

Will the DAX 50 ESG Establish the Standard for German Sustainable Investments? A Sustainability and Financial Performance Analysis

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Abstract

The demand for sustainable investments is growing worldwide. As a result, the DAX 50 ESG was introduced in March 2020 as the first ESG index by the German stock exchange. It is promoted as the new standard for German sustainable investments. We are the first to comprehensively examine the financial and non-financial performance of the index and its constituents. Therefore, we examine the sustainability performance using both ESG criteria and the alignment of products and services with the Sustainable Development Goals. Our results show that the DAX 50 ESG may only to a limited extent be promoted as the most sustainable German index. Moreover, since inception as well as during the COVID-19 crisis, the DAX 50 ESG's financial performance is comparatively worse. Our findings suggest that stock markets penalize the inclusion of a firm in the DAX 50 ESG in the short run, thus affecting the overall index performance. Our analysis of the DAX 50 ESG further increases investor attention to sustainable financial products and enables better investment decisions.

Keywords: Sustainable Finance, Equity Indices, Sustainability Performance, Financial Performance, ESG, SDG, ESG Disagreement, Event Study

JEL Classification: G11, G15, G34, Q56

I. Introduction

There is a growing demand from investors for sustainable finance opportunities. PRI, the world's leading proponent of responsible investments, has more than 3,000 signatories with more than 90 trillion US dollar in assets under management (PRI 2019). The total of sustainable investments reaches a new high of 219 billion euros in Germany. Sustainable funds and mandates have recorded

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their greatest growth since the FNG survey began, increasing by a total of 41 billion euros (FNG 2019). In addition, key figures in the financial industry, such as Larry Fink of Blackrock, are observing a fundamental reshaping of finance and predict a significant reallocation of capital into sustainable investments (Fink 2020).

To meet these new demands, Qontigo and the Deutsche Börse Group introduced a new German sustainability index in March 2020: the DAX 50 ESG. It is promoted as the new leading index for sustainable investments in Germany (Qontigo 2020). The DAX 50 ESG is designed as a sustainable flagship index that should be liquid and diversified, while also including ESG criteria. The DAX 50 ESG eligible universe is based on firms of the HDAX universe after standardized ESG exclusion screens are applied for controversial weapons, tobacco production, thermal coal, nuclear power, and military contracting. Subsequently, 50 constituents are selected based on their market capitalization, order book volume and Sustainalytics' ESG score. These constituents are then weighted by their free float market capitalization with a 7% cap. Currently, the composition of the DAX 50 ESG comprises of 23 DAX, 27 MDAX and 8 TecDAX firms.¹ After all, the index is intended to achieve high financial performance, sustainability and investability.

In this paper, we investigate the non-financial and financial performance of the DAX 50 ESG index. We look at both the index and on its constituents on its own as well as in comparison to major German indices and global ESG indices. Thereby, we first have to address two main challenges to assess the sustainability performance of the DAX 50 ESG: (1) the lack of a comprehensive assessment of a firm's sustainability and (2) the disagreement of data providers on the sustainability performance of a firm within their different frameworks.

In recent years, many investors have asked how the various CSR, ESG and Sustainable Development Goals (SDGs) frameworks can assess the sustainability of a firm. Until recently, an investor's primary focus has been on defining ESG policies and processes and providing basic reporting, either qualitative or through a selection of ESG-related KPIs. However, when measuring the sustainability of a firm, an investor usually limits the assessment only to the conduct dimension of sustainability. The main question of the investor is primarily: "How sustainable are the operations and processes of an investee firm?". The investor wants to know whether the firm, e.g. harms the environment, respects human rights in the supply chain, has a high employee satisfaction or a health and safety record. In a nutshell, the conduct dimension describes the sustainability of a firm's organization, usually measured by ESG ratings.

¹ Five firms are constituents of both MDAX and TecDAX, and three firms are constituents of both DAX and TecDAX after the change of the MDAX and TecDAX composition in 2018.

In addition, an investor should also look at the sustainability of a firm's products and services by asking: "Are the products and services of an investee firm contributing to sustainability?". The investor should incorporate the information whether a firm is, e.g. providing clean energy, water sanitation, pollution prevention or access to education. A SDGs framework enables investors to measure the impact of products and services on the achievement of sustainability goals (Schramade 2017). By considering both the conduct and the product dimension of sustainability, an investor can gain a holistic picture of a firm's sustainability. In our study, we therefore consider both ESG criteria and its individual pillars (Environmental, Social and Governance) as well as the contribution of a firm's products and services to the SDGs.

The differences in the approach taken by rating providers to calculate ESG scores can result in the same firm being rated quite high by one provider and quite low by another (Christensen/Serafeim/Sikochi 2019; Li/Polychronopoulos 2020). ESG metrics are very diverse in application and in terms of indicators measured, methodology used, and weights applied (Chatterji et al. 2016; Kotsantonis/Serafeim 2019). Studies try to explain why there is so little agreement on how to capture ESG performance using the social origin of data providers and their necessity to create a unique profile in a maturing market (Eccles/Stroehle 2018). The difference in ESG ratings have implications for the relationship between sustainability and financial performance (Busch et al. 2018; Gibson et al. 2019) or risk (Monk et al. 2019). To address this disagreement, we use two major ESG databases Refinitiv ESG and ISS ESG for our analyses to take differences within the sustainability assessment of a firm into account.

Our results on the sustainability performance of the DAX 50 ESG constituents show a mixed picture. If we look at all German firms that are not included in the DAX 50 ESG, it becomes clear they have performed consistently worse according to several sustainability measures. However, the DAX 50 ESG constituents are not significantly more sustainable compared to, e.g. the DAX constituents. Nonetheless, the new index can compete with other German indices as well as with global ESG indices from MSCI. Our various sub-studies show investors that they can buy the DAX 50 ESG index as a sustainable investment.

In the second part of the paper, we look at the financial performance of the DAX 50 ESG since its inception. We find a relatively poor performance measured by its raw return, as well as by risk-adjusted performance measures such as Sharpe Ratio and Carhart Alpha compared to major German and global ESG indices. Looking at different risk measures like standard deviation, market beta or maximum drawdown, the index performs as well as the average index within our sample. To explain the performance differences, we first examine the indices for different factor exposures. We find that the DAX 50 ESG Index has only a notable size exposure. This exposure is however comparable in magnitude to

the DAX and the HDAX and therefore not suitable to explain the performance differences. To further analyze the underperformance of the DAX 50 ESG, we analyze the risk and return of the index before and during the COVID-19 crisis. Thereby, we attempt to identify whether the focus of the index on sustainability has a positive financial effect. However, we do not find any significant improvements in the financial performance in any period. In a further investigation, we apply an event study approach following *Oberndorfer/Schmidt/Wagner/Ziegler* (2013). Our results show that firms are currently penalized for their inclusion in the DAX 50 ESG index. This may explain the relatively poor performance of the index currently, but future long-term performance studies should discuss this insight critically.

Our paper contributes to both the emerging literature on sustainability measurement in finance and on the relationship between sustainability and financial performance. Results of related studies usually differ due to different definitions of sustainable performance in various frameworks based on, e.g. CSR (*Fatemi/Fooladi/Tehrani* 2015), ESG (*Friede/Busch/Bassen* 2015), or SDGs (*Hussain/Rigoni/Cavezzali* 2018) concepts. Therefore, it is important that sustainability performance is assessed comprehensively. In particular, our work is related to studies that focus on a holistic perspective of sustainability (*Ferreira et al.* 2016). Regarding our research object, an equity index, there are also closely related studies analyzing the characteristics of U.S. sustainable indices (*Bianchi/Drew* 2012; *López/García/Rodríguez* 2007). In addition, there are also numerous studies on the impact of sustainability in other financial products, e.g. mutual funds (*Ceccarelli/Ramelli/Wagner* 2020), bonds (*Zerbib* 2019), credit (*Attig et al.* 2013), or portfolios (*Alessandrini/Jondeau* 2020; *Görgen/Jacob/Nerlinger* 2021). Nevertheless, to the best of our knowledge, no one has ever dealt in detail with the DAX 50 ESG nor measured the financial and non-financial performance of an index in such depth.

Our results are especially meaningful for investors. Recent studies show that investors want to contribute towards a more sustainable world with their investments. Some research studies deal with stakeholder preferring sustainable investments and for their sake even accept lower expected returns (*Bauer/Ruoff/Smeets* 2019), or show more willingness-to-pay in venture capital funds (*Barber/Morse/Yasuda* 2019). Asset managers have experienced that the introduction of the Morningstar Sustainability Rating has had a significant impact on their mutual fund flows and performance (*Ammann et al.* 2019; *Hartzmark/Sussman* 2019). Following this line of reasoning, we add to existing studies and provide insight for investors into sustainable indices like the DAX 50 ESG. Such information can help them to make better investment decision to achieve a high sustainable performance within their portfolios in consideration of the associated financial performance.

