



The Ultimate Owner of Environmental, Social, and Governance Investment

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The coronavirus (COVID-19) pandemic has affected society in immeasurable ways, including investment. As the pandemic has impacted society's values, it has proven to be a major turning point for environmental, social, and governance (ESG) investment. This investment approach, which evaluates a company's ESG ratings alongside traditional financial metrics, was already "coming off a banner year," and its reach continues to expand. Although numerous studies have investigated the impact of ESG scores on financial returns and the trend in ESG investment strategies, only a limited number of studies have attempted to capture the key players in ESG investment. Therefore, to determine the most influential investors in the ESG investment field, the cumulative impacts are calculated based on the ESG scores of invested companies, the total market price of invested companies, and the investor history portfolio report. We perform an iteration of calculation to convey the impacts that the invested companies have on the ultimate investors, and we identify the major players in the field and differences in the trend by type of investor and country.

Keywords: environmental, social, governance, ultimate ownership structure, network analysis, socially responsible investing, sustainable investment

INTRODUCTION

Through more than 20-years history of sustainable finance, there has been significant surge in ESG investment, ESG metrics, and related studies in the last few years. The 2020 *Global Sustainable Investment Review* (GSIR) published by the Global Sustainable Investment Alliance (GSIA) reports that sustainable investments across five markets, including the United States (the US) and the European Union, have reached US Dollar (USD) 35.3 trillion in assets under management, which is equivalent to 36% of all professionally managed assets in these markets. The US market alone grew 42% from 2018 to 2020, reaching USD 17.1 trillion (Global Sustainable Investment Alliance, 2021). Furthermore, the GSIA concluded that the most common sustainable investment strategy is "ESG integration, followed by negative screening, corporate engagement and shareholder action, norms-based screening and sustainability-themed investment" (Global Sustainable Investment Alliance, 2021). The coronavirus (COVID-19) pandemic has severely affected companies in the global supply chain, and studies have found that firms' governance and supply chain management ability are important in responding to adverse events (Khan et al., 2021a,b). Moreover, the ESG performances of firms have been considered a key to the resiliency of firms' financial performance (Yoo et al., 2021). As the pandemic has impacted society's values, it has proven to be a major turning point for ESG investment. In June 2020, the Morningstar report found that there were

approximately 3,432 sustainable funds on the market, comprising a mix of newly formed and revamped or rebranded funds (MorningStar, 2022). This represents an increase of 50% in the total number of sustainable funds over the past three years (Bryan et al., 2020). Furthermore, studies assessing ESG ratings are increasing. For instance, if the term “ESG ratings” is searched on Google Scholar, it produces 1,500 results from 2021. The increased interest

in ESG has also resulted in an increased influence on financial decisions, asset prices, and corporate policies, with potentially far-reaching effects on political and economic events, such as the Russia–Ukraine war (Funk and Hento, 2022).

Over the past decade, numerous studies have focused on the relation between ESG investment and financial performance, demonstrating that ESG portfolio tilting and integration of ESG

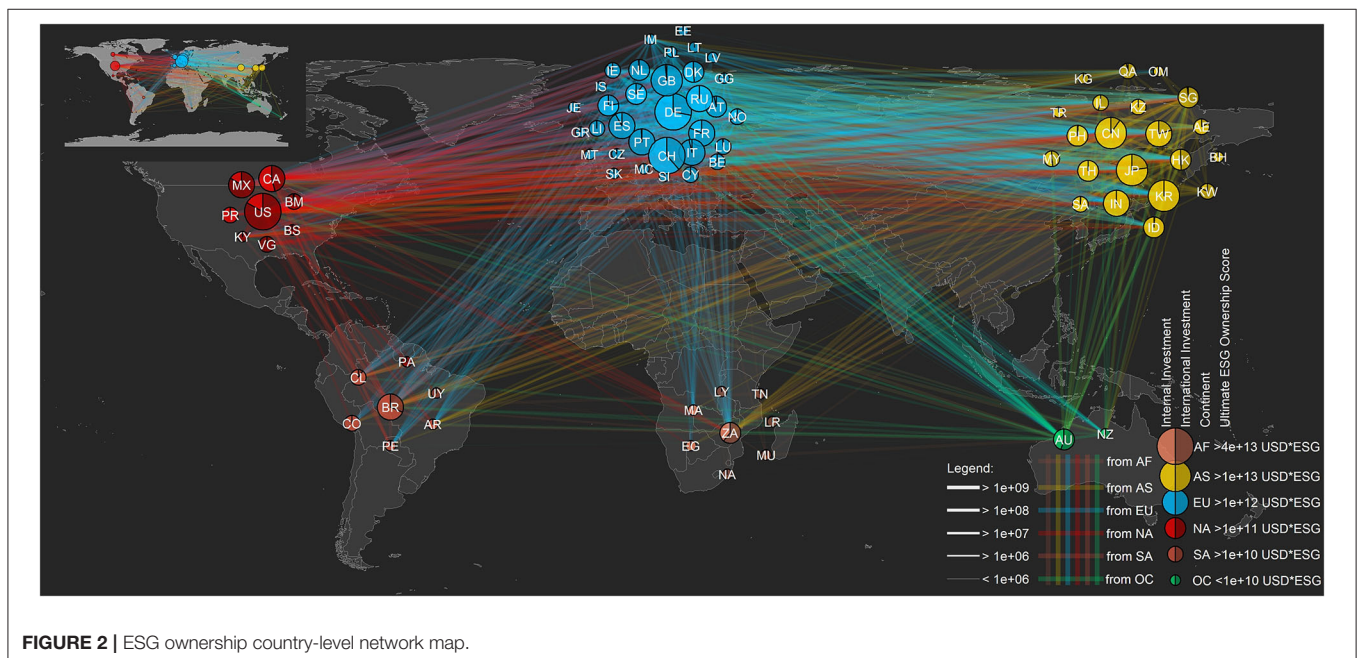
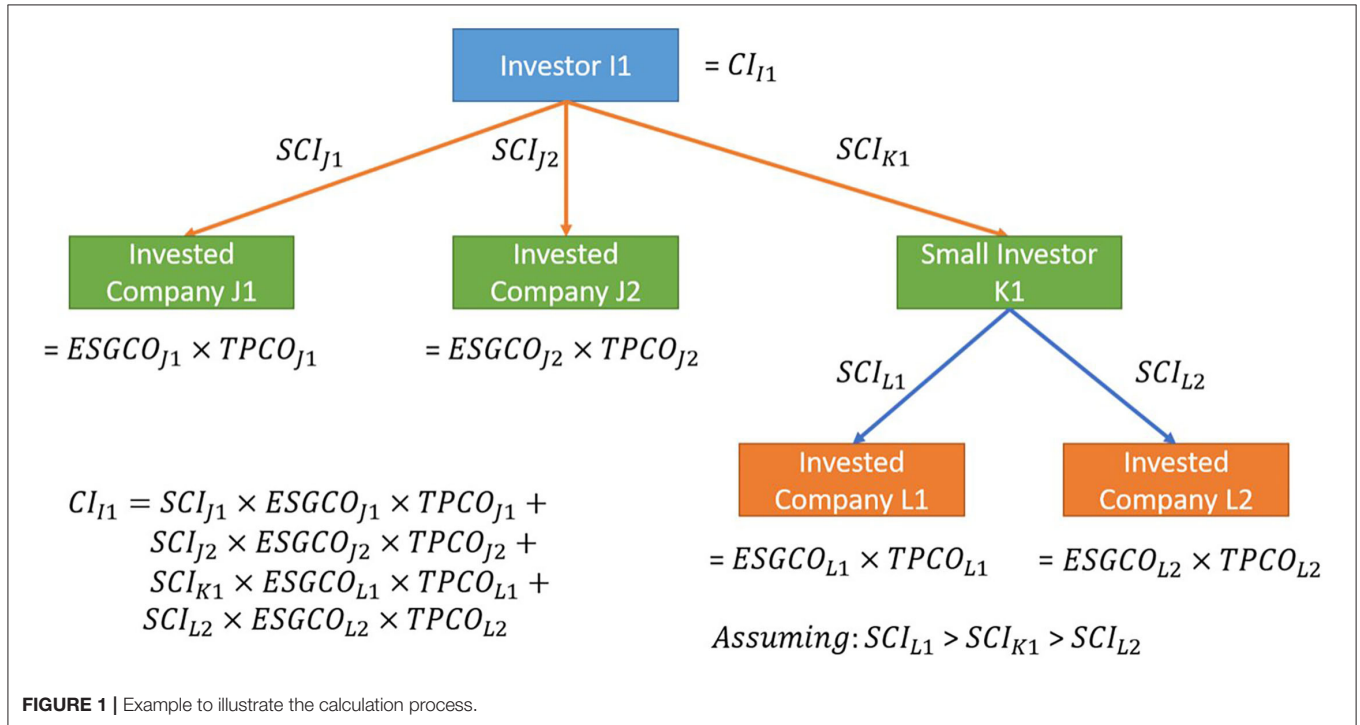
TABLE 1 | Summary of the ESG score multiplied with the total market price value.

