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Investment-Related Scope 3 Emissions: Ownership, Financial Control, and Calculation Methods

Yatırım Kaynaklı Kapsam 3 Emisyonları: Sahiplik, Finansal Kontrol ve Hesaplama Yöntemleri

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ABSTRACT

This study examines the calculation and management of investment-related Scope 3 emissions, presenting a scenario-based analysis within the context of equity investments in the financial sector. In line with increasing greenhouse gas (GHG) disclosure requirements, financial institutions must account for the emissions associated with their investment portfolios. However, methodological uncertainties and sectoral differences complicate the standardization of emission reporting. In particular, identifying and effectively managing emissions that financial investors indirectly contribute to through their portfolios has become a critical necessity for sustainable finance policies. This research compares the investment-specific and average-data methods through scenarios, evaluating their applicability based on ownership structure and financial control levels. The findings indicate that financial control is a key determinant in emission allocation. While majority shareholders report direct emissions (Scope 1 and Scope 2), minority shareholders must rely on sector-based estimates to report under Scope 3. Furthermore, financial institutions must adopt more transparent and consistent reporting practices to fully assess the environmental impact of their investment decisions. In this regard, the different calculation methods analyzed in this study, along with the presented scenarios, provide strategic insights that can help investors and regulatory bodies make more informed decisions.

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ÖZ

Bu çalışma, yatırım kaynaklı Kapsam 3 emisyonlarının hesaplanması ve yönetilmesi konusunu ele almakta ve finans sektöründeki özkaynak yatırımları bağlamında senaryo bazlı bir analiz sunmaktadır. Artan sera gazı (GHG) açıklama gereklilikleri doğrultusunda, finansal kurumların yatırım portföylerinden kaynaklanan emisyonları hesaplaması gerekmektedir. Ancak, metodolojik belirsizlikler ve sektörel farklılıklar, emisyon raporlamasının standartlaştırılmasını zorlaştırmaktadır. Özellikle, finansal yatırımcıların portföyleri aracılığıyla dolaylı olarak neden olduğu emisyonları belirlemesi ve bu emisyonların etkin bir şekilde yönetilmesi, sürdürülebilir finans politikaları açısından kritik bir gereklilik haline gelmiştir.
Bu araştırma, yatırıma özgü ve ortalama veri yöntemlerini senaryolar üzerinden karşılaştırarak, bu yöntemlerin sahiplik yapısı ve finansal kontrol düzeyine göre uygulanabilirliğini değerlendirmektedir. Bulgular, finansal kontrolün emisyon tahsisini belirleyici bir faktör olduğunu göstermektedir. Çoğunluk hissesine sahip yatırımcılar, doğrudan emisyonları (Kapsam 1 ve Kapsam 2) raporlarken, azınlık hissedarlarının sektör bazlı tahminlere dayanarak Kapsam 3 dahilinde raporlama yapmaları gerekmektedir. Ayrıca, yatırım kararlarının çevresel etkilerini tam olarak değerlendirebilmek için finansal kurumların daha şeffaf ve tutarlı raporlama yapması gerekmektedir. Bu bağlamda, çalışmada ele alınan farklı hesaplama yöntemleri ve sunulan senaryolar, yatırımcıların ve düzenleyici kurumların daha bilinçli kararlar almasına yardımcı olabilecek stratejik değerlendirmeler sunmaktadır.

1. Introduction

Scope 3 emissions are considered in a general scholarly context that encompasses their definition, how to calculate them, their correlation to finance, and their implications in regulation. Indirect greenhouse gas emissions that stem from operations of companies but not from their immediate operations but from across their supply chain, lifetime of

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their products, or their operations of investments include scope 3 emissions. Schmidt et al. (2022) posit that their measurement is not easy considering that companies have no full visibility in their supply chains to get necessary data to calculate their scope 3 emissions and that their measurement only captures their immediate tier of their suppliers. Huang et al. (2009) posit that more than 75% of carbon footprints in many industries have their roots in scope 3 activities, hence their negligence may make companies underestimate their carbon reduction potential. Shmelev and Gilardi (2025) further posit that scope 3 emissions from their utilization in markets or disposal at their lifetime contribute significantly to companies' environmental footprints as well as their profitability. They identify that high scope 3 emissions have their roots in higher operating costs as well as potential risks to their profitability, hence their visibility in their disclosures is crucial to their investors as well as other stakeholders.

The calculation of Scope 3 emissions largely depends on used providers of data and methods used. Nguyen et al. (2023) demonstrate that differing providers of data (Bloomberg, Refinitiv Eikon, ISS) have substantial discrepancies in their estimations of Scope 3 emissions, with ISS's estimations based on economic input-output analysis differing substantially from reported ones. Swinkels and Markwat (2024) analyze discrepancies in providers of carbon emissions in investment portfolios by examining how Scope 3 emissions have substantial variability. They compare four providers of varying data for developed markets' equity investments and emerging markets' ones as well as for corporate bond markets and determine that while Scope 1 and Scope 2 have relatively similar figures, Scope 3 have substantial discrepancies. Hakovirta et al. (2024) analyze discrepancies in carbon target alignment of investment companies with their managed energy and utility assets by demonstrating that Scope 3 carbon emissions reporting has inconsistent figures across finance companies. They determine that while Science-Based Targets initiative (SBTi) guidelines have clear guidelines for measurement of emissions, companies have largely not included full disclosures of Scope 3 in their own sustainability objectives.