The remainder of this paper is organized as follows: Chapter Two presents the data. Next, Chapter Three presents the analysis and results, including both the conduct and product dimensions of sustainability for the constituents of various indices. In the following Chapter Four the financial performance of these indices is compared. The paper concludes in Chapter Five with a short summary of the results and provides guidance for an investor who wants to invest sustainably.

II. Data

We use various data sources for our analyses. The index and financial data are provided by Refinitiv Datastream and MSCI ESG Indices. The sustainability data on the index constituents is from the two major ESG databases Refinitiv ESG and ISS ESG.² Furthermore, we use the Carhart factors for Germany from AQR.³

In addition to the index prices, Refinitiv Datastream also provides information on the constituents of all German indices: DAX 50 ESG, DAX, MDAX, TecDAX, SDAX, and HDAX. From MSCI ESG, we use indices data on index prices and information on the constituents of the following MSCI ESG indices for different regions: MSCI ESG Universal Germany, MSCI ESG Universal EMU, MSCI ESG Universal Europe, MSCI ESG Universal World, and MSCI ESG Universal ACWI.⁴ This index family is best suited for a comparison with the DAX 50 ESG, because MSCI builds these indices for investors who look to enhance their exposure to ESG while maintaining a broad and diversified universe to invest in. These indices exclude only firms found to be in violation of international norms (e.g. facing very severe controversies related to human rights, labor rights or the environment) and firms involved in controversial weapons (landmines, cluster munitions, depleted uranium, and biological and chemical weapons). The indices increase exposure to firms that have both a higher MSCI ESG rating and a positive ESG trend by reweighting free float market capitalization weights based on ESG indicators that are moving away from free float market capitalization weights. The MSCI ESG Germany, e.g. contains 41 constituents of the DAX 50 ESG that accounts for 75% of the constituents of the MSCI index.

The information on the conduct dimension of a firm's sustainability includes ratings and scores of ISS ESG and of Refinitiv ESG. The ESG Corporate Rating from ISS ESG provides highly relevant material and forward-looking environ-

² Refinitiv Datastream is formerly known as Thomson Reuters Datastream and Refinitiv ESG as Thomson Reuters ESG. ISS ESG also includes all data from oekom research through its acquisition.

³ <https://www.aqr.com/Insights/Datasets>.

⁴ In the following, the MSCI ESG Universal is shortened to MSCI ESG for reasons of better readability.

mental, social and governance data and performance evaluations. A firm's ESG performance is assessed using a standard set of cross-sector indicators, supplemented by sector-specific indicators to address a firm's key ESG challenges. An international methodology panel ensures high quality analysis, indicators, evaluation structures and results. An external rating committee (consisting of ESG and SDG experts) supports the design of the sector-specific criteria and carries out a final review of the results. Refinitiv ESG results are designed to objectively measure a firm's relative ESG performance, commitment and effectiveness in ten key areas (emissions, eco-innovation, resource use, human rights, community, workforce, product responsibility, management, shareholders, and CSR strategy) based on reported data. They also provide an overall ESG score, which is discounted for significant ESG controversies affecting a firm's sustainable performance. In our analyses, we use data points from both databases that can be very alike or are specific to one database.

In order to be able to make additional assessments about the product dimension of sustainability, we use a unique SDG dataset from ISS ESG to assess the impact of a firm's product and service portfolio on the UN Sustainable Development Goals (SDGs). The SDG performance of a firm is gathered from public sources (e.g. international media), from interviews with independent experts on corporate sustainability (e.g. international NGOs and scientific institutions) and from the firms evaluated (e.g. annual report, CSR report, and website).

We are aware that a strict separation of the two sustainability dimensions is not possible in all key figures. In recent years, both data providers have included

Table 1
Index Overview

| <i>Panel A. Germany</i> | <i>DAX 50 ESG</i> | <i>DAX</i> | <i>MDAX</i> | <i>TecDAX</i> | <i>SDAX</i> | <i>HDAX</i> |
|----------------------------|-----------------------|---------------------------------|-----------------------------|--------------------------------|-------------------------------|------------------------------|
| Constituents | 50 | 30 | 60 | 30 | 70 | 99 |
| Coverage ISS ESG (%) | 100.00 | 100.00 | 95.00 | 93.33 | 62.86 | 96.97 |
| Coverage Refinitiv ESG (%) | 54.00 | 53.33 | 61.67 | 76.67 | 71.43 | 61.62 |
| <i>Panel B. World</i> | <i>DAX 50 ESG</i> | <i>MSCI ESG Germany</i> | <i>MSCI ESG EMU</i> | <i>MSCI ESG Europe</i> | <i>MSCI ESG World</i> | <i>MSCI ESG ACWI</i> |
| Constituents | 50 | 55 | 238 | 426 | 1,614 | 2,921 |
| Coverage ISS ESG (%) | 100.00 | 96.36 | 98.32 | 96.95 | 97.03 | 83.40 |
| Coverage Refinitiv ESG (%) | 54.00 | 52.73 | 56.72 | 64.55 | 56.26 | 50.12 |

indicators on products and their sustainable impact within their ESG methodologies. Nevertheless, an explicit product orientation, as it is reasonable to address the SDGs, plays only a subordinate role in such methodologies and should therefore be considered separately.

All data from all databases refers to the same reporting date: 31 December 2019. The data collection took place in May 2020 to achieve the largest possible number of coverage and to ensure high data quality through correspondingly time-consuming checks in the databases. A brief overview of all indices analyzed can be found in Table 1.

Table 1 shows that data from ISS ESG is available for more than 90% of the index constituents in most cases. In the case of Refinitiv ESG, the coverage is limited to between 50% and 70% of the constituents of the various indices. It should be noted that, particularly in the case of Refinitiv ESG, new data points or changes in the data for 2019 may still occur in 2020 and, possibly, even 2021. We work with the available information in all databases, which means that not all variables are available for all constituents. However, it is ensured that not a few firms can drive the results of the index by not including the corresponding variables in the analysis. Overall, both databases contain a sufficient number of constituents to allow an assessment of the sustainability performance of the indices.

III. Sustainability Performance

In this paper, we measure the sustainability performance of an index at the conduct (ESG) and at the product (SDGs) dimension of its constituents. First, we look at ESG ratings and scores. We then provide the results for each of the three individual pillars E(nvironmental), S(ocial) and G(overnance), as well as of selected sub-categories. Finally, we compare the SDGs performance, i.e. the extent to which a firm's products and services are aligned with the SDGs. Thereby we want to investigate whether the DAX 50 ESG has a significantly higher sustainability performance than comparable indices.

1. Conduct Dimension of Sustainability

Typically, investors rely on ESG ratings and scores to assess the sustainability performance of a firm or index (Christensen et al. 2019). Within an ESG rating framework, a firm is usually assessed using a standard set of cross-sector indicators, supplemented by sector-specific indicators to address the firm's key ESG challenges (Li/Polychronopoulos 2020). In addition to an overall ESG rating, the sustainability performance for each of the individual pillars, E, S and G, can also be analyzed. In this section, we would like to measure the sustainability perfor-

mance of the DAX 50 ESG as well as of comparable indices, both at the top level of the ESG rating and within the individual pillars.

a) ESG

First, we examine the ESG ratings of ISS ESG and Refinitiv ESG in Table 2. It shows that the constituents of the DAX 50 ESG have on average the second highest ESG rating of all German indices in both databases. The DAX has the highest ESG rating, but it is not statistically significantly different from the DAX 50 ESG. This can also be explained by the fact that 23 of the 30 DAX firms are included in the DAX 50 ESG. Even if additional controversies are included, this result remains stable.⁵ If we also look at the other MSCI ESG Universal indices,

