

Portfolio Responsibility for ESG Characteristics

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August 8, 2022

Abstract

We measure investors' responsibility for the businesses, policies and practices of the companies they own. Our responsibility metric applies to the diverse collection of Environmental, Social and Governance issues considered by investors, and it can inform investment and engagement decisions. Relative to a benchmark, investor responsibility is active and satisfies a zero-sum property, which underscores the distinction between responsibility and impact.

1 Investor responsibility

Socially responsible investing (SRI) has long evoked the image of well-intentioned investors willing to accept subpar returns for selecting securities that they deem “good” or at least “not bad” on ethical grounds. The word “responsible” in SRI implies that the investor is acting as an ethical decision maker. SRI investors may attempt to align their portfolios with their values, for example, avoiding companies that sell tobacco or pornography, or choosing companies with the best records on human rights. We leave for another day a discussion of the ongoing debate regarding the financial performance of SRI portfolios, since our purpose is to define and analyze investor *responsibility*. In this note, we formalize responsibility with implications for portfolio reporting, and investment and engagement decision making.

Limited liability stock corporations cap the downside risk of investing to loss of principle and shareholders experience the financial benefit of being owners in proportion to their stakes. Investors exercise their desires and expectations through the election of boards of directors, who, in turn, hire and fire firm managers. This arm's-length control of a company does not obviate responsibility for the activities of the firm, which is carried by all investors. Thus, responsibility and its associated liabilities could be described as “ethical.” To understand the extent of their ethical liabilities, investors need accurate information about the range of businesses, policies, and practices for which they assume responsibility when they purchase a security.

We measure portfolio level responsibility for the diverse collection of Environmental, Social and Governance (ESG)¹ issues considered by investors who align their portfolios with their values. To put an investor's responsibility in perspective, we compare it to the responsibility of a same-size investment in a cap-weighted benchmark. The difference between the two is *active responsibility*. We provide formulas that can be used to calculate responsibility as well as schematic examples that show how the formulas work. Subsequently, we talk about how to interpret responsibility, and give a realistic example showing that responsibility for several ESG characteristics can be measured in a single portfolio. Our final point is that active responsibility satisfies a *zero-sum property*, which underscores the distinction between responsibility and impact.

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¹While the acronyms SRI and ESG are sometimes used interchangeably, we distinguish them. ESG is most appropriately considered as a set of issues within environmental, social and governance domains, different subsets of which may be of interest to different investors. ESG issues contain no judgement about values or bias. The purpose of our reference to SRI is to note the dominant understanding of “responsibility.”

2 Measuring responsibility

A company’s businesses, policies and practices have consequences. Companies hire workers and buy goods from suppliers, creating economic activity. Some companies build solar panels or install and maintain chargers, helping to tackle the issue of fossil fuel consumption and climate change. At the same time, companies may pollute rivers, sell products that directly harm humans or exploit their workers. Responsibility for a company’s impact can be allocated to investors based on the fraction of the company they own. Company-level responsibility for a given issue can be aggregated to portfolio-level responsibility, for which the investor is ethically accountable.

Our setup is a market with N companies, and we let m_n be the dollar value of company n , in other words, its market cap. As a benchmark, we take the market portfolio. The weight of company n in the benchmark is m_n/m , where $m = \sum_n m_n$ is the value of the market. We compute responsibility for an investor whose dollar allocation to company n is p_n , so $p = \sum_n p_n$ is the value of the investor’s portfolio.

We accompany our mathematical formulation of responsibility with schematic examples that show how the formulas work. These examples are based on a hypothetical five-company market worth \$2000 and a hypothetical investor with a stake of \$100. The details of the market and the investment are in Table 1.

Company (n)	Market Cap (\$) (m)	Investment (\$) (p)
1	300	25
2	300	30
3	500	20
4	600	15
5	300	10
Total	2000	100

Table 1: For illustrative purposes, we show a hypothetical five-company market that is worth a total of \$2000. In this example, a single investor has a stake of \$100.