Country/region	Count	Mean ESG-price	Country/region	Count	Mean ESG-price
United States	2,616	17,290,890,769	Colombia	22	2,576,361,779
China	885	9,259,978,013	Poland	21	1,632,832,335
United Kingdom	560	5,545,439,379	Qatar	18	3,096,385,653
Canada	507	10,210,697,484	United Arab Emirates	17	6,765,372,320
Japan	426	9,284,369,449	Philippines	16	4,771,530,768
Australia	298	3,878,531,833	Cyprus	10	1,149,318,279
Sweden	288	3,760,015,807	Jersey	10	938,270,975
Germany	242	8,922,779,941	Portugal	10	3,164,730,769
Switzerland	176	15,585,900,319	Cayman Islands	9	1,177,230,585
Brazil	173	5,052,692,113	Egypt	7	704,923,782
France	166	17,116,931,160	Iceland	7	945,416,432
India	153	9,839,711,767	Kuwait	6	1,654,790,323
South Korea	152	10,134,724,108	Oman	6	523,785,241
Taiwan	138	15,178,094,606	Monaco	5	202,451,681
Hong Kong	116	7,792,178,910	Puerto Rico	5	1,171,903,482
Italy	102	4,506,868,253	Czech Republic	4	5,002,480,431
Thailand	100	3,292,839,345	Isle of Man	4	2,514,196,007
South Africa	95	2,531,222,955	Macau	4	9,158,967,375
Netherlands	73	21,126,002,256	Malta	4	551,009,988
Russia	67	12,756,897,908	Pakistan	4	392,707,082
Singapore	67	4,596,479,516	Panama	4	302,139,638
Argentina	66	1,813,294,133	Bahrain	3	709,414,006
Finland	66	4,413,335,979	Kazakhstan	3	7,381,260,564
Spain	66	10,778,734,679	Romania	3	2,825,694,139
Denmark	63	12,341,266,284	Vietnam	3	3,887,567,877
Norway	63	12,561,551,031	Hungary	2	6,428,356,124
Malaysia	62	2,723,950,440	Jordan	2	1,675,108,638
Mexico	56	6,275,043,837	Liechtenstein	2	639,502,060
Bermuda	53	2,223,524,645	Ukraine	2	564,153,156
Turkey	53	1,108,180,405	Uruguay	2	634,325,149
Chile	51	2,405,046,793	Bahamas	1	317,208,058
Ireland	47	14,277,302,284	British Virgin Islands	1	13,259,754
New Zealand	45	1,290,262,405	Cambodia	1	2,699,443,454
Belgium	44	6,344,100,616	Costa Rica	1	760,185,572
Luxembourg	40	3,680,306,579	Faroe Islands	1	2,516,543,634
Indonesia	36	5,527,856,129	Gibraltar	1	776,433,042
Israel	29	3,443,914,513	Kenya	1	6,111,597,436
Peru	29	914,026,365	Morocco	1	6,346,036,210
Greece	25	915,702,038	Papua New Guinea	1	3,808,978,938
Guernsey	25	738,509,213	Slovenia	1	2,559,272,403
Saudi Arabia	25	8,298,867,053	Missing	70	2,215,114,276
Austria	23	2,020,398,644			

factors can impact portfolio and corporate financial performance in various ways (OECD, 2021). Whereas, some studies have demonstrated that integrating ESG criteria has no significant impact on portfolio return (Bauer et al., 2007; Cortez et al., 2009); many studies have found that it has a positive effect on returns by comparing equity portfolios with high and low ESG scores (Widyawati, 2020). Widyawati (2020) conducted a systematic review on socially responsive investment (SRI) and ESG metrics

and asserted that ESG metrics play a role of an enabler in the SRI market.

In addition, there has been growing interest in the study of the relation between the ESG strategy and actual ESG portfolio allocation. Brandon et al. (2021) calculated the direct ESG ownership scores of institutional investors and investigated whether institutional investors' public commitments to responsible investing and higher reported levels of ESG



incorporation result in more sustainable portfolio allocations. The findings revealed that the Principles for Responsible Investment (PRI) signatory institutions have better ESG scores in general but not in the US. To examine the ownership and control structure of large shareholders, relevant studies have examined the ultimate ownership of companies by mostly tracking portfolio and total market price data. For example,

La Porta et al. (1999) investigated the control chains of a sample of 30 firms in 27 countries and identified the ultimate controlling owners. Similarly, Claessens et al. (2000) examined 2,980 listed companies in nine East Asian countries, revealing that a large percentage of stock market capitalization in the investigated countries is owned by a small number of investors. Faccio and Lang (2002) analyzed the ownership structure using the ultimate

TABLE 2 | Total ultimate ESG ownership score by country.

Country	Total ultimate ESG ownership score	Number of investor	Country	Total ultimate ESG ownership score	Number of investor
Switzerland	8.27014E + 13	175	Cyprus	25,675,250,559	20
Germany	5.72266E + 13	231	Ireland	17,977,734,143	20
United States	4.65301E + 13	2,606	Colombia	16,937,905,030	23
China (Mainland)	2.27566E + 13	573	Liechtenstein	14,871,610,630	28
Japan	2.00865E + 13	1,379	Bermuda	12,970,382,575	9
South Korea	2.00643E + 13	85	Kuwait	12,541,070,793	3
United Kingdom	1.03016E + 13	458	Kazakhstan	10,920,018,272	1
France	7.94945E + 12	97	Cayman Islands	7,924,821,736	13
Canada	6.95242E + 12	186	Poland	5,921,687,310	21
Spain	5.64705E + 12	84	Turkey	4,611,654,837	2
Italy	4.9574E + 12	82	Peru	3,942,964,465	11
Brazil	2.86728E + 12	236	Morocco	3,493,924,925	9
India	2.18313E + 12	57	Monaco	3,319,268,299	2
Portugal	1.60532E + 12	4	New Zealand	2,561,005,844	16
Mexico	1.49459E + 12	29	Jersey	1,734,744,467	14
Russia	1.42537E + 12	17	Bahamas	1,539,192,807	8
Taiwan	1.02775E + 12	124	Guernsey	1,409,583,433	9
Sweden	9.38617E + 11	137	Czech Republic	1,277,659,891	5
Finland	4.36005E + 11	63	Argentina	1,054,893,765	20
Philippines	3.84733E + 11	26	Bahrain	913,981,720	1
Austria	3.33984E + 11	30	Tunisia	545,118,593	2
Netherlands	3.28674E + 11	67	Malta	534,298,615	7
South Africa	2.8943E + 11	80	Isle of Man	327,054,416	11
Singapore	2.60384E + 11	98	NA	296,935,231	1
Thailand	1.89867E + 11	18	Greece	262,443,065	1
Australia	1.71408E + 11	181	Kyrgyzstan	261,321,470	1
Hong Kong	1.2845E + 11	79	Oman	228,403,657	3
Denmark	1.20054E + 11	39	Mauritius	182,277,069	6
Indonesia	1.03904E + 11	45	Iceland	175,605,083	1
Luxembourg	96618161373	86	Panama	163,443,293	1
Norway	86334851352	65	Liberia	147,353,870	2
Qatar	70311100528	7	Libya	139,581,027	1
Saudi Arabia	64429600766	14	Egypt	122,983,423	2
Chile	55231057120	52	Gibraltar	16,330,931	3
United Arab Emirates	55085170802	21	Latvia	16,259,175	1
Malaysia	48030188239	58	Uruguay	10,020,831	1
Israel	38441061679	23	Slovakia	8,139,424	1
British Virgin Islands	32456747890	38	Lithuania	3,969,290	1
Belgium	31782228767	21	Namibia	1,592,377	1
Puerto Rico	30891546768	2	Estonia	1,374,334	1
Cyprus	25675250559	20	Slovenia	65,803	1

ownership data of 5,232 listed Western European corporations. Their research found that financial and large firms were more likely to be widely held, whereas nonfinancial and small firms were more likely to be privately owned. These aforementioned studies on ultimate ownership provide insight into patterns by the type of investor and nation–state political boundaries in the context of direct and indirect ownership chains. In the case of ESG ownership, previous studies have mostly used direct ownership scores of ESG at the portfolio level using the ESG portfolio data, total market price data, and ESG scores provided by leading ESG rating agencies. To capture the ownership structure of ESG investment, it is crucial to consider both direct and indirect ownership. Notably, while most studies on ESG ownership emphasize institutional investor, intercorporate investment also plays a critical role in the ESG investment field as investments in financial assets and associates and business combinations (Silver et al., 2021). Intercorporate investment can occur when a company invests in another company. These types of investments can be considered in different ways depending on the investment. In general, the archetypes of ownership stake by percentage fall into three categories—minority passive (<20% ownership), minority active (20–50% ownership), and controlling interest (over 50% ownership) (Kenton et al., 2021).

This study addresses these research gaps and investigates the ultimate ESG ownership, considering both direct and

indirect ownership of investors, including institutional investors and corporations, following the ultimate ownership analysis framework employed by Faccio and Lang (2002). We identify the major players in the field in terms of the ultimate ESG ownership score and provide insight into patterns by the type of investor and nation–state political boundaries in the context of direct and indirect ownership chains. By expanding the study by Brandon et al. (2021), we also re-examine whether the PRI signatory institutions and corporations demonstrate better ESG ownership scores and confirm that the PRI signatory investors have better ESG ownership score in general. Furthermore, our study contributes to extant literature examining fund flow reactions to ESG ratings (Hartzmark and Sussman, 2019) by providing the evidence that it is difficult to target the actual flow and ownership structure of ESG investment through ESG ratings of the investors themselves. In addition, this study reports that the top 10% investors own approximately 98% of the total ultimate ESG ownership score, showing that ESG investment is led by relatively small number of investors. Furthermore, the results of the study confirm the important role of corporations in ESG investment, which owns the most global shares (85.77%) measured by the ESG ownership score considering both direct and indirect ownership chains.

