,129 | 5,443,609,350 | 6,870,555,449 |
| R&D expenses (EUR) | 3 | 201 | 4,224,000 | 318,086 | 3,937,000 | 3,941,640 | 4,169,000 | 4,558,060 | 4,566,000 |
| Export revenues (EUR) | 20 | 184 | 55,339,054 | 65,019,538 | 0 | 0 | 15,870,207 | 199,703,826 | 201,354,873 |

*Table 11: Summary statistics on selected financial variables for companies in Italy (IT)*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 7,876 | 164 | 278,428,183 | 866,355,131 | 11,666 | 1,163,419 | 64,285,691 | 4,779,604,250 | 18,192,656,000 |
| Operating expenditures (EUR) | 8,032 | 8 | 269,258,123 | 851,507,294 | 46,673 | 1,191,107 | 61,165,595 | 4,602,724,230 | 19,304,217,000 |
| Operating profits (EUR) | 8,032 | 8 | 13,066,164 | 97,254,687 | -2,329,264,000 | -61,032,415 | 1,867,754 | 282,784,879 | 2,875,571,000 |
| Number of employees | 7,507 | 533 | 581 | 1,764 | 10 | 13 | 186 | 7,108 | 60,170 |
| Tangible fixed assets (EUR) | 7,915 | 125 | 126,452,936 | 659,126,007 | 1,173 | 110,179 | 20,539,000 | 2,061,103,240 | 16,133,819,000 |
| Material expenses (EUR) | 7,724 | 316 | 158,366,030 | 523,144,617 | 4 | 140,494 | 30,659,895 | 2,575,331,570 | 13,552,076,000 |
| After-tax profits (EUR) | 8,032 | 8 | 5,003,700 | 69,936,192 | -1,801,069,000 | -97,306,156 | 439,468 | 182,190,310 | 2,190,603,000 |
| R&D expenses (EUR) | 160 | 7,880 | 6,470,631 | 18,637,942 | 0 | 0 | 0 | 79,595,340 | 85,267,000 |
| Export revenues (EUR) | 0 | 8,040 | NaN | NA | Inf | NA | NA | NA | -Inf |

*Table 12: Summary statistics on selected financial variables for companies in Luxembourg (LU)*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 203 | 31 | 4,030,201,035 | 13,545,332,012 | 334,436 | 2,351,231 | 120,528,697 | 65,271,528,367 | 72,991,736,421 |
| Operating expenditures (EUR) | 214 | 20 | 4,027,303,861 | 13,658,827,994 | 130,705 | 2,334,277 | 114,352,183 | 65,334,049,022 | 79,728,429,033 |
| Operating profits (EUR) | 214 | 20 | 222,716,400 | 1,275,360,430 | -3,876,182,828 | -877,855,626 | 4,345,827 | 4,796,640,000 | 10,743,161,000 |
| Number of employees | 153 | 81 | 20,484 | 65,626 | 15 | 20 | 331 | 298,102 | 315,867 |
| Tangible fixed assets (EUR) | 227 | 7 | 2,163,126,283 | 8,287,121,522 | 91,117 | 121,847 | 28,003,698 | 41,925,232,166 | 43,293,116,113 |
| Material expenses (EUR) | 169 | 65 | 675,151,872 | 2,734,691,509 | 988,371 | 1,240,663 | 72,751,000 | 15,153,240,000 | 22,692,000,000 |
| After-tax profits (EUR) | 214 | 20 | 102,665,922 | 1,074,148,382 | -7,736,750,701 | -1,728,720,210 | 2,926,192 | 4,221,020,000 | 8,049,729,000 |
| R&D expenses (EUR) | 15 | 219 | 138,153,052 | 103,651,438 | 0 | 0 | 195,779,861 | 240,245,360 | 240,855,991 |
| Export revenues (EUR) | 0 | 234 | NaN | NA | Inf | NA | NA | NA | -Inf |