2.1 Physical characteristics

We begin with a formula that can be used to calculate an investor’s responsibility for Scope 1 carbon emitted² or the number of jobs offered in a particular region or any other physical characteristic that can be measured numerically. The investor’s responsibility for characteristic J at company n , $R_P^n(J)$ is the company’s contribution J_n scaled by p_n/m_n , the fraction of the company owned by the investor,

$$R_P^n(J) = \frac{p_n}{m_n} J_n. \quad (1)$$

Portfolio responsibility is obtained by aggregating over companies:

$$R_P(J) = \sum_n R_P^n(J) \quad (2)$$

For a cap-weighted benchmark portfolio equal in value to the investment, the fraction of portfolio value invested in company n is $p m_n/m$. Applying formula (1) to calculate company level responsibility $R_B^n(J)$ for this benchmark investment and formula (2) to aggregate to the portfolio level, benchmark responsibility for a portfolio with value p is

$$R_B(J) = \sum_n R_B^n(J_n) = \sum_n \frac{p}{m} J_n = \frac{p}{m} \sum_n J_n. \quad (3)$$

Active responsibility R_A is the difference between portfolio and benchmark responsibility:

$$R_A(J) = R_P(J) - R_B(J) = \sum_n \left(\frac{p_n}{m_n} - \frac{p}{m} \right) J_n. \quad (4)$$

²The carbon emissions for which a company is directly responsible are *Scope 1*. Carbon emissions for which a company is indirectly responsible are *Scope 2* or *Scope 3*.

Portfolio, benchmark and active responsibility measures depend on the value p of the investment.

Table 2 shows how to use our formulas to calculate responsibility for a physical characteristic in our hypothetical market. The characteristic J in our example is the number of jobs offered in the city of Denver, and the total is 98. Using weights obtained from Table 1, we calculate portfolio responsibility R_P to be 7.31 jobs offered and benchmark responsibility to be R_B is 4.90 jobs offered. Active responsibility R_A is 2.41 jobs offered, the difference between portfolio responsibility $R_P = 7.31$ and benchmark responsibility $R_B = 4.90$. The portfolio’s percentage increase in responsibility for jobs offered in Denver relative to the benchmark is $2.41/4.90 = 47\%$.

Company (n)	Jobs in Denver (J_n)	Responsibility		
		Portfolio $((p_n/m_n)*J_n)$	Benchmark $((p/m)*J_n)$	Active $((p_n/m_n)-(p/m))*J_n)$
1	46	3.83	2.3	1.53
2	27	2.70	1.35	1.35
3	6	0.24	0.3	-0.06
4	12	0.30	0.6	-0.30
5	7	0.23	0.35	-0.12
Total	98	7.31	4.9	2.41

Table 2: For illustrative purposes, we calculate responsibility for jobs offered in Denver in a hypothetical five-company market. Fraction of ownership used to compute portfolio and benchmark responsibility relies on the hypothetical investment data in Table 1. Active portfolio responsibility is 2.41 jobs offered, which is an increase of 47% over the same investment in the benchmark.

2.2 Ratios of characteristics

Suppose we want to measure responsibility for carbon emissions per revenue or the fraction of women on a board. These are ratios of physical characteristics. We can’t apply formula (2) directly because a sum of ratios of companies’ physical characteristics weighted by fraction of ownership does not properly reflect the ratio of physical characteristics at the portfolio level, which is what we’re after. Instead, we compute responsibility at the portfolio level for the numerator and denominator characteristics separately and take the quotient.

Let J be the characteristic in the numerator, say the number of women on a company’s board. Let K be the characteristic in the denominator, say the total number of board members. We are interested in responsibility for J/K , the fraction of the board that is composed of women.³ In this example, portfolio responsibility for the size of the board $R_P(K)$ is calculated by applying (2) to characteristic K . The same calculation applied to characteristic J gives us portfolio responsibility for the number of women on boards of firms in the investor’s portfolio. Responsibility for gender diversity in the portfolio is given by

$$R_P(J/K) = \frac{R_P(J)}{R_P(K)}. \tag{5}$$

Applying formula (3), which computes responsibility for cap-weighted benchmark scaled to the level of investment, benchmark responsibility for gender diversity is given by

$$R_B(J/K) = \frac{R_B(J)}{R_B(K)} = \frac{\frac{p}{m} \sum_n J_n}{\frac{p}{m} \sum_n K_n} = \frac{\sum_n J_n}{\sum_n K_n}. \tag{6}$$