The remainder of this paper is structured as follows. Section Data and Methods outlines the data and analytical methods employed in this study. Section Results discusses the results of

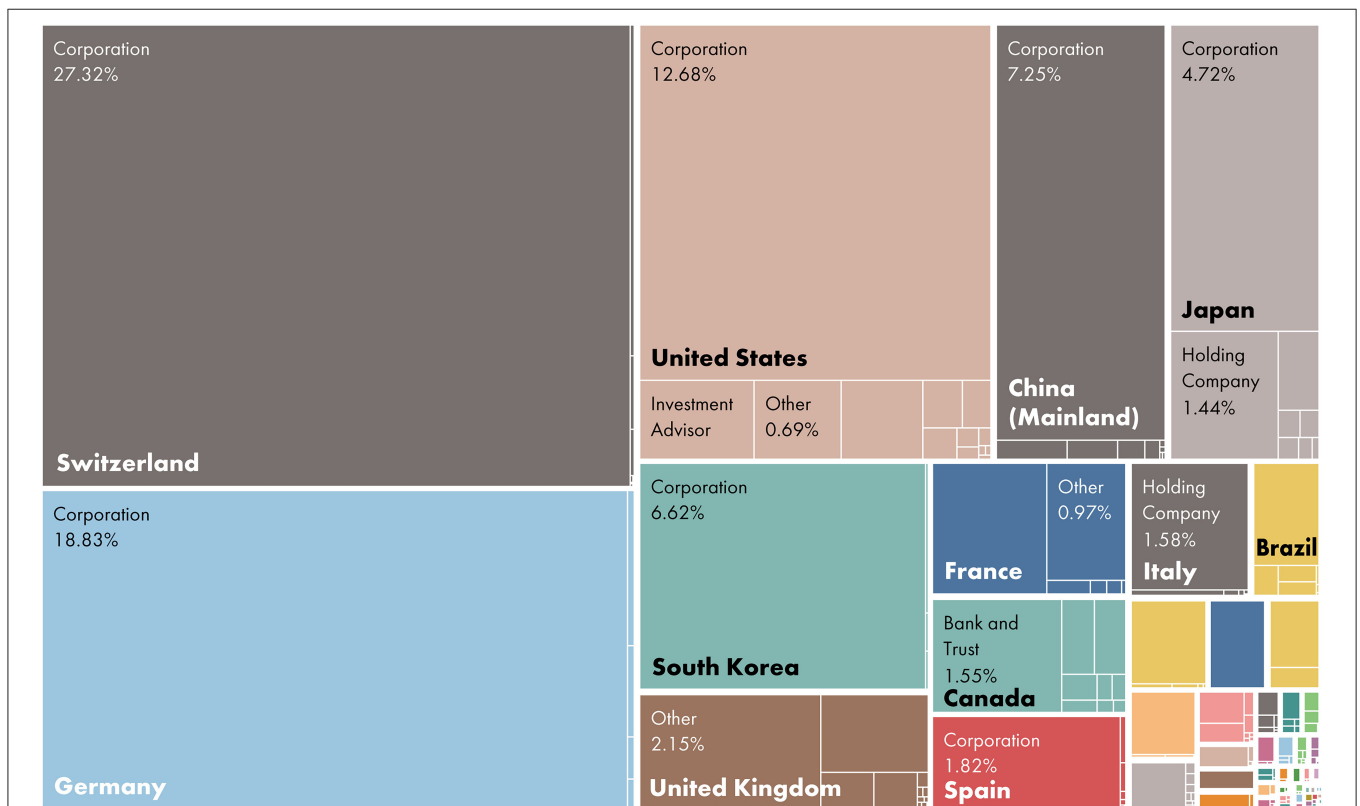


FIGURE 3 | Total ultimate ESG ownership by country.

the ultimate ESG ownership analysis, and Section Discussion and Conclusion presents the discussion and conclusion.

DATA AND METHODS

Data

ESG Score

To obtain the ESG scores of important companies across the world, we use the data management system of Refinitiv Eikon to download the records of 30,857 companies. As Refintiv Eikon does not gather all the data of these companies, we acquire the ESG combined scores of 8,662 companies. Companies that can be used in the analysis have to provide their ESG combined scores and the total market price. In this study, we employ the latest ESG combined scores in 2020. The ESG combined scores range from 0 to 1. Additionally, although the ESG combined scores of several companies are not listed on the summary page, they present their ESG reports, comprising the rankings of their ESG combined scores. The rankings are from “A+” to “D-,” that is, 12 levels. According to the official statements from Refintiv, the raw ESG scores are converted into a numeric format, from 1 (12/12) to 0.0833 (1/12). The companies with ESG scores are from 83 countries or regions. Most companies in our dataset are based in the US, China (Mainland), and the UK, having 2,616, 885, and 560 companies, respectively (detailed information is presented in **Appendix Table A**).

Investor History Portfolio Reports

The investors’ data, which are the investor history portfolio reports of each investor company, are also from Refinitiv Eikon. These reports capture the shares of the investors in the invested company. We assume that the shares represent the voice of the ESG strategies of the investors in the invested companies. The most recent data, generally for the first quarter of 2021, are employed in this study. To cover the invested companies with ESG scores, 43,482 investors, including investment companies and individual investors, are investigated and 12,258 investor history portfolio reports are downloaded. The investment share of a specific investor is recorded in the investor history portfolio. For example, the investor history portfolio of the investor company Storebrand Kapitalforvaltning AS is 0.04% of Apple Inc., 0.04% of Microsoft Corp., 0.03% of Amazon.com Inc., and others. In this case, 0.04% of the ESG investment results of Apple Inc. should be attributed to Storebrand Kapitalforvaltning AS. The investor history portfolios are the critical data set to link the invested and investing companies.

Total Market Price of Companies With ESG Reports

Furthermore, the total market prices of the aforementioned invested companies are from Refinitiv Eikon. The total market price varies in real time. We secured all the available data within a week—the last week in December 2021. After several downloading waves, we retrieved the total market prices of 8,662

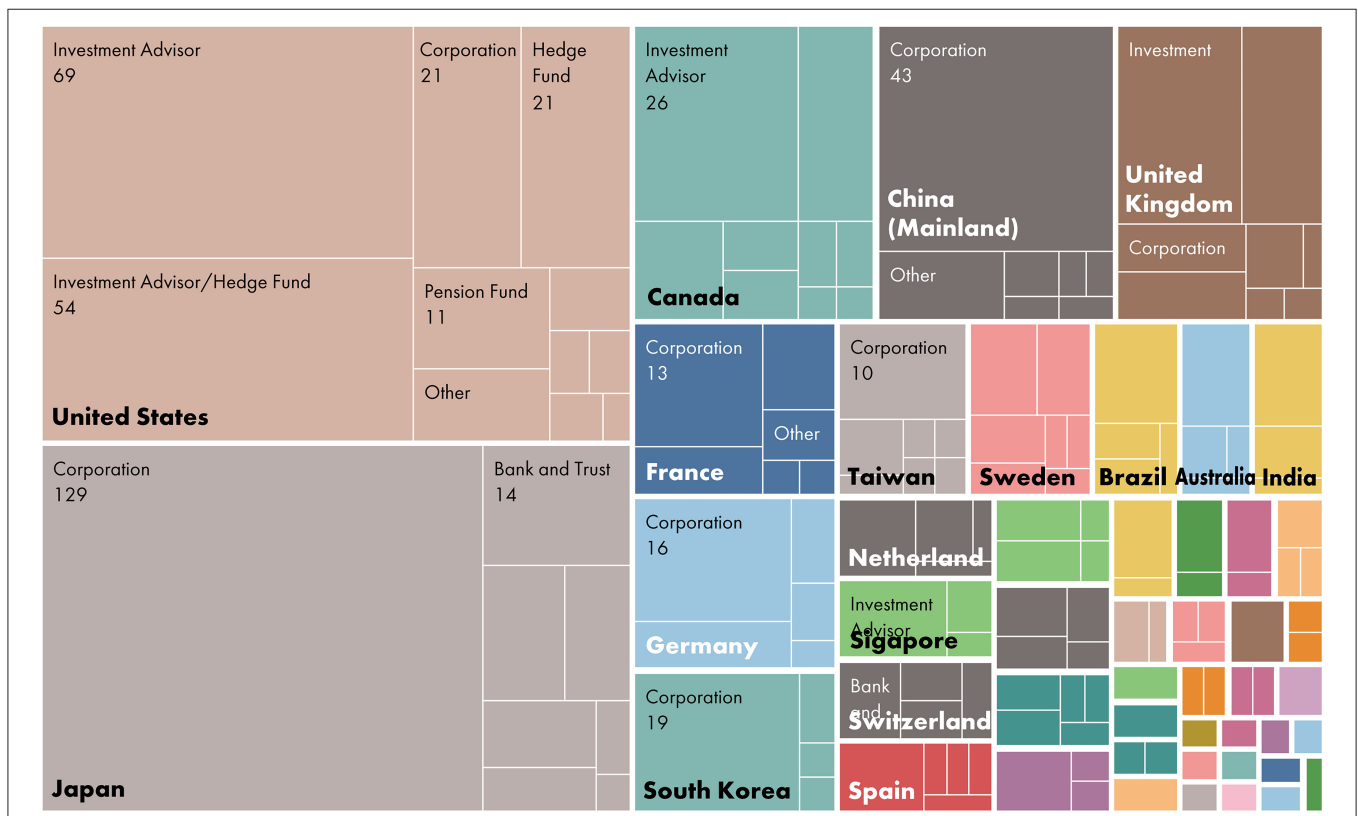


FIGURE 4 | Number of investors in the top 10% by country.

companies with the ESG combined scores. The currency unit of the total market price is the USD, which is converted by the Refinitiv Eikon system directly. The total market price represents the value of the invested company. A summary of the total market values of the companies is reported in **Table 1**.