*Table 13: Summary statistics on selected financial variables for companies in the Netherlands (NL)*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 1,194 | 1,036 | 406,032,479 | 1,018,452,608 | 318,000 | 5,402,290 | 110,363,500 | 4,268,740,000 | 12,528,156,000 |
| Operating expenditures (EUR) | 1,165 | 1,065 | 400,058,272 | 1,003,743,907 | 303,351 | 5,672,560 | 112,605,000 | 4,028,079,280 | 12,306,554,000 |
| Operating profits (EUR) | 1,329 | 901 | 15,245,201 | 83,150,415 | -844,195,000 | -223,630,080 | 3,361,000 | 348,798,760 | 707,000,000 |
| Number of employees | 2,042 | 188 | 439 | 1,065 | 10 | 12 | 169 | 7,586 | 10,223 |
| Tangible fixed assets (EUR) | 1,505 | 725 | 114,936,316 | 370,418,748 | 2,103 | 93,582 | 18,413,000 | 1,381,598,920 | 6,917,500,000 |
| Material expenses (EUR) | 388 | 1,842 | 225,549,718 | 566,039,557 | 568,032 | 3,235,774 | 60,847,500 | 2,887,462,400 | 5,275,148,000 |
| After-tax profits (EUR) | 1,364 | 866 | 12,662,191 | 63,506,042 | -950,140,000 | -67,629,400 | 1,593,500 | 283,969,710 | 501,580,000 |
| R&D expenses (EUR) | 10 | 2,220 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Export revenues (EUR) | 0 | 2,230 | NaN | NA | Inf | NA | NA | NA | -Inf |

*Table 14: Summary statistics on selected financial variables for companies in Portugal (PT)*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 2,990 | 112 | 138,501,291 | 656,426,419 | 12,365 | 207,207 | 27,760,307 | 1,818,272,402 | 10,848,665,854 |
| Operating expenditures (EUR) | 3,048 | 54 | 128,058,701 | 632,309,173 | 24,260 | 261,559 | 26,080,438 | 1,681,829,826 | 10,861,554,128 |
| Operating profits (EUR) | 3,089 | 13 | 8,531,170 | 50,085,029 | -376,237,244 | -20,330,138 | 609,653 | 167,949,880 | 860,672,940 |
| Number of employees | 1,979 | 1,123 | 325 | 502 | 10 | 12 | 175 | 2,968 | 5,368 |
| Tangible fixed assets (EUR) | 3,036 | 66 | 68,815,538 | 366,117,421 | 2,490 | 166,977 | 9,299,544 | 1,225,092,750 | 5,120,891,412 |
| Material expenses (EUR) | 2,869 | 233 | 87,934,334 | 555,945,224 | -43,000 | 28,982 | 13,364,000 | 1,300,405,162 | 9,937,417,508 |
| After-tax profits (EUR) | 3,099 | 3 | 4,855,426 | 35,273,112 | -414,632,017 | -38,474,457 | 172,000 | 126,270,540 | 733,210,135 |
| R&D expenses (EUR) | 63 | 3,039 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Export revenues (EUR) | 0 | 3,102 | NaN | NA | Inf | NA | NA | NA | -Inf |

*Table 15: Summary statistics on selected financial variables for companies in Spain (ES)*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 11,596 | 301 | 264,752,293 | 1,354,462,011 | 10,541 | 500,312 | 25,069,875 | 5,184,658,300 | 26,272,000,000 |
| Operating expenditures (EUR) | 11,821 | 76 | 248,887,247 | 1,279,135,749 | 2,000 | 579,699 | 23,465,122 | 5,054,748,400 | 25,396,821,000 |
| Operating profits (EUR) | 11,884 | 13 | 14,102,282 | 109,348,953 | -856,121,000 | -41,644,130 | 919,509 | 286,677,520 | 3,450,000,000 |
| Number of employees | 10,848 | 1,049 | 451 | 1,457 | 10 | 11 | 97 | 7,891 | 36,395 |
| Tangible fixed assets (EUR) | 11,741 | 156 | 114,157,943 | 802,582,327 | 2,380 | 98,306 | 9,197,000 | 2,038,738,800 | 24,683,000,000 |
| Material expenses (EUR) | 10,779 | 1,118 | 160,654,197 | 918,656,264 | -2,913,660 | 47,241 | 13,472,000 | 3,781,700,966 | 23,475,881,000 |
| After-tax profits (EUR) | 11,872 | 25 | 9,531,705 | 96,653,292 | -2,521,850,000 | -59,065,340 | 464,000 | 239,141,210 | 5,387,896,000 |
| R&D expenses (EUR) | 214 | 11,683 | 2,463,383 | 9,022,057 | 0 | 0 | 0 | 51,350,390 | 60,000,000 |
| Export revenues (EUR) | 0 | 11,897 | NaN | NA | Inf | NA | NA | NA | -Inf |