Both the numerator and the denominator in formula (6) scale with the value p of the portfolio, which cancels out. In contrast to our calculation of portfolio responsibility for a ratio, benchmark

³At the time of this writing, gender is typically treated as a categorical characteristic in ESG portfolios, and we adopt that practice here. Responsibility can be modified to allow for a more general treatment of gender.

responsibility for a ratio does not rely on the level of investment.⁴

Here’s the active responsibility formula for ratios:

$$\begin{aligned}
 R_A(J/K) &= R_P(J/K) - R_B(J/K) \\
 &= \frac{R_P(J)}{R_P(K)} - \frac{R_B(J)}{R_B(K)}
 \end{aligned}
 \tag{7}$$

Table 3 shows how to use our formulas to calculate responsibility for a ratio of characteristics in our hypothetical market. Using weights obtained from Table 1, applications of formula (2) tell us that the portfolio’s board has $R_P(K) = 2.91$ members, $R_P(J) = 0.67$ of which are women. Applying formula (5), portfolio responsibility for gender diversity is $R_P(J/K) = 0.67/2.91 = 0.23$, or 23.0%. At the same level of investment, applications of formula (3) tell us that the benchmark’s board has $R_B(K) = 2.45$ members, $R_B(J) = 0.65$ of which are women. Applying formula (6), benchmark responsibility $R_B(J/K) = 0.65/2.45 = 0.265$ or 26.5%. Based on a calculation with formula (7), the investor’s portfolio is less gender diverse than the benchmark: active responsibility is -0.035 , or -3.5% .

Company (n)	Board Size (K_n)	Women (J_n)	Responsibility			
			Board		Women on Board	
			Portfolio $((p_n/m_n)*K_n)$	Benchmark $((p/m)*K_n)$	Portfolio $((p_n/m_n)*J_n)$	Benchmark $((p/m)*J_n)$
1	10	3	0.83	0.5	0.25	0.15
2	12	1	1.20	0.6	0.10	0.05
3	8	5	0.32	0.4	0.20	0.25
4	9	2	0.23	0.45	0.05	0.1
5	10	2	0.33	0.5	0.07	0.1
Total	49	13	2.91	2.45	0.67	0.65

Table 3: For illustrative purposes, we calculate responsibility for board gender diversity in a hypothetical five-company market. Fraction of ownership used to compute portfolio and benchmark responsibility rely on the hypothetical investment data in Table 1. The fraction of women on the board of the portfolio is $0.67/2.91 = 0.23$ or 23.0%. The fraction of women on the board of the benchmark is $0.65/2.45 = 0.265$ or 26.5%. The portfolio’s board is less diverse than the benchmark’s, and the active responsibility is -0.035 or -3.5% .

2.3 Policies and other binary characteristics

ESG investors may consider policies on child labor or paternity leave or human rights as they evaluate companies. Portfolio responsibility for a policy can be viewed as a ratio. The denominator characteristic K indicates the potential for a company to have the policy in question, and it is always set to 1. The numerator characteristic J is set to 1 if a company has the policy and 0 otherwise. This allows us to measure portfolio and active responsibility for policies and other binary characteristics using the ratio formulas in Section 2.2.

Table 4 shows how to use our formulas to calculate responsibility for a human rights policy in our hypothetical market. Using weights obtained from Table 1, applications of formula (2) tell us that the portfolio has the potential to have responsibility for $R_P(K) = 0.28$ policies, while the responsibility for actual policies is $R_P(J) = 0.07$. Applying formula (5), portfolio responsibility for a human rights policy is $R_P(J/K) = 0.07/0.28 = 0.26$, or 26%. At the same level of investment, applications of formula (3) tell us that the benchmark has the potential to have responsibility for $R_B(K) = 0.25$ human rights policies, while the actual responsibility is $R_B(J) = 0.10$. Applying formula (6), benchmark responsibility for a human rights policy is $R_B(J/K) = 0.10/0.25 = 0.40$, or 40%. Based on a calculation with formula (7), the investor’s portfolio has a lower percentage of human rights policies than the benchmark: active responsibility is -0.14 , or -14% .