METHODS

To detect the most influential investors in the ESG investment field, the cumulative impacts are calculated based on the ESG scores of invested companies, total market prices of invested companies, and investor history portfolio reports. The basic logic of calculating the cumulative impacts is to accumulate the products of the ESG scores and total market prices of the invested

companies. However, in the real world, some large investors also invest in small investors. Therefore, we iterate the calculation to convey the impacts of invested companies on the ultimate investors. The cumulative impacts are calculated as follows:

$$CI_i = \sum_{j=1}^m (SCI_j \times ESGCO_j \times TPCO_j) + \sum_{k=1}^n \left\{ \sum_{l=1}^p [\min (SCI_k, SCI_l) \times (ESGCO_l \times TPCO_l)] \right\} \tag{1}$$

where CI_i denotes the cumulative impacts of investor i ; SCI_j indicates the shares of investor i in invested company j ; $ESGCO_j$

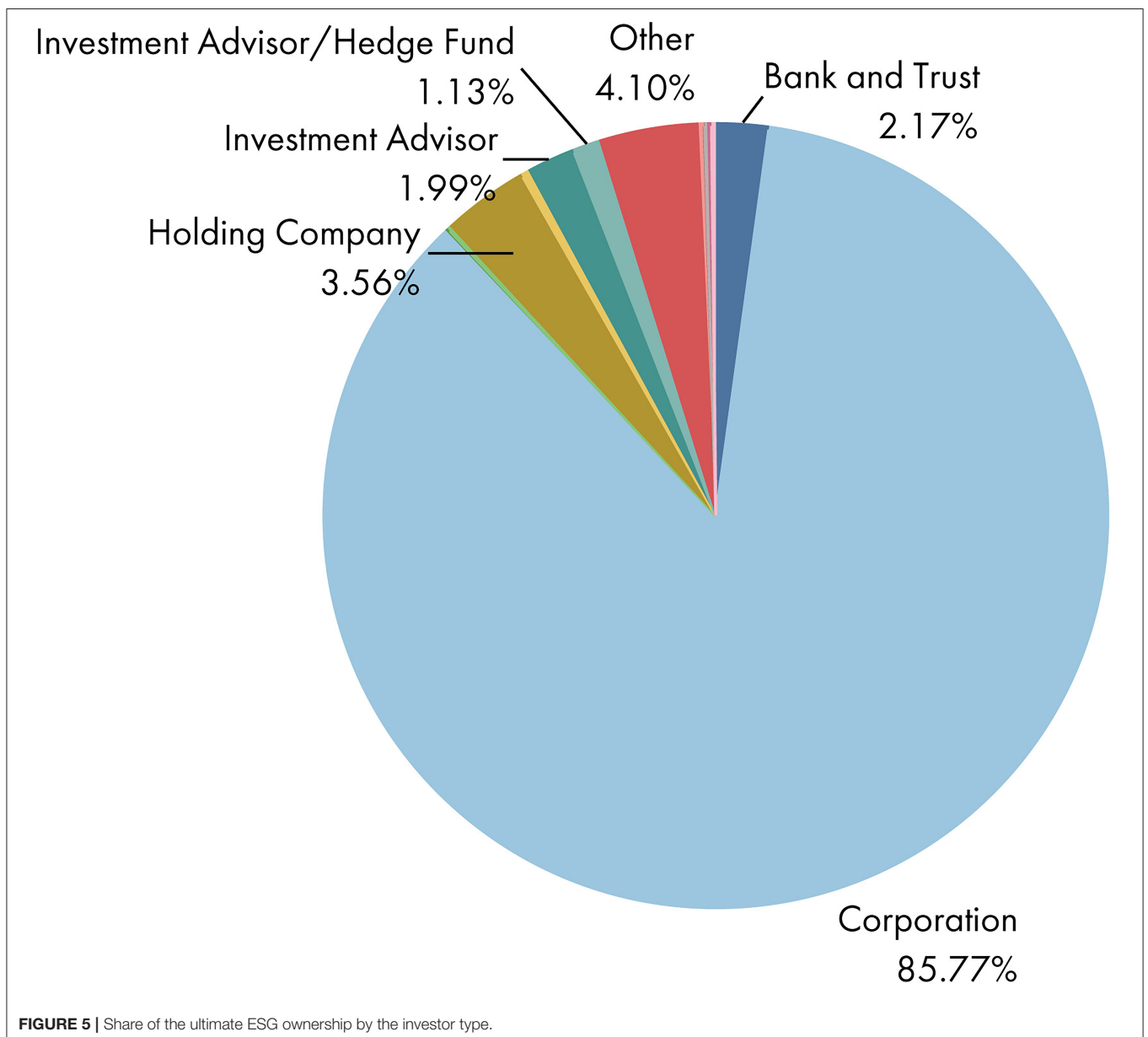


FIGURE 5 | Share of the ultimate ESG ownership by the investor type.

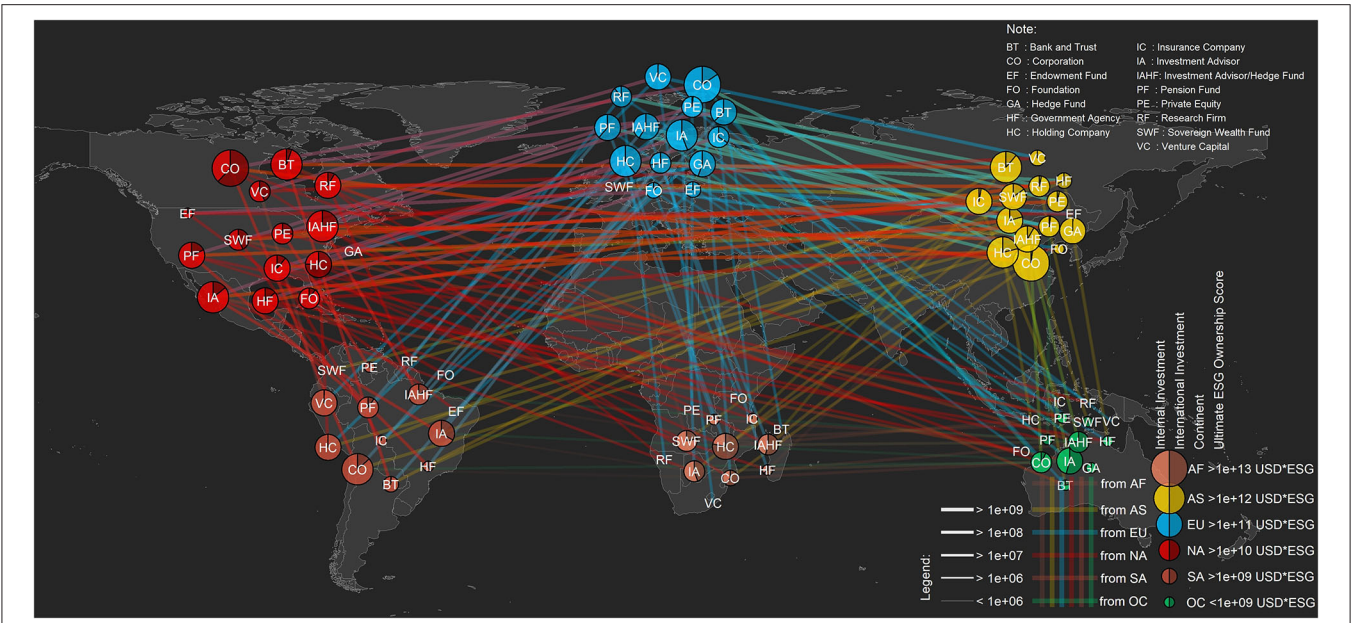


FIGURE 6 | ESG ownership network map by the investor type.