Table 2
ESG Performance Measures

| <i>Panel A. Germany</i> | <i>DAX 50 ESG</i> | <i>Ex DAX 50 ESG</i> | <i>DAX</i> | <i>MDAX</i> | <i>TecDAX</i> | <i>SDAX</i> | <i>HDAX</i> |
|-------------------------|-----------------------|------------------------------|---------------------------------|-----------------------------|--------------------------------|-------------------------------|------------------------------|
| <i>ISS ESG</i> | | | | | | | |
| ESG Performance Score | 51.25 | 38.38*** | 53.53 | 41.40*** | 39.08*** | 38.75*** | 44.26*** |
| <i>Refinitiv ESG</i> | | | | | | | |
| ESG Score | 72.12 | 46.83*** | 80.09* | 57.69*** | 45.92*** | 41.81*** | 60.72** |
| ESG Controversies Score | 55.42 | 79.81*** | 41.29 | 69.53 | 79.00** | 86.58*** | 63.40 |
| ESG Combined Score | 56.58 | 44.21*** | 58.49 | 51.48 | 44.83** | 40.94*** | 51.29 |
| <i>Panel B. World</i> | <i>DAX 50 ESG</i> | <i>Ex DAX 50 ESG</i> | <i>MSCI ESG Germany</i> | <i>MSCI ESG EMU</i> | <i>MSCI ESG Europe</i> | <i>MSCI ESG World</i> | <i>MSCI ESG ACWI</i> |
| <i>ISS ESG</i> | | | | | | | |
| ESG Performance Score | 51.25 | 31.70*** | 49.70 | 49.32* | 47.95** | 36.17*** | 32.05*** |
| <i>Refinitiv ESG</i> | | | | | | | |
| ESG Score | 72.12 | 56.67*** | 73.03 | 71.76 | 70.00 | 59.21*** | 56.94*** |
| ESG Controversies Score | 55.42 | 71.53*** | 49.83 | 56.62 | 62.38 | 75.52*** | 71.21*** |
| ESG Combined Score | 56.58 | 52.03 | 57.40 | 60.30 | 59.77 | 53.63 | 52.12 |

Notes: The stars indicate the significance of the difference between the mean of an index and the mean of the DAX 50 ESG measured using an unpaired t-test: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

⁵ When considering the controversies, a higher value here represents a higher number and worse impact of controversies on the sustainability performance.

the ESG performance score of ISS ESG is always lower, but the ESG score of Refinitiv ESG is higher for the MSCI ESG Germany compared to the DAX 50 ESG.

If we consider the ESG score alone as the key indicator of how an investor should evaluate the sustainability performance of an investment, an investment in the DAX is the best choice. Nevertheless, the ESG rating is an aggregation of numerous sustainability indicators. Taking them into account, we get a holistic, yet much more complex picture of the sustainability of an index.

b) Environment

In this first section, we analyze the environmental performance of the different indices. There are numerous studies on measuring corporate environmental performance and its relationship to financial performance (*Chava 2014; De Haan/Dam/Scholtens 2012; Horváthová 2010*). However, there is an unclear relationship here, which depends, inter alia, on which figures are used to determine environmental performance.

To measure our environmental performance, we first review the Environmental Rating of ISS ESG and the Environmental Pillar Score of Refinitiv ESG in Table 3. The highest value in both databases for a German index is assigned to the DAX, followed by the DAX 50 ESG and the HDAX. Firms that are not part of the DAX 50 ESG have an average 17% to 28% significant lower environmental performance. Compared to global indices, the DAX 50 ESG has the highest Environmental Rating, but only the third highest Environmental Pillar Score after the MSCI ESG EMU and the MSCI ESG Germany. However, the mean values do not differ statistically singularly from one another. Beyond that, we find some evidence of the disagreement between the two databases on the environmental performance of their constituents.

In both databases, the environmental performance is divided into three sub-categories. For ISS ESG: Environmental Management, Products and Services, and Eco-Efficiency. For Refinitiv ESG: Emission Score, Environmental Innovation Score, and Resource Use Score. We detect the same ranking of the indices for all six sub-categories, which indicates an overall higher environmental performance of the DAX compared to the DAX 50 ESG. Despite this result, the DAX 50 ESG constituents are on average more sustainable in these environmental categories than non-included German firms or compared to the firms of the MSCI ESG Universal ACWI.

In the following, we would like to take a closer look at one key issue of environmental sustainability. The role of carbon emissions is widely discussed in the literature. Studies, e.g. show that it is cost-effective to minimize emissions, thereby reducing, inter alia, the level and likelihood of physical and transitory risks (*Görge et al. 2020; Matsumura/Prakash/Vera-Muñoz 2014*). Our results

Table 3
Environmental Performance Measures

| <i>Panel A. Germany</i> | | | | | | | |
|----------------------------------|-----------------------|------------------------------|---------------------------------|-----------------------------|--------------------------------|-------------------------------|------------------------------|
| | <i>DAX 50 ESG</i> | <i>Ex DAX 50 ESG</i> | <i>DAX</i> | <i>MDAX</i> | <i>TecDAX</i> | <i>SDAX</i> | <i>HDAX</i> |
| <i>ISS ESG</i> | | | | | | | |
| Environmental Rating | 2.20 | 1.83*** | 2.27 | 1.88*** | 1.81*** | 1.88*** | 1.98*** |
| Environmental Management | 2.51 | 1.83*** | 2.63 | 2.00*** | 1.83*** | 1.80*** | 2.16*** |
| Products and Services | 2.00 | 1.81** | 2.05 | 1.81** | 1.81* | 1.86 | 1.87* |
| Eco-efficiency | 2.70 | 1.82*** | 2.77 | 1.98*** | 1.65*** | 1.96*** | 2.17*** |
| <i>Refinitiv ESG</i> | | | | | | | |
| Environment Pillar Score | 70.48 | 50.46*** | 76.25 | 57.32** | 44.85*** | 46.61*** | 58.70** |
| Emission Score | 74.64 | 45.10*** | 76.06 | 56.68*** | 45.70*** | 42.58*** | 59.41** |
| Environmental Innovation Score | 57.83 | 36.68*** | 68.14 | 48.94 | 39.23* | 30.04*** | 49.62 |
| Resource Use Score | 80.89 | 49.33*** | 86.22 | 62.28*** | 48.98*** | 44.99*** | 64.66** |
| CO ₂ Total (10.000 t) | 301.35 | 98.60* | 394.08 | 174.47 | 20.22 | 57.01* | 245.55 |
| <i>Panel B. World</i> | | | | | | | |
| | <i>DAX 50 ESG</i> | <i>Ex DAX 50 ESG</i> | <i>MSCI ESG Germany</i> | <i>MSCI ESG EMU</i> | <i>MSCI ESG Europe</i> | <i>MSCI ESG World</i> | <i>MSCI ESG ACWI</i> |
| <i>ISS ESG</i> | | | | | | | |
| Environmental Rating | 2.20 | 1.72*** | 2.16 | 2.19 | 2.14 | 1.82*** | 1.73*** |
| Environmental Management | 2.51 | 1.86*** | 2.45 | 2.50 | 2.43* | 1.99*** | 1.88*** |
| Products and Services | 2.00 | 1.63*** | 1.98 | 1.99 | 1.95 | 1.72*** | 1.64*** |
| Eco-efficiency | 2.70 | 1.89*** | 2.58 | 2.71 | 2.64 | 2.06*** | 1.90*** |
| <i>Refinitiv ESG</i> | | | | | | | |
| Environment Pillar Score | 70.48 | 54.30*** | 71.36 | 73.37 | 68.83 | 55.50*** | 54.58*** |
| Emission Score | 74.64 | 58.96*** | 72.56 | 79.38 | 75.60 | 60.91** | 59.21** |
| Environmental Innovation Score | 57.83 | 45.19** | 60.30 | 62.23 | 55.79 | 44.77** | 45.44** |
| Resource Use Score | 80.89 | 58.20*** | 80.89 | 79.71 | 75.72 | 60.23*** | 58.57*** |
| CO ₂ Total (10.000 t) | 301.35 | 454.05 | 306.92 | 423.95 | 354.03 | 297.61 | 451.46 |

Notes: The stars indicate the significance of the difference between the mean of an index and the mean of the DAX 50 ESG measured using an unpaired t-test: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

show that the DAX 50 ESG have lower carbon emissions than the DAX constituents. However, the larger firms in the DAX, as they usually emit more carbon emissions, distort the results. Furthermore, a global comparison shows that the carbon emissions caused by DAX 50 ESG firms are on average the second lowest. Although carbon emissions will have to be significantly reduced in the fu-

ture to combat climate change, it is evident that DAX 50 ESG firms are better prepared due to their high scores regarding their GHG emission reduction targets & action plans and their disclosure of their climate change risks & mitigation strategies.

c) Social

In this second section, we are going to discuss the social performance of the constituents of each index. Corporate social performance is important, as it can also be a driver of financial performance. Previous studies have found a U-shaped relationship, i. e. low social performance delivers higher and high social performance delivers the highest financial performance compared to moderate social performance (*Barnett/Salomon 2012*).