⁴The dependence of portfolio and active responsibility on portfolio value p is generally greater for physical characteristics than for ratios.

Company (n)	Potential to have a Human Rights Policy		Potential		Actual	
	Rights Policy (K _n)	Human Rights Policy (J _n)	Portfolio	Benchmark	Portfolio	Benchmark
			$((p_n/m_n)*K_n)$	$((p/m)*K_n)$	$((p_n/m_n)*J_n)$	$((p/m)*J_n)$
1	1	0	0.08	0.05	0.00	0
2	1	0	0.10	0.05	0.00	0
3	1	1	0.04	0.05	0.04	0.05
4	1	0	0.03	0.05	0.00	0
5	1	1	0.03	0.05	0.03	0.05
Total			0.28	0.25	0.07	0.10

Table 4: For illustrative purposes, we calculate responsibility for a human rights policy in a hypothetical five-company market. Fraction of ownership used to compute portfolio and benchmark responsibility rely on the hypothetical investment data in Table 1. The fraction of the portfolio that has a human rights policy is $0.07/0.28 = 0.26$ or 26.0%. The fraction of the benchmark that has a human rights policy is $0.10/0.25 = 0.40$ or 40.0%. Portfolio responsibility for human rights policies is lower than benchmark responsibility, and active responsibility is -14.0% .

3 Interpreting responsibility

Responsibility for a physical characteristic such as carbon emissions is straightforward: an investor’s share of the carbon emitted by a company’s activities increases with the size of the share. Investors who want to offset their portfolio carbon emissions can use responsibility to indicate the amount of carbon that needs to be addressed. A more nuanced example is the level of gender diversity of a board of directors, which doesn’t break down into fractional shares as easily as a metric ton of carbon. Every investor in a company has the same board of directors.⁵ An additional complication arises for boards when we aggregate company responsibilities to yield portfolio responsibility. Here, we are aggregating partial board members across companies. It is helpful to think of the board of directors for the portfolio as an aggregate of the board members for the constituent companies, with adjustments made for their weights. This makes it possible to consider portfolio level board characteristics, such racial or ethnic diversity. Similar considerations apply to policies and other characteristics that do not naturally divide across investors.

4 Calculating responsibility for several issues in a realistic portfolio

Since ESG covers a diverse set of issues, it is possible for a portfolio to be stronger in some areas and weaker on others. We illustrate this in the context of a realistic, hypothetical portfolio.

Portfolios constructed by excluding unwanted companies from a diversified index are widely used by ESG investors.⁶ We consider a hypothetical \$10,000,000 investment in the S&P 500[®] Fossil Fuel Free Index benchmarked against the S&P 500 Index. We compute responsibility for carbon emissions per year, women on boards and human rights policies⁷ as of 20 May 2022.

⁵While influence on the election of directors increases, in theory at least, with investment size, all investors have the same board once it is elected.

⁶For detailed analysis of exclusion portfolios, see Branch et al. (2019) and Bohn et al. (2022).

⁷Carbon emissions data, human rights policy data, index constituents and market capitalization come from MSCI. The latter is a binary indication of whether a robust human rights policy exists. Data regarding women serving on boards of directors come from ISS.

	Portfolio	Benchmark	Active
Carbon Emissions/year (tons)	4569.4	5088.2	-518.8
Board Gender Diversity (% women)	31.6	31.5	0.1
Human Rights Policy (%)	7.0	8.5	-1.6

Table 5: For illustrative purposes, we calculate responsibility for three issues in a hypothetical \$10,000,000 fossil-free portfolio benchmarked against the S&P 500 Index on 20 May 2022. Responsibility for carbon emissions was lower in the hypothetical fossil-free portfolio than in a comparable investment in the benchmark. Portfolio and benchmark responsibility for gender diversity on boards were almost identical. Excluding fossil fuel companies from the benchmark lowered responsibility for human rights policies. Sources: MSCI and ISS.