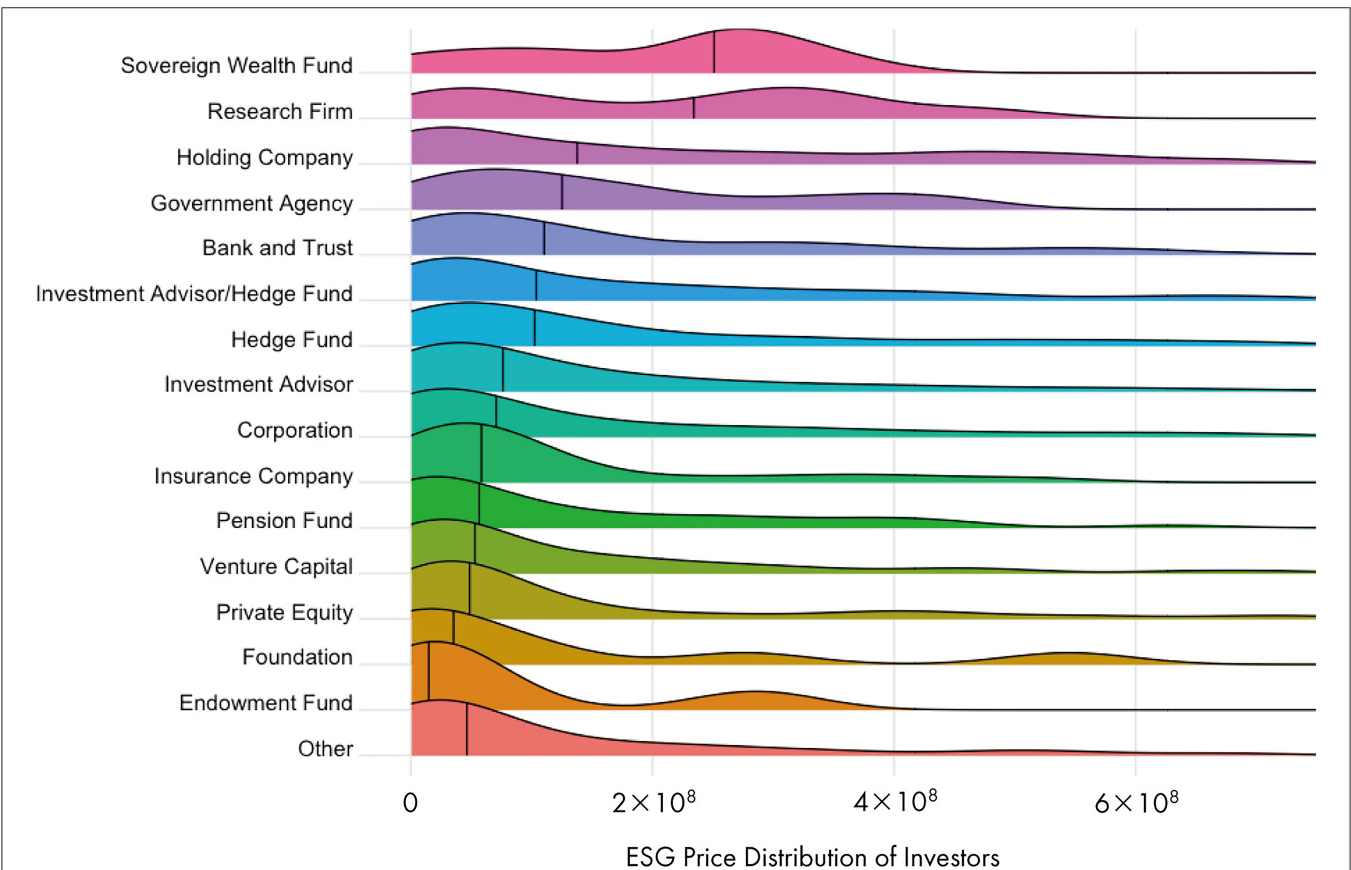


FIGURE 7 | Density ridgeline plots by the investor type.

represents the ESG scores of invested company j ; $TPCO_j$ denotes the total market price of invested company j ; m indicates the number of companies investor i has invested in; SCI_k is the shares of investor i (a large investor) in small investor k ; SCI_l is the shares of small investor k in invested company l ; $ESGCO_l$ denotes the ESG scores of invested company l ; $TPCO_l$ represents the total market price of invested company l ; n denotes the number of small investors that investor i has; and p indicates the number of companies that small investor k has invested in. We provide a simple example of the calculation process in **Figure 1**.

RESULTS

Based on the evaluations of the ultimate ESG ownership scores of investors, including institutional investors and corporations, this section presents the results by first revealing the patterns of the ESG ownership structure by the type of investor and nation-state political boundaries, followed by the results of the relation between the calculated ESG ownership scores and investors' ESG performances (e.g., PRI signatory status and investors' ESG ratings).

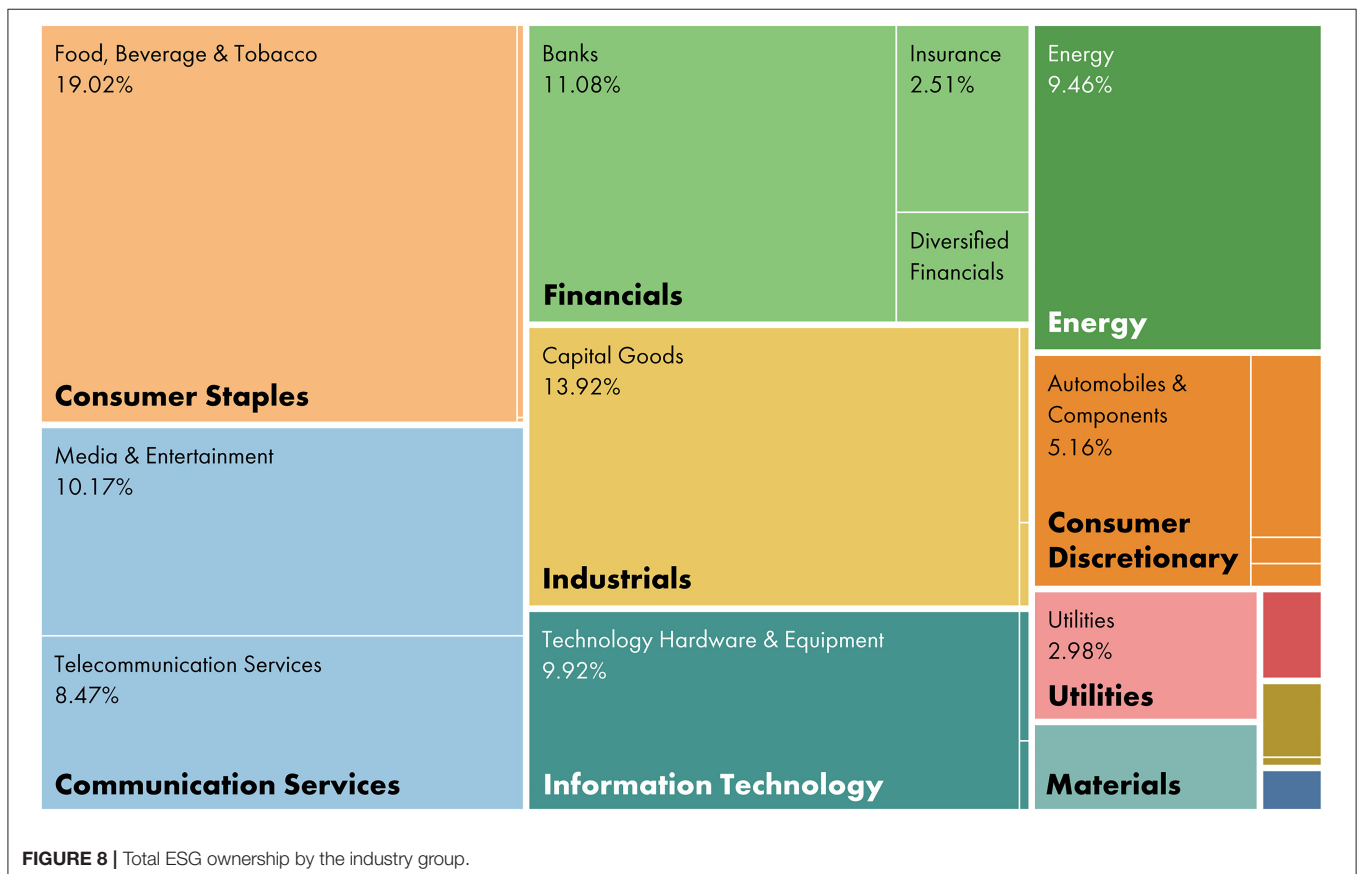
Ultimate ESG Owner: Trend by Country Level

Based on the cumulative ESG ownership calculated using the methods discussed in Section Data and Methods, **Table 2**

reports the results of the total ultimate ESG ownership score of 7,957 investors at the country level (the investors' country distribution map is illustrated in Figure A of the **Appendix**). The investors' country-level ESG ownership network map is presented in **Figure 2**. **Figure 2** presents the share of the internal ESG investment and international ESG investment volumes in bubbles and denotes outflow investments through lines colored by the continent level. The size of the bubble represents the volume of the cumulative ultimate ESG ownership score.

As illustrated in **Figure 2**, the international ESG investment volume is much larger than the internal ESG investment volume in most North American countries, whereas the internal ESG investment volume has the largest share in Asia. The network figure demonstrates that the link between North American and Asian countries is especially strong. The strong link between European and Asian countries, with a stronger link from European to Asian countries, is noteworthy. The links from Asian to European countries are stronger than the links from Asian to other countries.