Table 4 provides the results for several social performance measures. First, we look at the two aggregated social ratings. Regarding ISS ESG, it should be noted that the social rating is combined with the governance rating. The highest values are found for the DAX, closely followed by the DAX 50 ESG constituents. The values do not differ statistically here. The DAX 50 ESG firms have a 20% higher social performance compared to the other firms in the HDAX universe. The differences remain if we look at the ISS ESG category Staff and Suppliers. A higher value for Staff and Suppliers can indicate a higher future financial performance, e. g. through a higher employee satisfaction (*Edmans 2011*).

At Refinitiv ESG, the Social Score consists of four different sub-categories: Workforce, Human Rights, Community, and Product Responsibility. Our results show that DAX and DAX 50 ESG firms have very high scores in the first two categories, followed by lower scores in the second two categories. Overall, the DAX 50 ESG has a very similar social performance to its next two indices, the DAX and the MSCI ESG Universal Germany, but mostly a higher performance compared to the other indices.

d) Governance

In this third section, we are going to discuss the governance performance of the constituents of each index. Most of the existing evidence points to a positive association between corporate governance and various performance indicators. Yet this line of research suffers from endogeneity problems that are difficult to solve. The emerging conclusion is that corporate governance is likely to evolve endogenously and from specific characteristics of the firm and its environment (*Love 2011*).

Table 4
Social Performance Measures

| <i>Panel A. Germany</i> | | | | | | | |
|------------------------------------|-----------------------|------------------------------|---------------------------------|-----------------------------|--------------------------------|-------------------------------|------------------------------|
| | <i>DAX 50 ESG</i> | <i>EX DAX 50 ESG</i> | <i>DAX</i> | <i>MDAX</i> | <i>TecDAX</i> | <i>SDAX</i> | <i>HDAX</i> |
| <i>ISS ESG</i> | | | | | | | |
| Social and Governance Rating | 2.41 | 1.99*** | 2.46 | 2.12*** | 2.03*** | 1.96*** | 2.19*** |
| Staff and Suppliers | 2.44 | 1.97*** | 2.53 | 2.09*** | 1.92*** | 1.95*** | 2.20*** |
| Society and Product Responsibility | 2.27 | 1.89*** | 2.34 | 2.01*** | 1.99*** | 1.85*** | 2.08*** |
| <i>Refinitiv ESG</i> | | | | | | | |
| Social Pillar Score | 77.60 | 56.03*** | 83.23 | 66.92** | 52.75*** | 47.96*** | 68.01** |
| Workforce Score | 87.63 | 63.25*** | 90.55 | 75.04*** | 68.67*** | 58.95*** | 77.28** |
| Human Rights Score | 80.31 | 50.70*** | 86.49 | 65.68** | 51.52*** | 44.16*** | 67.83* |
| Community Score | 68.09 | 41.98*** | 73.76 | 56.16 | 34.30*** | 35.41*** | 56.65 |
| Product Responsibility Score | 74.53 | 51.87*** | 80.54 | 62.40* | 51.24*** | 47.14*** | 65.17 |
| <i>Panel B. World</i> | | | | | | | |
| | <i>DAX 50 ESG</i> | <i>EX DAX 50 ESG</i> | <i>MSCI ESG Germany</i> | <i>MSCI ESG EMU</i> | <i>MSCI ESG Europe</i> | <i>MSCI ESG World</i> | <i>MSCI ESG ACWI</i> |
| <i>ISS ESG</i> | | | | | | | |
| Social and Governance Rating | 2.41 | 1.86*** | 2.38 | 2.32** | 2.27*** | 1.98*** | 1.87*** |
| Staff and Suppliers | 2.44 | 1.74*** | 2.43 | 2.36** | 2.28*** | 1.84*** | 1.75*** |
| Society and Product Responsibility | 2.27 | 1.79*** | 2.25 | 2.18** | 2.14*** | 1.88*** | 1.79*** |
| <i>Refinitiv ESG</i> | | | | | | | |
| Social Pillar Score | 77.60 | 56.65*** | 77.99 | 75.01 | 72.72** | 59.84*** | 57.01*** |
| Workforce Score | 87.63 | 63.67*** | 86.21 | 80.76** | 79.19** | 65.08*** | 64.04*** |
| Human Rights Score | 80.31 | 50.36*** | 83.31 | 80.70 | 77.31* | 53.08*** | 50.89*** |
| Community Score | 68.09 | 53.27*** | 68.77 | 69.16 | 67.68 | 60.56* | 53.52*** |
| Product Responsibility Score | 74.53 | 55.52*** | 72.26 | 68.32 | 65.56 | 58.40*** | 55.83*** |

Notes: The stars indicate the significance of the difference between the mean of an index and the mean of the DAX 50 ESG measured using an unpaired t-test: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5 presents the results for numerous governance performance measures. As social and governance performance are determined together at ISS ESG, we find here the same results as in the previous chapter: The DAX 50 ESG has the second highest performance after the DAX. In the case of Refinitiv ESG, a Governance Pillar Score is explicitly collected. The constituents of the DAX 50 ESG have an average governance performance that is almost 50 % higher than that of firms that are not included. However, the DAX also has the highest governance

Table 5
Governance Performance Measures

| <i>Panel A. Germany</i> | | | | | | | |
|--|-------------------|----------------------|-------------------------|---------------------|------------------------|-----------------------|----------------------|
| | <i>DAX 50 ESG</i> | <i>EX DAX 50 ESG</i> | <i>DAX</i> | <i>MDAX</i> | <i>TecDAX</i> | <i>SDAX</i> | <i>HDAX</i> |
| <i>ISS ESG</i> | | | | | | | |
| Social and Governance Rating | 2.41 | 1.99*** | 2.46 | 2.12*** | 2.03*** | 1.96*** | 2.19*** |
| Corporate Governance and Business Ethics | 2.63 | 2.22*** | 2.63 | 2.40*** | 2.20*** | 2.17*** | 2.44** |
| <i>Refinitiv ESG</i> | | | | | | | |
| Governance Pillar Score | 67.48 | 45.52*** | 79.25 | 52.33*** | 41.71*** | 39.14*** | 56.72* |
| Management Score | 68.00 | 41.84*** | 85.88** | 49.17** | 41.83*** | 36.44*** | 56.71 |
| Shareholders Score | 62.31 | 45.18** | 62.56** | 56.16 | 38.95*** | 40.75*** | 54.04 |
| CSR Strategy Score | 71.89 | 36.73*** | 73.98 | 50.37*** | 34.82*** | 33.70*** | 53.26*** |
| <i>Panel B. World</i> | | | | | | | |
| | <i>DAX 50 ESG</i> | <i>EX DAX 50 ESG</i> | <i>MSCI ESG Germany</i> | <i>MSCI ESG EMU</i> | <i>MSCI ESG Europe</i> | <i>MSCI ESG World</i> | <i>MSCI ESG ACWI</i> |
| <i>ISS ESG</i> | | | | | | | |
| Social and Governance Rating | 2.41 | 1.86*** | 2.38 | 2.32** | 2.27*** | 1.98*** | 1.87*** |
| Corporate Governance and Business Ethics | 2.63 | 2.23*** | 2.59 | 2.55 | 2.56 | 2.45** | 2.24*** |
| <i>Refinitiv ESG</i> | | | | | | | |
| Governance Pillar Score | 67.48 | 57.24*** | 68.78 | 65.63 | 67.11 | 60.12** | 57.43*** |
| Management Score | 68.00 | 59.77** | 72.54 | 69.26 | 70.87 | 64.18 | 59.95* |
| Shareholders Score | 62.31 | 51.69 | 58.88 | 54.87 | 54.19 | 52.15 | 51.79 |
| CSR Strategy Score | 71.89 | 53.42*** | 65.90 | 64.90* | 68.77 | 52.51*** | 53.75*** |

Notes: The stars indicate the significance of the difference between the mean of an index and the mean of the DAX 50 ESG measured using an unpaired t-test: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

performance by this measure compared to the DAX 50 ESG. Taking the MSCI ESG indices into account, only the MSCI ESG Germany index has a higher Governance Pillar Score than the DAX 50 ESG.

Governance performance in ESG can only be examined more closely in the sub-category Corporate Governance and Business Ethics. Here it can be seen that the DAX 50 ESG and the DAX are on a par. In Refinitiv, the Governance Pillar Score is split into three sub-categories: Management Score, Shareholders Score, and CSR Strategy Score. Our results show that the difference between DAX 50 ESG and DAX in their governance performance according to Refinitiv ESG is mainly due to the different Management Score. Compared to the MSCI

ESG Germany, the DAX 50 ESG also has a lower Management Score, but a higher Shareholder and CSR Strategy Score. Overall, the DAX 50 ESG can achieve a comparable governance performance.