Responsibility for carbon emissions, a physical quantity, relies on the formulas (1) through (4) in Section 2.1. As expected, responsibility for carbon emissions was lower in the fossil-free portfolio than in a comparable investment in the benchmark, yielding a negative active responsibility. The fraction of women on boards is a ratio, so responsibility calculations rely on the formulas (5) through (7) in Section 2.2. We find the portfolio and benchmark responsibility to be almost identical, at around 0.30. Following the logic in Section 2.3, we use formulas (5) through (7) from Section 2.2 to calculate responsibility for a human rights policy. Fossil fuel companies were more likely than average to have human rights policies, leading to negative active responsibility for the fossil-free portfolio on this issue. This example illustrates that conscious decision making based on a specific issue is required to ensure better active responsibility for that issue.

5 Investor impact and the responsibility zero sum formula

Investors have impact when they change a company’s businesses, policies or practices. Impact requires a causal mechanism, which might be direct engagement through which investors lobby to change a policy or procedure, exiting or short selling in sufficient quantity to put financial pressure on a company to change behavior, altering public policies to force the company to change behavior to stay within the law, or other mechanisms that pressure management to alter company characteristics. Responsibility, in contrast to impact, is an investor’s proportional ownership of everything a company does, and it can be aggregated to the portfolio level.

Using our formulas, investors might discover their responsibility for diversity, equity and inclusion (DEI) is lower than they would like it to be. There are several actions these investors can take. For example, they could exclude companies that lack racial or ethnic minority board members or overweight companies with lots of minority board members. These options would alter responsibility but might or might not have impact on the company or the world. Alternatively, investors can maintain a status quo portfolio and engage with the companies they own to increase minority representation on boards. While this engagement strategy does not guarantee impact, it offers the possibility. Before any change, responsibility remains fixed for all investors. If the engagement has impact, then the responsibility of all investors adjusts accordingly.

Anecdotes indicate the potential for engagement to have impact. For example, investors in Monster Beverage partnered with As You Sow (AYS) in 2020 on a shareholder resolution to promote racial justice. Upon receiving the resolution and engaging with AYS, the company made several commitments, including the promise to elect a board member from an underrepresented community. Based on this commitment, AYS withdrew the shareholder resolution. This engagement had impact on Monster Beverage.

Engagement, however, does not have the potential to create impact on all ESG issues. Consider that investors with positions in a tobacco company bear responsibility for tobacco revenues. They may wish for the company to change its business to something other than tobacco, but the SEC will allow companies to omit resolutions that micromanage. In other words, engagement is not a mechanism for impact that alters a company’s business. These investors may choose to sell their tobacco stock, absolving them of responsibility for tobacco revenue. Responsibility is shifted to another investor, and that typically does not result in immediate impact.

There is disagreement about whether divestment, from the perspective of impact is a hollow gesture. In a 1996 research article, Teoh et al. (1999) argue that divestment activities related to South African apartheid did not force a change in that country, but Nelson Mandela and Archbishop Desmond Tutu credit divestment and selective purchasing laws for putting pressure on companies to leave South Africa which in turn pressured the government of South Africa to dismantle apartheid. A similar debate is now taking place regarding fossil fuels. In a 2022 research article, Berk & von Binsberger (2021) argue that divestment and other so-called impact investing strategies cannot change a company’s cost of capital, and hence cannot have impact. In contrast, Bill McKibben and 350.org have argued that divesting from fossil fuels could exert pressure on policy makers even if these campaigns do not directly force a company to change its business model.⁸

It is for investors to determine their own reactions to their responsibility for the businesses, policies and practices of the companies in their portfolios. Different responses may be appropriate for different issue areas. The essential takeaway is that responsibility and impact should not be conflated. The zero-sum property of active responsibility shows that buying or selling a security has no impact unless it causes companies to change. Rather, responsibility is simply transferred to another investor. In case an investor, through engagement or buying and selling, does cause a company to change, the zero-sum property applies to the new situation, with responsibility for company businesses, practices and policies reallocated proportionally to all shareholders.