*Table 16: Summary statistics on selected financial variables for companies in Sweden (SE)*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 2,503 | 34 | 579,119,804 | 1,954,826,117 | 45,852 | 3,653,883 | 97,321,651 | 11,505,769,798 | 24,049,815,455 |
| Operating expenditures (EUR) | 2,508 | 29 | 533,497,896 | 1,802,254,058 | 209 | 3,710,978 | 91,698,000 | 11,162,543,620 | 20,635,184,733 |
| Operating profits (EUR) | 2,511 | 26 | 53,780,963 | 314,139,887 | -2,476,522,511 | -107,774,148 | 5,407,895 | 1,485,098,531 | 7,655,709,905 |
| Number of employees | 2,457 | 80 | 1,323 | 4,817 | 10 | 18 | 279 | 32,797 | 49,385 |
| Tangible fixed assets (EUR) | 2,481 | 56 | 345,832,009 | 2,065,697,620 | 13,000 | 641,233 | 53,819,000 | 2,799,822,049 | 32,542,857,099 |
| Material expenses (EUR) | 1,485 | 1,052 | 100,212,202 | 185,066,825 | 561 | 759,483 | 36,116,000 | 1,035,209,291 | 1,996,619,990 |
| After-tax profits (EUR) | 2,497 | 40 | 47,183,424 | 306,123,334 | -2,722,230,357 | -125,136,043 | 3,484,233 | 1,195,005,032 | 7,742,944,806 |
| R&D expenses (EUR) | 408 | 2,129 | 105,761,594 | 284,043,494 | 0 | 0 | 2,627,254 | 1,532,217,902 | 1,599,434,391 |
| Export revenues (EUR) | 58 | 2,479 | 48,363,810 | 67,324,664 | 921,000 | 1,572,510 | 23,130,299 | 286,754,870 | 329,681,000 |

*Table 17: Summary statistics on selected financial variables for companies in the United Kingdom (UK)*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 6,131 | 694 | 1,676,027,586 | 11,998,229,475 | 13,609 | 2,105,371 | 130,867,036 | 24,645,083,488 | 291,699,880,724 |
| Operating expenditures (EUR) | 6,236 | 589 | 1,521,866,948 | 11,142,407,314 | 16,000 | 2,470,364 | 119,653,000 | 21,246,852,217 | 287,692,799,266 |
| Operating profits (EUR) | 6,352 | 473 | 136,682,408 | 1,077,055,765 | -8,195,095,543 | -258,987,089 | 4,279,848 | 3,230,629,820 | 28,162,989,000 |
| Number of employees | 6,003 | 822 | 2,980 | 10,654 | 10 | 21 | 417 | 62,578 | 115,250 |
| Tangible fixed assets (EUR) | 6,329 | 496 | 736,757,106 | 5,198,197,352 | 1,308 | 85,375 | 36,378,501 | 11,361,264,485 | 123,097,480,495 |
| Material expenses (EUR) | 128 | 6,697 | 13,633,933,598 | 44,746,050,080 | 29,638,968 | 30,834,014 | 2,338,237,880 | 221,586,859,456 | 232,194,103,326 |
| After-tax profits (EUR) | 5,857 | 968 | 103,773,002 | 881,257,731 | -12,420,111,000 | -246,246,800 | 3,466,166 | 2,445,976,212 | 20,169,257,395 |
| R&D expenses (EUR) | 1,161 | 5,664 | 153,724,800 | 673,143,241 | 0 | 0 | 2,116,917 | 4,186,639,811 | 5,510,864,648 |
| Export revenues (EUR) | 2,871 | 3,954 | 405,292,143 | 4,200,555,918 | 1,167 | 64,181 | 27,128,365 | 8,090,728,247 | 159,916,417,000 |