2. Product Dimension of Sustainability

If an investor wants to look at the sustainability of a firm's products and services, SDGs can enable him to measure a product's impact on the achievement of sustainability goals. However, in many cases, the pursuit of social goals is often associated with higher environmental impacts. Studies have shown, e.g. that the eradication of extreme poverty and the reduction of income inequalities often leads to higher environmental impact. (Scherer et al. 2018).

Our ISS SDG dataset comprises information on the impact of a firm's product and service portfolio on the UN Sustainable Development Goals (SDGs). As the UN SDGs primarily target states and the public sector, not all the goals are relevant for firms. For this reason, ISS rates firms according to its own 15 specified firm-relevant Sustainability Objectives that are closely aligned with the UN's 17 SDGs; the ISS SDG objectives belong to either the environment pillar or the social pillar as shown in Table 6.

ISS conducts a qualitative analysis for each individual sustainability objectives: (1) whether a product or service category makes a significant or limited net contribution to the achievement of the objective; (2) whether it has neither an explicitly positive nor an explicitly negative impact; (3) or whether the product or service actually represents a limited or significant obstacle to the achieve-

Table 6
Sustainable Products Performance Measures

| Panel A. Germany | | | | | | | |
|-----------------------------------|---------------|---------------------|------|-------|--------|-------|-------|
| | DAX 50 ESG | EX DAX 50 ESG | DAX | MDAX | TecDAX | SDAX | HDAX |
| <i>ISS ESG</i> | | | | | | | |
| Sustainable Solutions Score | 0.91 | 1.74 | 0.56 | 1.46 | 2.66** | 1.96 | 1.20 |
| Social Pillar Score | 1.12 | 1.22 | 1.45 | 1.31 | 2.07 | 0.83 | 1.25 |
| Alleviating Poverty | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Combating Hunger and Malnutrition | -0.02 | -0.06 | 0.00 | -0.01 | 0.00 | -0.10 | -0.01 |
| Ensuring Health | 0.74 | 1.00 | 1.09 | 0.85 | 1.69 | 0.83 | 0.85 |
| Delivering Education | 0.01 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 |
| Attaining Gender Equality | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 |
| Providing Basic Services | 0.47 | 0.37 | 0.62 | 0.46 | 0.41 | 0.20 | 0.49 |
| Safeguarding Peace | 0.00 | -0.06 | 0.00 | -0.06 | -0.01 | -0.03 | -0.05 |

| <i>Panel A. Germany</i> | | | | | | | |
|--|-------------------|----------------------|-------------------------|---------------------|------------------------|-----------------------|----------------------|
| | <i>DAX 50 ESG</i> | <i>EX DAX 50 ESG</i> | <i>DAX</i> | <i>MDAX</i> | <i>TecDAX</i> | <i>SDAX</i> | <i>HDAX</i> |
| Environmental Pillar Score | -0.16 | 0.52 | -0.80* | 0.12 | 0.63* | 1.16** | -0.04 |
| Achieving Sustainable Agr. & Forestry | -0.02 | 0.00 | -0.05 | 0.01 | 0.00 | 0.01 | -0.01 |
| Conserving Water | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Contributing to Sustainable Energy use | -0.17 | 0.24* | -0.79 | 0.03 | 0.63** | 0.74* | -0.09 |
| Promoting Sustainable Buildings | 0.09 | 0.15 | 0.03 | 0.08 | 0.00 | 0.25 | 0.06 |
| Optimizing Material use | 0.01 | 0.13 | 0.01 | 0.04 | 0.00 | 0.19 | 0.03 |
| Mitigating Climate Change | -0.16 | 0.30 | -0.64 | 0.03 | 0.63** | 0.76* | -0.05 |
| Preserving Marine Ecosystems | -0.06 | -0.01 | -0.04 | -0.04 | 0.00 | -0.01* | -0.03 |
| Preserving Terrestrial Ecosystems | -0.05 | -0.02 | -0.08 | -0.04 | 0.00 | 0.00* | -0.05 |
| <i>Panel B. World</i> | | | | | | | |
| | <i>DAX 50 ESG</i> | <i>EX DAX 50 ESG</i> | <i>MSCI ESG Germany</i> | <i>MSCI ESG EMU</i> | <i>MSCI ESG Europe</i> | <i>MSCI ESG World</i> | <i>MSCI ESG ACWI</i> |
| <i>ISS ESG</i> | | | | | | | |
| Sustainable Solutions Score | 0.91 | 0.01 | 1.07 | 0.35 | 0.36 | 0.34 | 0.02 |
| Social Pillar Score | 1.12 | 0.51 | 1.47 | 0.59 | 0.59 | 0.69 | 0.52 |
| Alleviating poverty | 0.00 | -0.03 | 0.00 | -0.02 | -0.02 | -0.03 | -0.03 |
| Combating Hunger and Malnutrition | -0.02 | -0.28 | -0.02 | -0.33 | -0.34 | -0.26 | -0.27 |
| Ensuring Health | 0.74 | 0.36 | 1.08 | 0.47 | 0.46 | 0.51 | 0.37 |
| Delivering Education | 0.01 | 0.03 | 0.00 | 0.01 | 0.05 | 0.03 | 0.03 |
| Attaining Gender Equality | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Providing Basic Services | 0.47 | 0.26 | 0.56 | 0.33 | 0.28 | 0.29 | 0.26 |
| Safeguarding Peace | 0.00 | 0.01 | 0.00 | -0.03 | -0.01 | 0.01 | 0.01 |
| Environmental Pillar Score | -0.16 | -0.50 | -0.35 | -0.18 | -0.20 | -0.33 | -0.49 |
| Achieving Sustainable Agr. & Forestry | -0.02 | 0.02 | 0.00 | 0.07 | 0.07 | 0.02 | 0.01 |
| Conserving Water | 0.00 | -0.01 | 0.00 | 0.03 | 0.05 | -0.03 | -0.01 |
| Contributing to Sustainable Energy use | -0.17 | -0.53 | -0.41 | -0.42 | -0.41 | -0.44 | -0.53 |
| Promoting Sustainable Buildings | 0.09 | 0.09 | 0.08 | 0.15 | 0.12 | 0.12 | 0.09 |
| Optimizing Material use | 0.01 | 0.03 | 0.01 | 0.06 | 0.05 | 0.03 | 0.03 |
| Mitigating Climate Change | -0.16 | -0.49 | -0.33 | -0.34 | -0.38 | -0.38 | -0.48 |
| Preserving Marine Ecosystems | -0.06 | -0.06 | -0.05 | -0.02 | -0.06 | -0.06 | -0.06 |
| Preserving Terrestrial Ecosystems | -0.05 | -0.11 | -0.07 | 0.00 | -0.03 | -0.08 | -0.11 |

Notes: The stars indicate the significance of the difference between the mean of an index and the mean of the DAX 50 ESG measured using an unpaired t-test: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

ment of the objective. The relevant share of net sales is indicated for each of the classified categories of products and services for which a net sales share of 1 % or higher can be reasonably estimated.

We first look at the ISS Sustainability Solutions Score. It is a single score that evaluates the aggregated contribution of a firm's product portfolio to the achievement of SDGs – in short: it represents the overall performance of a firm's SDGs. The Sustainability Solutions Scores only considers the most pronounced sustainable objectives (i. e. the highest positive and/or the lowest negative score). For firms without negative target scores, it is determined by the highest positive SOS and vice versa. For firms that have both positive and negative impacts on sustainability targets, the score is calculated as the sum of the highest positive and lowest negative sustainable objectives. The score is on a scale of -10.0 to 10.0. The Social and Environmental Pillar Scores follow the same general idea, but only consider the social or environmental target scores.

A look at the results shows that the TecDAX has the significant highest Sustainable Solutions Score, followed by firms in the SDAX and in the HDAX universe that are not included in the DAX 50 ESG. In the following, we will break down how this ranking emerged.

a) Social

The social pillar comprises seven sustainable objectives: alleviating poverty, combating hunger and malnutrition, ensuring health, delivering education, attaining gender equality, providing basic services, and safeguarding peace. The social pillar score is highest on average for the TecDAX and lowest for the SDAX in Germany. The main driver for the high SDG performance of the TecDAX is the high contribution to the sustainable objectives ensuring health and providing basic services. This means that TecDAX firms manufacture products or provide services in these two areas that are beneficial to the assigned SDGs. Across all indices, included firms provide on average unhealthy food (combating hunger and malnutrition) or are involved in the production of weapons or weapons (safeguarding peace) systems. This reduces the overall social SDG performance among German indices. Viewed globally, the MSCI ESG Universal Germany has the highest and the MSCI ESG Universal ACWI the lowest social pillar score. Global indices show a lower contribution to ensuring health and even higher damage to combating hunger and malnutrition. In addition, a few firms also contribute or harm the SDGs in other social sustainable objectives to a minor degree.

b) Environmental

The environmental pillar comprises of seven sustainable objectives: achieving sustainable agriculture & forestry, conserving water, contributing to sustainable energy use, promoting sustainable buildings, optimizing material use, mitigating climate change, preserving marine ecosystems, and terrestrial ecosystems.