6 Outlook

In this paper, we explored the concept of investor responsibility and provided tools that can be used to calculate it. We argued that investors own the businesses and business practices of companies in their portfolios, good and bad, in the same proportion that they own financial rewards. For socially inclined investors who may have previously identified as socially responsible investors, our definition of responsibility represents a shift in thinking. Rather than seeking to make responsible investment, investors take responsibility for the activities of the companies of which they are partial owners. With this mindset, investors can calculate their aggregate responsibility for the physical characteristics of the companies in their portfolios, as they do for financial performance. In addition, investors can evaluate their active responsibility—the amount above or below benchmark responsibility at a comparable level of investment. Investors can use our formulas to assess their responsibility for ESG issues, which they incur when they own securities. We acknowledge that each investor’s reaction to this responsibility will be unique, ranging from decisions to avoid the responsibility by exiting a security to seeking to change a company’s behavior, with the potential to change all investors’ responsibility in that area, to ignoring the notion altogether.

A Proofs of zero-sum properties

We mathematically verify the zero-sum properties of our responsibility formulas.

For a physical characteristic J , active responsibility with respect to a cap-weighted benchmark sums to zero. This can be seen by summing over investors, indexed by ℓ , and reversing the order of

⁸Additional references on the debate about divestment and impact include Grossman & Sharpe (1986) and Rohleder et al. (2022). The issue of “exit versus voice” is addressed in Hart & Zingales (2017) and Broccardo et al. (2022).

summation.

$$\begin{aligned}
\sum_{\ell} R_A^{\ell}(J) &= \sum_{\ell} R_P^{\ell}(J) - R_B^{\ell}(J) \\
&= \sum_{\ell} \sum_n \left(\frac{p_n^{\ell}}{m_n} - \frac{p^{\ell}}{m} \right) J_n \\
&= \sum_n \sum_{\ell} \left(\frac{p_n^{\ell}}{m_n} - \frac{p^{\ell}}{m} \right) J_n \\
&= \sum_n \left(\frac{m_n}{m_n} - \frac{m}{m} \right) J_n \\
&= 0.
\end{aligned}$$

A consequence of the zero sum property is that the sum over all investors of portfolio responsibility and benchmark responsibility agree, and we denote the common sum by R_M . For any characteristic J ,

$$R_M(J) = \sum_{\ell} R_B^{\ell}(J) = \sum_{\ell} R_P^{\ell}(J). \quad (8)$$

For a ratio of characteristics J/K , the simple zero-sum property does not hold. Instead, active responsibility weighted by portfolio responsibility of the denominator characteristic is zero sum. To see this, note first that formula (3) implies that for characteristics J and K and investor ℓ ,

$$\frac{R_B^{\ell}(J)}{R_B^{\ell}(K)} = \frac{R_M(J)}{R_M(K)} \quad (9)$$

Applying formula (9), which tells us that the ratio $R_B^{\ell}(J)/R_B^{\ell}(K)$ is the same for all investors ℓ ,

$$\begin{aligned}
\sum_{\ell} R_P^{\ell}(K) R_A^{\ell}(J/K) &= \sum_{\ell} R_P^{\ell}(K) \left(\frac{R_P^{\ell}(J)}{R_P^{\ell}(K)} - \frac{R_B^{\ell}(J)}{R_B^{\ell}(K)} \right) \\
&= \sum_{\ell} R_P^{\ell}(J) - \sum_{\ell} \frac{R_B^{\ell}(J)}{R_B^{\ell}(K)} R_P^{\ell}(K) \\
&= \sum_{\ell} R_P^{\ell}(J) - \frac{R_M(J)}{R_M(K)} \sum_{\ell} R_P^{\ell}(K) \\
&= R_M(J) - R_M(J) \\
&= 0.
\end{aligned}$$

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Acknowledgement

We thank David Baron, Jonathan Berk, Dan diBartolomeo, Jordan Famularo, Pete Hand, Ola Mahmoud, Caroline Ribet, Ken Ribet, Stephanie Ribet, Paul Solli and Andrew Schein for thoughtful comments on an early draft of this article. We are grateful to Kirsten Meder and Simge Ulucam, who provided substantial support for the development of our ideas.

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