Figure 3 presents the total ultimate ESG ownership by country, with the size of the box representing the volume of the share of the total ultimate ESG ownership score. According to the results, Switzerland, Germany, and the US are the leading countries in terms of the volume of the share of the total ultimate ESG ownership score. In addition, the results reveal that the



top 10% investors own approximately 98% of the total ultimate ESG ownership score. The number of investors in the top 10% by country is another important perspective to interpret the result, which is presented in **Figure 4**. Regarding the number of investors in the top 10%, the US, Japan, and China are the leading countries. Among the leading countries, there are differences in the types of investors leading (non-financial firms, such as corporations, and financial firms, including investment advisors, insurance companies, as well as banks and trusts). In the US, financial firms are the major players, whereas non-financial firms are the major players in Japan and China. Switzerland is not among the top countries in terms of the number of investors in

the top 10% as the two leading investors in Switzerland (Novartis AG and Nestle SA) have a 27.3% share of the total ultimate ESG ownership score.

Ultimate ESG Owner: Trend by Investor Type and Industry

Based on the Refinitiv Business Classification, investors are classified into one of the following: corporation (CO), holding company (HC), insurance company, investment advisor (IA), bank and trust (BT), endowment fund, government agency (GA), foundation (FO), hedge fund, sovereign wealth fund (SWF), investment advisor/hedge fund (IAHF), venture capital (VC),

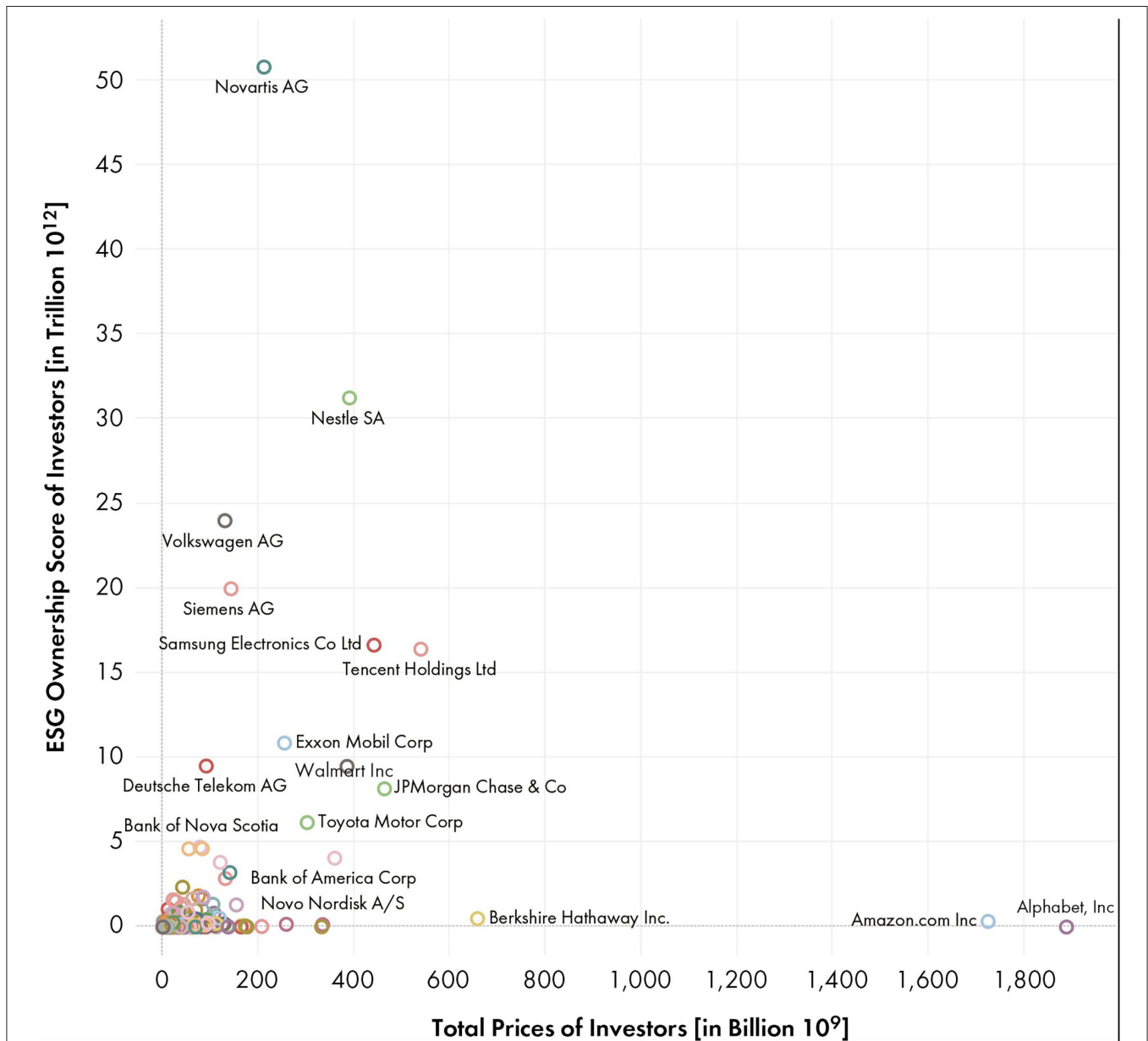


FIGURE 9 | Relation between investors' total market price and ESG ownership ($n = 1,716$).

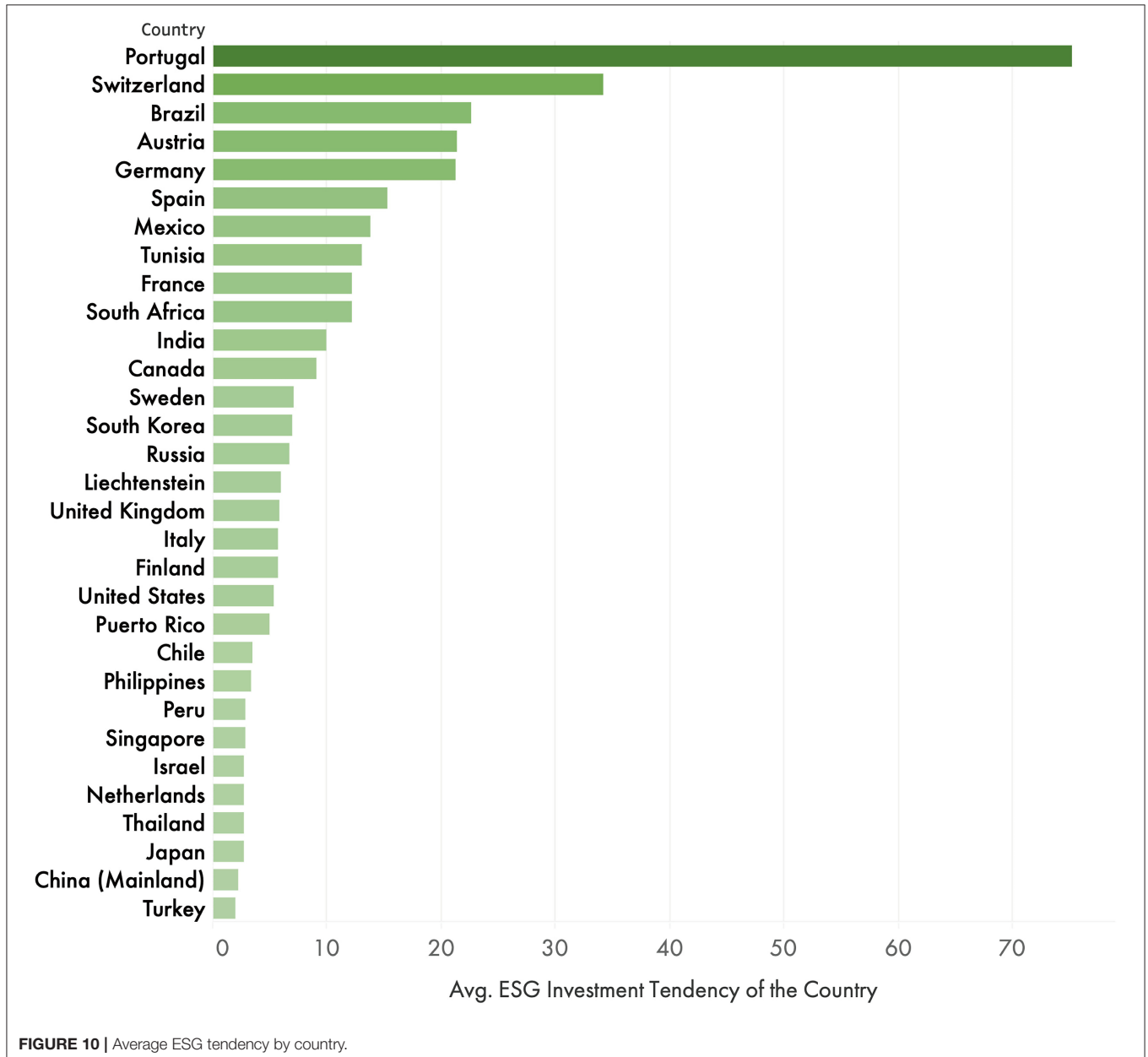
research firm (RF), pension fund (PF), and private equity. **Figure 5** reports the share of the total ultimate ESG ownership by investor type. CO, HC, and IA are the three top investor types, but as depicted in the figure, CO has the most global shares (85.77%).