On average, the environmental pillar score is highest for the SDAX, followed by the TecDAX and firms that are not included in the DAX 50 ESG. A closer look at the SDAX shows that the constituents in particular offer products and services that provide sustainable & climate-friendly energy. In addition, they promote sustainable business and are resource efficient by optimizing their material use. The contribution to these sustainable objectives and yet no significant negative impact leads to this high environmental SDG performance. However, the DAX 50 ESG has firms that provide non-sustainable energy, facilitate climate change, and threaten the marine and terrestrial ecosystem. The largest contribution to sustainable objectives across many indices lies in the promotion of sustainable buildings. All single results indicate an overall negative contribution to SDGs. Compared to the DAX or even the international indices, however, this influence is less negative.

Overall, it can be said that the DAX 50 ESG shows a good sustainable performance in many areas but is not significantly better than comparable indices. It should, however, take particular account of firms' products in terms of their impact on the environment related SDGs. Besides, the data providers disagree on some data points as to which index is more sustainable. In order to create a holistically sustainable index, it is not enough (1) to use only ESG and thereby neglect SDGs data and (2) to use sustainability data from only one data provider. A German investor can draw the following conclusions. An index with a focus on ESG only covers part of the sustainability the investor may seek. And a conventional index can show a similarly high sustainability performance as a sustainable one within the German market.

IV. Financial Performance

We assess the financial performance of each index in five steps. First, we look at raw returns and risk-adjusted performance measures. Second, we analyze three different risk measures. To explain the relatively poor performance of the DAX 50 ESG, we third examine the factor exposures of the various indices. Fourth, we divide our time period into the period before and during the COVID-19 crisis and consider these periods separately. Fifth, we apply an event study approach to show whether firms are rewarded or penalized when they are included in the DAX 50 ESG.

1. Performance

Besides the sustainability performance of a sustainable index, it is important for an investor to be aware of the associate financial performance. Hence, we look at performance indicators such as raw returns, Sharpe Ratio and both

CAPM and Carhart Alpha in the following analysis. The period for the German indices begins with the availability of the first historical quote (backtesting period) of the DAX 50 ESG on 24 September 2012 and for the MSCI ESG indices on 28 May 2015 and ends in both cases on 30 April 2020.

a) Return

First, we look at raw returns of all indices in Table 7. The average annual return of the DAX 50 ESG since its inception is 3.37%. This is significantly the lowest value compared to the other German indices. In a comparison with the MSCI ESG indices, the DAX 50 ESG achieves the lowest return of -2.52% for the shorter period from 28 May 2015 onwards.

b) Sharpe Ratio

In the next step, we consider the Sharpe Ratio as a risk-adjusted performance indicator. We calculate the Sharpe Ratio as the average return earned in excess of the risk-free rate per unit of volatility. We see the same ranking as for the raw returns. The DAX 50 ESG index performs worst, while the TecDAX still performs best.

Table 7
Performance Measures

| <i>Panel A. Germany</i> | | | | | | |
|-------------------------|-----------------------|---------------------------------|-----------------------------|--------------------------------|-------------------------------|------------------------------|
| | <i>DAX 50 ESG</i> | <i>DAX</i> | <i>MDAX</i> | <i>TecDAX</i> | <i>SDAX</i> | <i>HDAX</i> |
| Return | 3.37 | 5.44*** | 10.12** | 16.29*** | 9.99* | 6.51*** |
| Sharpe Ratio | 0.20 | 0.33 | 0.62 | 0.91 | 0.62 | 0.39 |
| CAPM Alpha | -2.05 | 0.38 | 5.62 | 12.90 | 5.73 | 1.51 |
| Carhart Alpha | -0.01 | 2.37 | 5.06 | 10.60 | 6.30 | 2.81 |
| <i>Panel B. World</i> | | | | | | |
| | <i>DAX 50 ESG</i> | <i>MSCI ESG Germany</i> | <i>MSCI ESG EMU</i> | <i>MSCI ESG Europe</i> | <i>MSCI ESG World</i> | <i>MSCI ESG ACWI</i> |
| Return | -2.52 | -1.38 | -0.85 | -1.49 | 3.33 | 3.08 |
| Sharpe Ratio | -0.18 | -0.12 | -0.10 | -0.15 | 0.20 | 0.18 |
| CAPM Alpha | -5.57 | -4.11 | -3.52 | -4.19 | 2.42 | 2.03 |
| Carhart Alpha | -2.41 | -2.22 | -1.70 | -3.20 | 2.95 | 2.50 |

Notes: The stars indicate the significance of the difference between an index and the DAX 50 ESG measured using a paired t-test for daily returns: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

c) Alpha

We use alpha as our third performance indicator to indicate if an index manages to beat the market return. We use both the alpha estimated by a CAPM and a Carhart Four Factor Model (Carhart 1997). We use the German market factor of AQR capital management, which includes all common German stocks. For the estimation of the Carhart Alpha, we also include the three usual risk factors: SMB (Size), HML (Value) and WML (Momentum). Our results show that the DAX 50 ESG cannot beat the market measured by a positive alpha in either period.

In summary, the DAX 50 ESG has a relatively poor performance according to all performance indicators.

2. Risk

In the following, we calculate risk indicators such as standard deviation, market beta and maximum drawdown to be able to assess the risk of the DAX 50 ESG and all other indices.

a) Standard Deviation

As a first risk measure, we consider the annualized standard deviation and the annualized downside standard deviation in Table 8. The latter takes only the standard deviation of negative returns into account in its calculation. The TecDAX has the highest standard deviation of all German indices, while the DAX has the highest downside standard deviation. The DAX 50 ESG has in both indicators an average value compared to the other indices. A similar picture is also evident worldwide. We find that the MSCI ESG EMU has the highest standard deviation and the MSCI ESG Germany the highest downside standard deviation while the DAX 50 ESG ranks for both indicators in the middle.

b) Market Beta

Our next risk indicator is the market beta estimated from a CAPM model. The market beta of an investment is the measure of the risk arising from exposure to general market movements as opposed to idiosyncratic factors. It therefore covers the systematic risk of an investment. The market beta of the DAX 50 ESG is close to one, which means that the market and the index move similarly. In comparison to the German indices, this is the second highest systematic risk, only exceeded by the DAX.

Table 8
Risk Measures

| <i>Panel A. Germany</i> | | | | | | |
|-------------------------|-----------------------|---------------------------------|-----------------------------|--------------------------------|-------------------------------|------------------------------|
| | <i>DAX 50 ESG</i> | <i>DAX</i> | <i>MDAX</i> | <i>TecDAX</i> | <i>SDAX</i> | <i>HDAX</i> |
| Standard Deviation | 19.00 | 19.34 | 17.12*** | 19.93** | 16.68*** | 18.80 |
| Downside SD | 15.12 | 15.48 | 13.69 | 15.30 | 14.04 | 15.23 |
| Market Beta | 1.01 | 1.02 | 0.86 | 0.92 | 0.81 | 1.00 |
| Maximum Drawdown | 44.75 | 38.78 | 38.99 | 33.18 | 38.81 | 39.49 |
| <i>Panel B. World</i> | | | | | | |
| | <i>DAX 50 ESG</i> | <i>MSCI ESG Germany</i> | <i>MSCI ESG EMU</i> | <i>MSCI ESG Europe</i> | <i>MSCI ESG World</i> | <i>MSCI ESG ACWI</i> |
| Standard Deviation | 20.43 | 19.57* | 19.15** | 18.02** | 17.27*** | 16.85*** |
| Downside SD | 16.76 | 16.36 | 16.78 | 15.69 | 15.21 | 14.84 |
| Market Beta | 1.03 | 0.99 | 0.96 | 0.87 | 0.59 | 0.58 |
| Maximum Drawdown | 44.75 | 40.69 | 37.75 | 34.59 | 33.22 | 32.98 |

Notes: The stars indicate the significance of the difference between an index and the DAX 50 ESG measured using a variance homogeneity F test for daily returns: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

c) Maximum Drawdown

As a last risk indicator, we consider the maximum drawdown (MDD). We calculate the MDD as the maximum loss from a peak to a trough of an index before a new peak is attained. The DAX 50 ESG had the highest maximum loss within the period with 44.75% loss in the COVID-19 stock crash. Comparably high values can also be found for all other indices.