*Table 18: Summary statistics on selected financial variables for companies in Hungary (HU)*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 888 | 50 | 321,093,684 | 869,167,053 | 10,000 | 219,290 | 52,128,488 | 4,941,337,690 | 8,421,536,000 |
| Operating expenditures (EUR) | 895 | 43 | 303,044,512 | 815,194,066 | 14,410 | 350,861 | 49,040,913 | 4,713,110,660 | 7,995,188,000 |
| Operating profits (EUR) | 903 | 35 | 34,021,622 | 310,284,011 | -194,834,000 | -75,687,094 | 1,702,000 | 425,973,000 | 8,956,368,129 |
| Number of employees | 544 | 394 | 1,431 | 2,338 | 10 | 17 | 466 | 11,543 | 12,159 |
| Tangible fixed assets (EUR) | 886 | 52 | 114,674,224 | 259,855,792 | 4,845 | 58,674 | 27,835,027 | 1,065,441,550 | 2,763,835,000 |
| Material expenses (EUR) | 696 | 242 | 226,834,399 | 674,962,908 | 200 | 1,650 | 31,326,510 | 4,044,642,700 | 6,291,978,000 |
| After-tax profits (EUR) | 902 | 36 | 35,341,130 | 259,406,733 | -132,905,225 | -71,650,895 | 1,366,839 | 556,577,827 | 7,207,799,284 |
| R&D expenses (EUR) | 39 | 899 | 39,483,821 | 44,588,539 | 0 | 0 | 34,516,000 | 138,178,812 | 138,794,111 |
| Export revenues (EUR) | 624 | 314 | 327,244,437 | 1,105,487,008 | 0 | 13,568 | 24,144,235 | 5,580,766,580 | 14,029,389,839 |

*Table 19: Summary statistics on selected financial variables for companies in Norway (NO)*

| Variable | Obs | Missings | Mean | SD | Min | P01 | P50 | P99 | Max |
|---|---|---|---|---|---|---|---|---|---|
| Operating revenues (EUR) | 1,130 | 30 | 252,825,499 | 709,574,000 | 39,000 | 489,811 | 59,093,230 | 4,097,325,860 | 7,068,282,000 |
| Operating expenditures (EUR) | 1,159 | 1 | 236,871,755 | 673,995,860 | 41,675 | 361,557 | 54,562,794 | 3,885,206,858 | 6,588,686,000 |
| Operating profits (EUR) | 1,160 | 0 | 13,532,695 | 57,469,562 | -395,718,424 | -83,343,656 | 2,482,515 | 244,706,860 | 646,710,000 |
| Number of employees | 429 | 731 | 672 | 1,708 | 10 | 10 | 159 | 9,327 | 11,295 |
| Tangible fixed assets (EUR) | 1,133 | 27 | 114,217,208 | 408,505,044 | 2,053 | 74,389 | 14,848,000 | 1,971,575,801 | 4,666,761,000 |
| Material expenses (EUR) | 1,048 | 112 | 175,386,272 | 548,295,192 | 36,000 | 385,314 | 32,994,988 | 3,350,351,409 | 6,000,289,000 |
| After-tax profits (EUR) | 1,160 | 0 | 7,623,338 | 56,263,370 | -378,415,859 | -111,732,060 | 1,320,182 | 200,109,554 | 988,627,074 |
| R&D expenses (EUR) | 26 | 1,134 | 2,199,664 | 5,208,848 | 0 | 0 | 107,158 | 19,785,250 | 20,494,000 |
| Export revenues (EUR) | 0 | 1,160 | NaN | NA | Inf | NA | NA | NA | -Inf |

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