We observe different trends among the continents in terms of the cross-continent and internal ESG investment volumes, as presented in **Figure 6**. In Asian countries, the internal ESG investment comprises the most ESG investment volume, especially for CO, GA, and VC. However, in North America, the cross-continent ESG investment volume is larger than the internal volume for CO; in Europe, GA and PF actively conduct cross-continent investment, whereas CO has more internal ESG investment volume. Similar to the country-level

network map presented in **Figure 2**, we observe strong links from North American investors to Asian companies, whereas between Europe and Asia, the links are more bidirectional. The links from European investors are relatively more diversified than those from other regions, with slightly stronger links to Asia.

Figure 7 illustrates the density ridgeline plots by the investor type, revealing that, on average, SWF and RF are performing better.

We provide a closer look of the leading industries in **Figure 8**. Each investor is classified into an industry group based on the Global Industry Classification Standard. As **Figure 8** demonstrates, consumer staples, financials, and industrials are



the leading industry groups in terms of the volume of the share of total ultimate ESG ownership.

ESG Tendency: Total Market Price Adjusted ESG Ownership

As an investor with a larger total market price can make more investments than smaller investors, its ultimate ESG ownership score can be affected by investors' total market prices. However, as shown in **Figure 9**, the total market prices of the investors and their ultimate ESG ownership scores have a very weak correlation. The Pearson correlation is performed to analyze the relationship, and the correlation strength is defined as a correlation coefficient (*R*-value) of 0.27 ($p \leq 0.001$).

Although the correlation between the total market prices of investors and their ultimate ESG ownership scores is very weak, to reduce the potential bias owing to the size of the investor, we calculate the ESG tendency score by dividing the ultimate ESG ownership score by the total market price of each investor.

Figures 10, 11 report the results of the ESG tendency by country and investor type based on 1,716 investors. Here, two outliers (Aditya Birla Sun Life AMC Limited [2048] and Schweizerische Nationalbank [588]) are removed. By country, Portugal, Switzerland, and Brazil are the top countries, whereas in terms of the accumulated total ultimate ESG ownership score of the 7,957 investors, several leading countries, such as the US, Japan, and China, have low average ESG tendency. **Figure 11** demonstrates an interesting trend among the investor type—the average ESG tendency is high in VC, IAHF, and BT, whereas it is low in CO, which owns the most global shares.

Using the calculated ESG tendency score, **Figure 12** illustrates the relation between investors' ESG tendency and their own ESG score rated by Refinitiv. The Pearson correlation is performed

to analyze the relation between investors' ESG tendency and their own ESG score, and the correlation strength is defined as a correlation coefficient (*R*-value) of -0.05 ($p \leq 0.155$). **Figure 12** shows that some investors, such as Siemens AG, Deutsche Telecom AG, Novartis AG, and Volkswagen AG, have relatively high ESG scores and a high ESG tendency. However, overall, the figure and results reveal that investors with high ESG ratings do not necessarily have higher incorporation of ESG investment strategies.

ESG Ownership and PRI Signatory

To examine the relation between the PRI signatory status and ESG ownership, we classify the investors into PRI and non-PRI signatory investors based on the PRI (2022). **Figure 13** reveals that the PRI signatories have higher ESG ownership with higher mean value, and **Figure 14** reveals that, on average, the PRI signatories' average ESG tendency, that is, the total market price adjusted ESG ownership, is higher than that of the non-PRI signatories.

In addition, we perform the Welch two-sample *t*-tests to determine if the PRI signatory investors' ultimate ESG ownership scores differ significantly from those of the non-PRI signatory investors. The results of the two-sample *t*-test reveal statistically significant difference in the mean ultimate ESG ownership score of the PRI and non-PRI signatory investors, with $t(df = 7609) = -3.23$, $p = 0.0012$, 95% CI as the difference in means $[-5.24e10, -1.28e10]$. The figures and result imply that investors who commit to invest responsibly certainly do so in practice. This result is mostly consistent with the recent study of Brandon et al. (2021), which revealed that, overall, signatory investors have better portfolio-level ESG scores, barring the US.

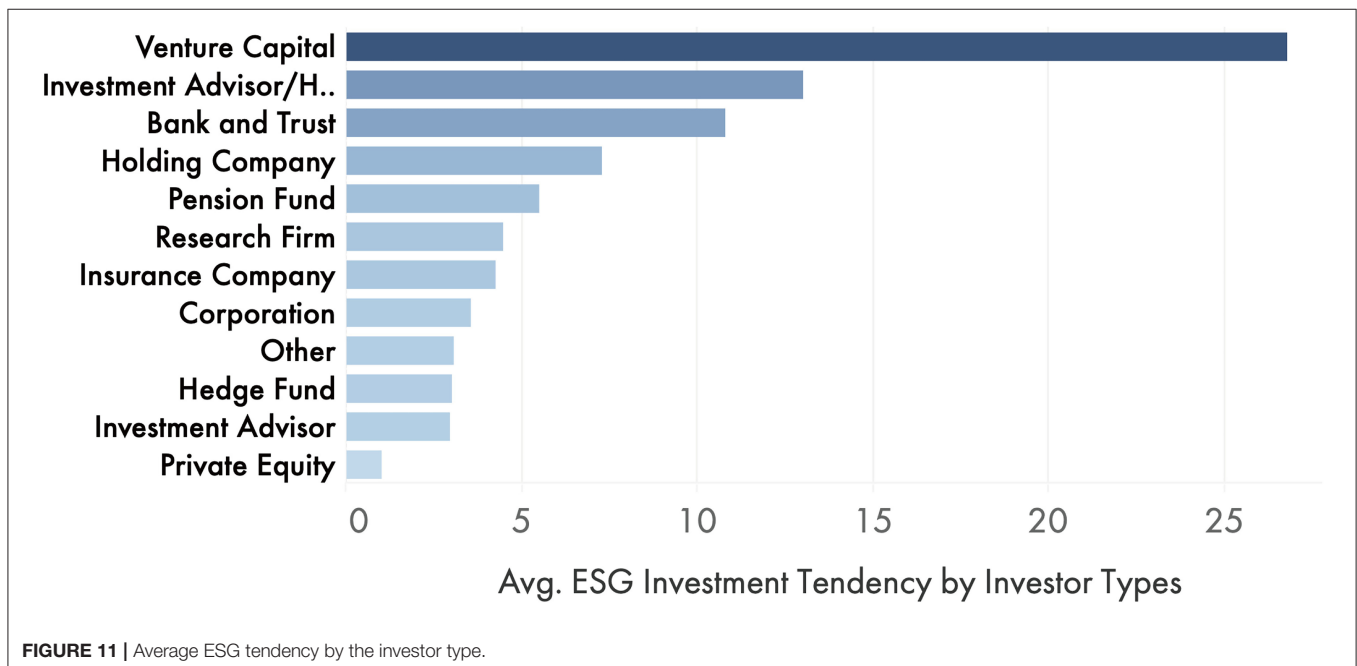
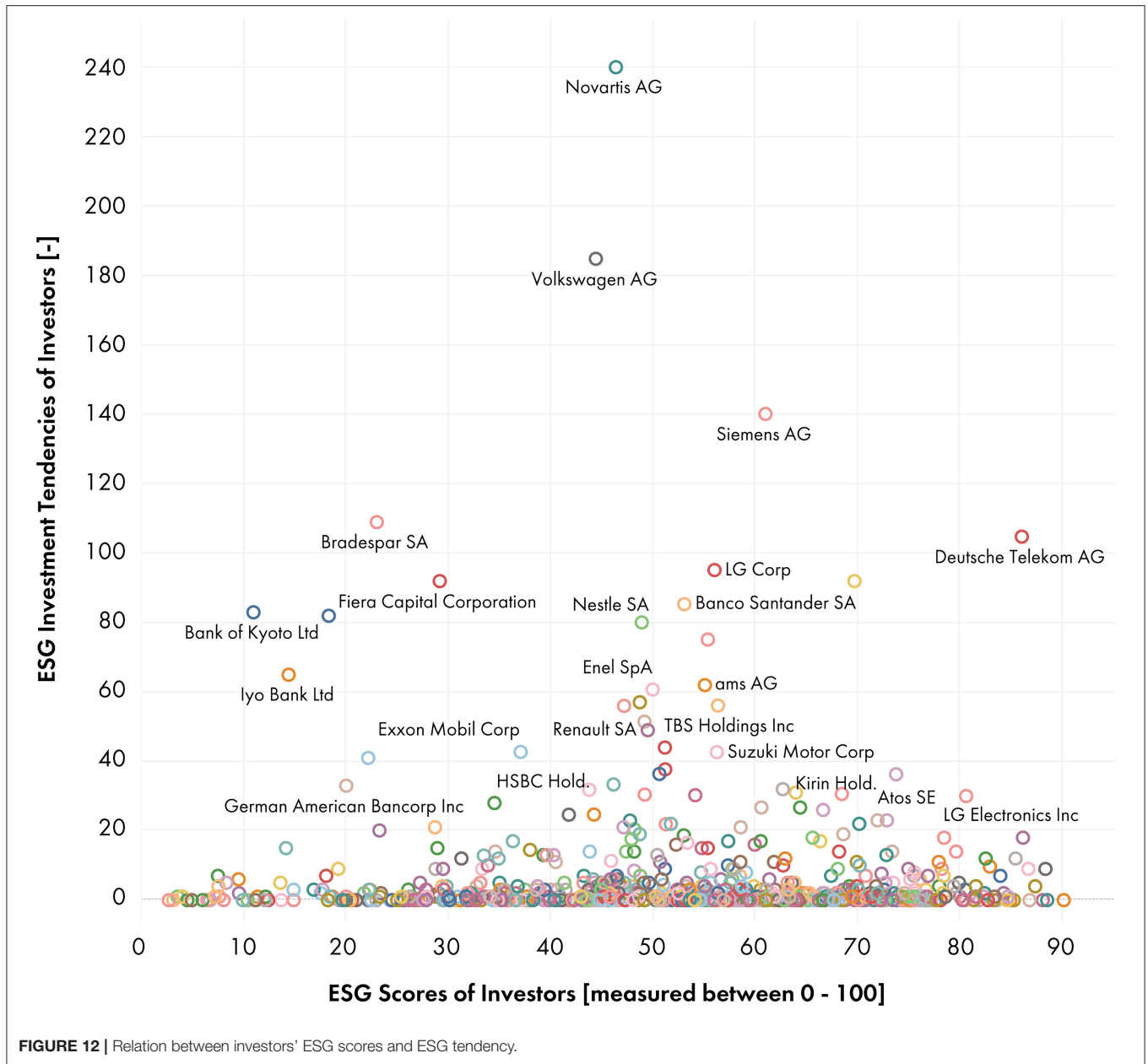


FIGURE 11 | Average ESG tendency by the investor type.