Overall, it can be stated that the DAX 50 ESG ranks in the middle by the various risk indicators. It should be noted, however, that our results are significantly influenced by the COVID-19 stock market crash. We therefore carry out an explicit investigation in the second-next section.

3. Factor Exposures

In order to be able to examine the differences in the performance of the various indices in more detail, we look at the factor exposures to size, value, and momentum in Table 9. For this purpose, we use German factors from the AQR Database and estimate constant betas for the entire period. If we look at the DAX 50 ESG or the DAX, we have a notable negative exposure on the size fac-

Table 9
Factor Exposures

| <i>Panel A. Germany</i> | | | | | | |
|-------------------------|-------------------|-------------------------|---------------------|------------------------|-----------------------|----------------------|
| | <i>DAX 50 ESG</i> | <i>DAX</i> | <i>MDAX</i> | <i>TecDAX</i> | <i>SDAX</i> | <i>HDAX</i> |
| Size | -0.56 | -0.64 | -0.20 | 0.02 | 0.20 | -0.54 |
| Value | 0.01 | -0.01 | -0.05 | -0.31 | -0.01 | -0.03 |
| Momentum | -0.04 | -0.03 | 0.05 | 0.11 | -0.06 | 0.00 |
| <i>Panel B. World</i> | | | | | | |
| | <i>DAX 50 ESG</i> | <i>MSCI ESG Germany</i> | <i>MSCI ESG EMU</i> | <i>MSCI ESG Europe</i> | <i>MSCI ESG World</i> | <i>MSCI ESG ACWI</i> |
| Size | -0.55 | -0.53 | -0.47 | -0.42 | -0.30 | -0.28 |
| Value | 0.04 | -0.02 | 0.01 | 0.01 | 0.07 | 0.07 |
| Momentum | -0.04 | 0.03 | 0.02 | 0.06 | 0.06 | 0.06 |

tor. This was to be expected, since the largest firms in Germany are a component of both indices. Regarding the value and momentum factor, the DAX 50 ESG as well as other major German indices do not show any exposure. Therefore, the lower financial performance of the DAX 50 ESG cannot be attributed to differences in factor exposures.

4. Financial Performance During the COVID-19 Crisis

In order to examine the financial performance differences in times of a crisis, we divide our time series into three periods using the COVID-19 crisis in line with previous papers (*Albuquerque et al. 2020; Ramelli/Wagner 2020*). First, we consider the period prior to 2020. Second, we analyze a long crisis period defined as first quarter of 2020. Third, we investigate a short and more pronounced crisis period starting from 24 February to 31 March. We would like to examine here whether the sustainable DAX 50 ESG is more resilient in times of crisis than an index that is not explicitly sustainable, such as the DAX or the HDAX.

First, we note that in the period before COVID-19, the DAX 50 ESG was the worst performing of all German indices, both in terms of return and Sharpe Ratio. The lower risk in this period measured by the standard deviation is not sufficiently compensated. In addition, the DAX 50 ESG has the highest maximum drawdown in this period. If we look at the second period, which includes the first quarter of 2020, the TecDAX performs best. During this COVID-19 period,

the sustainable index cannot outperform the other indices. The same result also occurs when we look at the third period. Even in this most pronounced period of the COVID-19 crisis, we do not find any significant differences between the DAX 50 ESG and other German indices. One possible explanation is that the DAX 50, as can be seen from Chapter 3, does not have a significantly higher sustainability performance, which could allow being more resilient. However, a similar picture emerges when we look at the MSCI ESG Germany. This sustainability index is also not able to outperform the DAX or the HDAX. It might be that ESG performance did not improve resilience during the COVID-19 crisis. A superior performance of sustainable stocks during the crisis period, as *Albuquerque et al. (2020)* find for the American market, cannot be confirmed in our study for the German market.

5. Short-Term Performance Effect of the Inclusion in the DAX 50 ESG

In order to further investigate the performance of the DAX 50 ESG, we analyze the impact of the inclusion of a firm into this index. There are two different

Table 10
Financial Performance During the COVID-19 Crisis

| <i>Panel A. Germany</i> | | | | | | |
|-------------------------|-------------------|------------|-------------|---------------|-------------|-------------|
| | <i>DAX 50 ESG</i> | <i>DAX</i> | <i>MDAX</i> | <i>TecDAX</i> | <i>SDAX</i> | <i>HDAX</i> |
| Return | | | | | | |
| 2012 – 2019 | 6.19 | 8.37*** | 13.71*** | 18.99*** | 13.39* | 9.73*** |
| 2020 Q1 | -19.17 | -18.02 | -18.61 | -15.32** | -17.26 | -19.27 |
| COVID-19 | -27.35 | -26.83 | -27.40 | -19.74 | -28.15 | -27.70 |
| Sharpe Ratio | | | | | | |
| 2012 – 2019 | 0.39 | 0.52 | 0.90 | 1.05 | 0.91 | 0.61 |
| 2020 Q1 | -1.23 | -1.13 | -1.41 | -0.26 | -1.22 | -1.28 |
| COVID-19 | -4.11 | -4.02 | -4.61 | -3.31 | -4.84 | -4.28 |
| Standard Deviation | | | | | | |
| 2012 – 2019 | 16.80 | 17.18 | 15.25*** | 18.58*** | 14.53*** | 16.69 |
| 2020 Q1 | 45.74 | 45.87 | 40.19 | 39.42 | 41.87 | 44.72 |
| COVID-19 | 69.02 | 69.03 | 62.65 | 58.92 | 61.82 | 67.59 |
| Maximum Drawdown | | | | | | |
| 2012 – 2019 | 29.40 | 29.27 | 22.41 | 21.28 | 26.84 | 27.14 |
| 2020 Q1 | 39.62 | 38.78 | 38.99 | 33.18 | 38.81 | 39.49 |
| COVID-19 | 36.09 | 35.24 | 35.77 | 29.30 | 34.72 | 36.03 |

Panel B. World

| | DAX 50 ESG | MSCI ESG Germany | MSCI ESG EMU | MSCI ESG Europe | MSCI ESG World | MSCI ESG ACWI |
|--------------------|---------------|------------------------|--------------------|-----------------------|----------------------|---------------------|
| Return | | | | | | |
| 2012–2019 | 6.19 | 5.76 | 7.12 | 1.66 | 5.91 | 5.73 |
| 2020 Q1 | -19.17 | -18.68 | -19.89 | -17.24 | -9.60 | -10.17 |
| COVID-19 | -27.35 | -26.39 | -26.38 | -24.34 | -22.95 | -22.89 |
| Sharpe Ratio | | | | | | |
| 2012–2019 | 0.39 | 0.38 | 0.48 | 0.06 | 0.40 | 0.39 |
| 2020 Q1 | -1.23 | -1.25 | -1.40 | -1.30 | -0.50 | -0.59 |
| COVID-19 | -4.11 | -4.04 | -4.08 | -4.00 | -3.20 | -3.37 |
| Standard Deviation | | | | | | |
| 2012–2019 | 16.80 | 16.03* | 15.88** | 15.31*** | 13.33*** | 13.19*** |
| 2020 Q1 | 45.74 | 44.29 | 43.10 | 39.82 | 44.53 | 42.66 |
| COVID-19 | 69.02 | 67.46 | 66.74 | 62.42 | 70.89 | 67.70 |
| Maximum Drawdown | | | | | | |
| 2012–2019 | 29.40 | 29.32 | 26.46 | 24.45 | 20.47 | 20.94 |
| 2020 Q1 | 39.62 | 39.22 | 37.75 | 34.59 | 33.22 | 32.98 |
| COVID-19 | 36.09 | 35.84 | 34.26 | 31.17 | 29.89 | 29.62 |

Notes: The stars indicate the significance of the difference between an index and the DAX 50 ESG measured using a paired t-test and variance homogeneity F test for daily returns: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

competing theoretical perspectives here, namely the revisionist view (Porter 1991; Porter/van der Linde 1995), which suggests a positive impact on the inclusion into a sustainable index, and the traditional view (Friedman 2002; Walley/Whitehead 1994), which suggests a negative impact.⁶ The revisionist view says that considering sustainability enhances a firm's reputation, especially by avoiding negative headlines, as well as by reducing conflicts between a firm and its stakeholders, both leading to a higher financial performance. In contrast, the traditional view states that policies increasing a firm's sustainability performance are not productive. The respective operational costs of, e.g., environmental or social activities are higher than the resulting financial benefits leading to an overall lower performance.

In order to figure out which theory applies to the DAX 50 ESG, we use a similar approach like Oberndorfer et al. (2013) and conduct an event study for the

⁶ A more in-depth introduction to these theories can be found in, e.g., Revelli/Viviani (2015) or Molina-Azorín et al. (2009).

inclusion in the DAX 50 ESG.⁷ Our study is based on the analysis of abnormal returns estimated by asset pricing models. We employ two of the most well-known models; the Capital Asset Pricing Model (CAPM) and the Fama and French Three-Factor Model; to estimate normal returns. The so-called abnormal returns are defined as the difference between actual and normal returns. By aggregating these abnormal returns both over time and in a cross section, we obtain cumulative average abnormal returns (CAARs). Using the CAARs, we can determine the average effect of the inclusion into the DAX 50 ESG for a firm over several days.

A key task of an event study is to test the null hypothesis that the event has no impact on returns. In this respect, we consider three different tests. First, we assume that the CAARs are normally distributed and test their statistical significance. Second, we use the BMP test (*Boehmer/Masumeci/Poulsen* 1991), which improves the Patell test by taking into account the possible cross-sectional increase in the variance of returns that may occur within the event window. Third, we use the adjusted Patell test (*Kolari/Pynnönen* 2010) to respond to the fact that the previous two tests suffer from the cross-sectional correlation of abnormal returns. It heavily affects their outcome in the case of event-day clustering that verifies when a single event simultaneously affects all firms included in the analysis.

Our estimation window covers 100 trading days and ends 25 days before the event. We include the event day [0] and five days after the event day (*Oberndorfer et al.* 2013). To support our results, we have additionally analyzed CAARs for several time intervals prior to the event. If the new information on inclusion in a sustainability stock index is not expected before the event but is relevant for investors, the CAARs should be insignificant before the event but significantly different from zero in the event window. Therefore, we additionally investigate the time intervals [-24,-19], [-18,-13], [-12,-7], and [-6,-1] before the event. As a robustness test, we also implement a portfolio approach, which is an alternative method for calculating CAARs (*Kothari/Warner* 2007).⁸

Table 11 reports the CAARs and the portfolio CAR for the different time interval. The table additionally reports the p-values of the three different test statistics to evaluate the significance of the results. It shows that the CAAR in the complete event window [0,5] is significantly negative. In contrast, the CAARs in the time intervals [-24,-19], [-18,-13], [-12,-7], and [-6,-1] before the event

⁷ Numerous other studies also apply a similar event study approach dealing with sustainability, e. g., *Alsaifi/Elnahass/Salama* (2020); *Grewal/Riedl/Serafeim* (2019); *Keele/DeHart* (2011); *Krueger* (2015); *Ramiah/Martin/Moosa* (2013).

⁸ Portfolio CARs (instead of CAARs) may be calculated based on an equally weighted portfolio combining all the firms under review (before the calculation of the abnormal returns), whereby the portfolio is considered as a single firm.

Table 11
Event Study for the Inclusion in the DAX 50 ESG

| <i>Panel A. CAPM</i> | | | | | |
|---------------------------------|-----------|-----------|----------|---------|----------|
| | [-24,-19] | [-18,-13] | [-12,-7] | [-6,-1] | [0,5] |
| CAAR | 0.42 | 0.28 | -0.47 | -0.79* | -1.42*** |
| <i>Normal</i> | 0.42 | 0.58 | 0.37 | 0.13 | 0.01 |
| <i>BMP</i> | 0.52 | 0.52 | 0.35 | 0.06 | 0.06 |
| <i>Adj. Patell</i> | 0.64 | 0.70 | 0.47 | 0.09 | 0.01 |
| PF CAR | 0.45 | 0.28 | -0.64 | -0.96 | -1.80* |
| <i>Adj. Patell</i> | 0.61 | 0.75 | 0.48 | 0.29 | 0.06 |
| <i>Panel B. Fama and French</i> | | | | | |
| | [-24,-19] | [-18,-13] | [-12,-7] | [-6,-1] | [0,5] |
| CAAR | 0.18 | 0.00 | -0.17 | -0.88* | -1.04** |
| <i>Normal</i> | 0.71 | 1.00 | 0.72 | 0.07 | 0.03 |
| <i>BMP</i> | 0.86 | 0.98 | 0.65 | 0.04 | 0.17 |
| <i>Adj. Patell</i> | 0.89 | 0.98 | 0.70 | 0.05 | 0.04 |
| PF CAR | 0.24 | 0.06 | -0.44 | -1.08 | -1.50* |
| <i>Adj. Patell</i> | 0.77 | 0.94 | 0.59 | 0.19 | 0.07 |

Notes: The stars indicate the significance of the cumulative average abnormal return (CAAR) or the portfolio cumulative abnormal return (PF CAR) using the adjusted Patell test: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

are not only insignificantly different from zero. We find a similar result when we compare the results in panel B with the Fama and French three-factor model. Consequently, it can be concluded that the inclusion of German firms in the DAX 50 ESG index had a negative impact on their stock returns. This result is also in line with the findings of *Oberndorfer/Schmidt/Wagner/Ziegler (2013)* that firms there were also penalized if they joined a sustainability index. The result of our event study approach may explain why the index has performed relatively poorly. However, a statement on the long-term performance of the DAX 50 ESG can only be made to a limited extent at the present time and should be part of future research.

V. Conclusion

In our study we provide an in-depth analysis of the sustainability performance of the DAX 50 ESG index. We examine both the conduct (ESG) and the product (SDGs) dimensions of sustainability. We also address the problem of ESG disagreement by using two different major databases. Our results show

that the DAX 50 ESG has a relatively high sustainability performance compared to most indices, but is not significantly different from, e.g. the DAX. The results of the financial analysis show that the DAX 50 ESG has performed relatively poorly. The low performance compared to comparable indices does not seem to be driven by a difference in factor exposures. Even when looking at different time periods before and during the COVID-19 crisis, no significant outperformance of the DAX 50 ESG can be found. An explanation for the relatively poor performance may be that the inclusion of a firm in the index is currently penalized.

Our results can be discussed critically in relation to the press statement that the “DAX 50 ESG will be the standard for ESG investments in Germany” (Qontigo 2020). Our results show that the DAX 50 ESG should take in particular account of firms’ products in terms of their impact on environmental SDGs to provide a more holistic sustainable performance. In addition, as data providers disagree on the assessment of the sustainability of a firm, a sustainability index should incorporate ratings and scores from more than one sustainability data provider.

Furthermore, studies have shown that of all the different ESG investment styles, negative screening is considered the least advantageous for investment and is driven by product-related and ethical considerations. A full sustainability integration and engagement is considered more beneficial (Amel-Zadeh/Serafeim 2018). A comparable “DAX Sustainable Impact” index could be another step further towards financing sustainability.

It is also important to make statements like “The real economy is facing a process of transformation and it is the responsibility of the financial sector to finance this process; indices such as the DAX 50 ESG offer an important base” understandable for investors, and to show what impact they can really have (Qontigo 2020). Since the purchase of the DAX 50 ESG means that the shares for its constituents only change hands on the secondary market, there is initially no sustainable impact on them. It may be that, e.g., when a sustainable firm issues new shares, it can profit from a higher share price due to increased investor demand by sustainable indices. Subsequently, this firm can use this profit to expand its sustainable activities and achieve an impact.

As with other studies, our research exhibits several limitations. Due to the recent announcement of the DAX 50 ESG, we were only able to investigate a relatively short period of time. Therefore, it is not possible to make a statement about the long-term impact of sustainability on the financial performance of an index. Another limitation is that the multitude of different sustainability ratings could only be approached to a certain extent in this study. Future studies may also include fundamentally different perspectives for measuring the sustainability of firms and indices. In addition, this study is limited in its choice of finan-

cial and non-financial indicators. A selection of the most essential ones has been done, but it can certainly be extended further to gain additional insights. The approach for the event study is derived from the literature, but here, too, many other approaches can be found not only to further test the robustness of the results, but also to be able to study further aspects of the inclusion of a firm in a sustainable index.

Notwithstanding these limitations, this study remains a valuable starting point as it invites further research. We suggest future research should address which of the sustainable factors are the main drivers of the financial and non-financial performance. In particular, the materiality of sustainability needs to be addressed for individual firms, sectors and investors (*Betti/Consolandi/Eccles* 2018). In addition, we consider it worthwhile to further investigate how the reactions of investors to the inclusion of a firm in a sustainable index can be explored. Interesting research questions can be, e.g., which investor groups have which incentives to reward or punish an inclusion in the index, and which incentives are necessary for a firm seeking to be included in such an index? Finally, it would be interesting in the future to expand the analysis within a comparative international analysis, e.g., with other European, American, or Asian sustainable indices. Such comparable indices help to gain a better understanding of the role of sustainability in the financial and non-financial performance of indices worldwide.

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