DISCUSSION AND CONCLUSION

Businesses are increasingly expected to understand and manage their exposure to ESG risks associated with their investments in financial assets, strategic partners, and business portfolio interests. Although numerous studies have investigated the impact of the ESG scores of companies on their financial returns and the trend in the ESG investment strategies, studies that identify the major players and regional trend in ESG investment by considering the direct and indirect ownership structure are scarce. Faccio and Lang's (2002) framework considers the cumulative impacts of ownership using the total market price of invested companies and investor history portfolio

report by iterating the calculation to convey the impacts of invested companies to ultimate investors. The study expands this comprehensive approach to the field of ESG investment to address the research gap and detects the most influential investors in the ESG investment field and the ownership structure by considering the direct and indirect ESG ownership.

Based on the results, the patterns by the type of investor and nation-state political boundaries in the context of direct and indirect ownership chains are examined. We identify strong links between several countries, such as a strong link between North America and Asian countries, and differences in the pattern of ESG investment in terms of regional inflow and outflow (i.e., the international ESG investment volume is much larger than

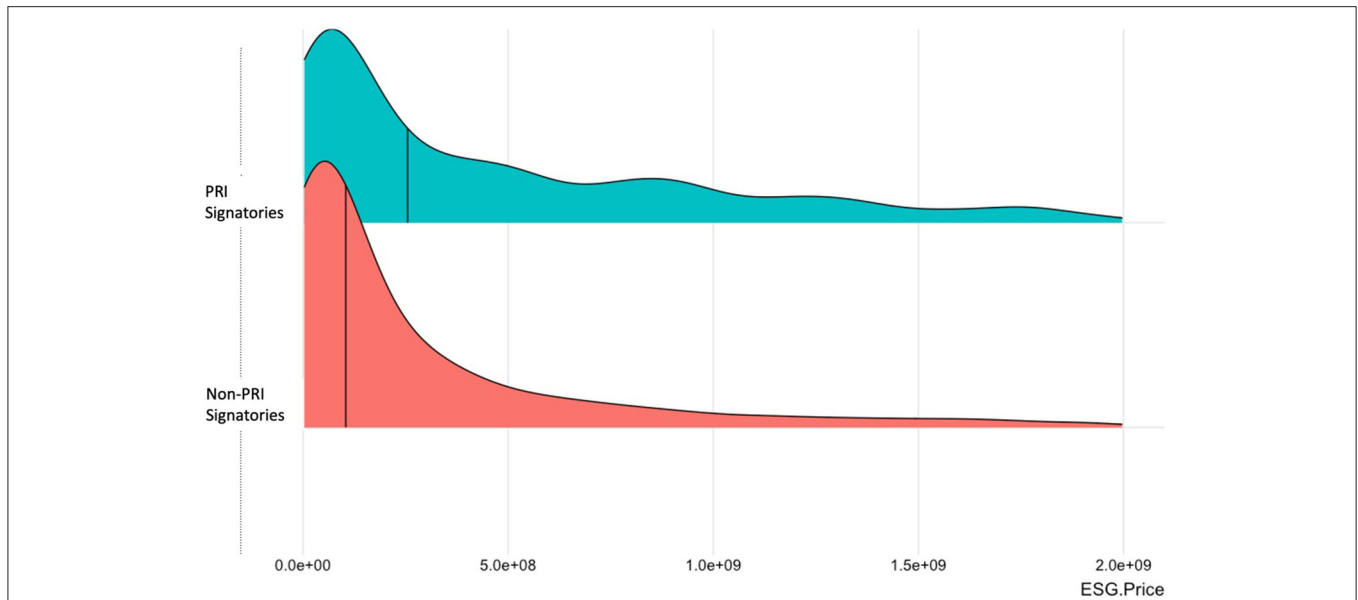


FIGURE 13 | Density ridgeline plots of ESG ownership score by the PRI signatory status.

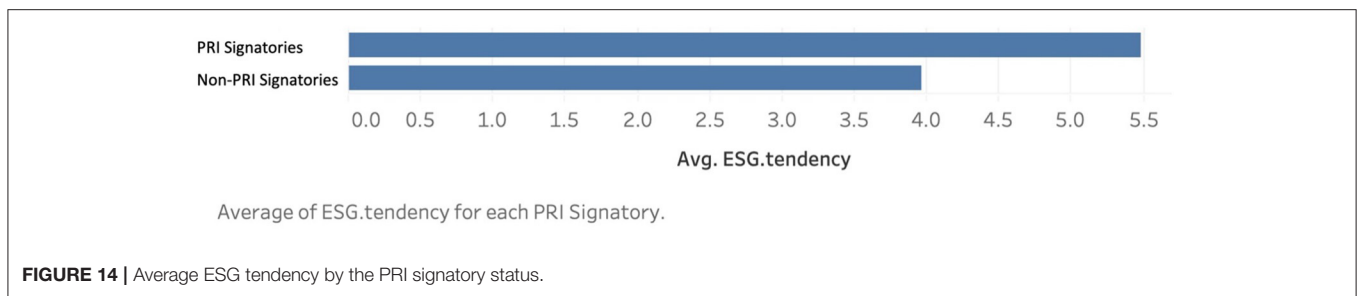


FIGURE 14 | Average ESG tendency by the PRI signatory status.

the internal ESG investment volume in most North American countries, whereas the internal ESG investment volume has the largest share in Asia). Through the analysis, we find that the top 10% investors own approximately 98% of the total ultimate ESG ownership score and the key players differ among the leading countries. In the US, financial firms are the major players, whereas non-financial firms are the major players in Japan and China. Furthermore, the results of the study confirm the important role of corporations in ESG investment, which owns the most global shares (85.77%) measured by the ESG ownership score, considering the direct and indirect ownership chains. Even minority shareholders may be directly linked to adverse environmental and social impacts directly or indirectly caused by investee companies in their portfolios (PRI, 2017). Therefore, it is important for investors to undertake ESG risk-based due diligence and consider ESG risks in their investment processes. Moreover, investors can manage and influence the responsible business conduct of the investee companies through direct and indirect ownership (OECD, 2017). The results of this study highlight the need of wider implementation of investments considering ESG risks.

Using the results of the ultimate ESG ownership analysis, this study also investigated the relation between the calculated

ESG ownership score and Investor’s ESG commitment and ESG performance (i.e., the PRI signatory status, investors’ ESG ratings). The study by Brandon et al. (2021) showed that the PRI signatory institutional investors have better ESG ownership score (calculated based on the direct ownership data) in general, barring the US. Our analysis includes institutional investors and other financial and non-financial corporations, and the results demonstrating that the PRI signatory investors have better ESG ownership score than non-signatory investors are consistent with Brandon et al. (2021). The analysis of the relation between the calculated ESG ownership scores and investors’ ESG performances (ESG ratings provided by Refinitiv) reveals that investors with high ESG ratings do not necessarily have higher incorporation of the ESG investment strategies. This result supports the findings of previous studies examining fund flow reactions to ESG ratings (Hartzmark and Sussman, 2019) by providing the evidence that it is difficult to target the actual flow and ownership structure of ESG investment through ESG ratings of the investors themselves.

Although evaluating the ESG ownership score by considering the direct and indirect ESG ownership structure and covering both institutional investors and other corporations expand the literature on ESG investment and ownership structure in various

ways, our study only evaluates the score of the latest year owing to difficulties in data collection and the time required to calculate the scores for multiple years. Future studies can address this issue by constructing the ESG ownership score as time-series data, which would help in investigating the causal relationship between the ESG ownership score and investors' ESG performances, such as the PRI signatory status and investors' ESG ratings, more accurately.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

AK and CL carried out the experiment. ST conducted additional analyses using the calculated data. AK, CL, ST,

and TG wrote the manuscript with support from SM. All authors contributed to the article and approved the submitted version.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/frsus.2022.909239/full#supplementary-material>

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Conflict of Interest: TG was employed by Industrial Ecology Consultants.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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