Among the approaches to estimate Scope 3 emissions, economic input-output life cycle analysis (EIO-LCA) and life cycle assessment (LCA) play leading roles. Not only carbon footprints of companies' own operations but their entire supply chain must be measured through life cycle assessment by Lee and Ma (2013). Economic input-output analysis has been shown by Hertwich and Wood (2018) to increase industrial carbon footprints from Scope 3 emissions by 84% in global economy while these emissions account for more than direct emissions to industrial and building sectors in proportion to their carbon footprints.

The financial industry plays a leading role in shaping global carbon footprints through investment portfolios. Brans and Peters (2024) point out that financial institutions face greater risks of legal liability for carbon emissions from companies in their investment portfolios. Mejia and Kajikawa (2024) identify that lack of adequate data is a severe hindrance in estimating Scope 3 carbon emissions from investments to make their carbon contribution to investment portfolios incomplete. Popescu et al. (2023) estimate carbon risks for sustainable investment funds by considering their exposure to carbon emissions and conclude that if Scope 3 carbon emissions are accounted for, these funds have carbon risks of 2 to 3 times that of conventional market indices.

Moreover, the economic impact of Scope 3 emissions has implications that reach far beyond investment funds to the finance industry at large. Pasiouras et al. (2023) explore the correlation between financed emissions (Scope 3) and public listed banks' cost of equity in 35 countries. They establish that financed emissions have a statistically significant correlation with higher cost of equity for these listed banks, where higher financed emissions increase cost of equity for these listed banks. Climate finance risks drive their correlation largely by influencing investor demand for higher returns on higher carbon assets that these listed banks have more exposure to. They further establish that economic preparedness and regulation play their part in reducing this impact through their research by finding that listed banks in countries with more stringent climate policies have lower cost of funds even if their Scope 3 emissions are high.

Two primary approaches to computing investment-linked Scope 3 emissions have been presented by Wang et al. (2024) as consisting of investment-specific or ownership proportion allocation of investee company Scope 1 and Scope 2 emissions to investor level. As noted by Xia and Cai (2023), where investor-allocated emissions figures cannot be traced, the average figures method is used that makes investor-allocated estimations by industry-based emission factors. Downie and Stubbs (2013) analyze companies' methods of disclosing Scope 3 emissions in Australia and identify scope discrepancies across industries while advocating for all-around guidelines of reporting.

Scope 3 emissions have assumed greater importance not only from environmental but from profitability as well as from regulation risks. Panjwani et al. (2023) establish that companies that make disclosures of Scope 3 emissions have lower cost of borrowing in credit markets with an average financing advantage of -20 basis points. Similarly so, accounting for Scope 3 emissions in finance risk models is gaining importance as carbon risks must get priced in to equities valuations (Pasiouras et al., 2023).

The European Union and other worldwide regulators have begun to require finance industry investment-related emissions to be reported. Borghesi et al. (2025) consider how global investing is influenced by EU rules on non-financial reporting in that these rules set a landmark for green finance practice. Tian et al. (2025) provide empirical results that verify that rules by the International Sustainability Standards Board (ISSB) on disclosures of Scope 3 emissions have a beneficial impact on United States manufacturers' valuations in markets.

2. Literature

Scope 3 emissions are analyzed in broad scholarly context in their definition, methods of calculation, correlation with finance, and regulation implications. Indirect greenhouse gas emissions not coming from companies' own operations but from throughout their supply chain, their product lifetime, or their investment activities comprise scope 3 emissions. Schmidt et al. (2022) point out that these emissions' calculation is complicated by lack of access to

necessary data in their supply chain and that only to their first-tier supplier these emissions may trace typically. According to Huang et al. (2009), in numerous industries more than 75% of their carbon footprint comes from scope 3 origins, emphasizing that their negligence might cause companies to overestimate their potential for carbon reduction. Jain (2024) focuses on scope 3 in the context of scope 3 in the cement industry, illustrating that scope 3 significantly contribute to carbon footprint of their industry. He points out in his research that upstream/downstream processes like extraction of materials or transport significantly contribute to their total emissions so voluntary reporting as well as detailed mitigation measures are inevitable. Shmelev and Gilardi (2025) further argue that scope 3 emissions, especially from their use of products or disposal at their lifetime's end, significantly contribute to companies' environmental footprints as well as their finance performance. They point out in their research that high scope 3 emissions have typically higher operating expenditures as well as potential risks for finance so for their investors and other stakeholders their publication must be transparent.

The calculation of Scope 3 emissions largely depends on used providers of data and methods. Nguyen et al. (2023) demonstrate that different providers of data (Bloomberg, Refinitiv Eikon, ISS) have substantial discrepancies in their estimations of Scope 3 emissions with ISS's estimations based on economic input-output analysis differing substantially from reported figures. Swinkels and Markwat (2024) analyze discrepancies in providers of data in carbon estimations of carbon emissions in investment portfolios considering that Scope 3 emissions have substantial variability. They compare four providers of varying data for investments in developed markets and emerging markets as well as for corporate bond markets to demonstrate that while Scope 1 and Scope 2 have relatively low variability, Scope 3 has substantial deviations. Hakovirta et al. (2024) analyze mismatch of carbon objectives of investment companies with their managed energy and utility assets to demonstrate that Scope 3 emissions reporting is not consistent in finance companies. They conclude that while Science-Based Targets initiative (SBTi) guidelines make measurement of emissions more unambivalent, majority of companies lack full inclusion of Scope 3 disclosures in their objectives of sustainability.

Among the approaches used to estimate Scope 3 emissions, economic input-output life cycle analysis (EIO-LCA) and life cycle assessment (LCA) play leading roles. As stated by Lee and Ma (2013), life cycle assessment is not only necessary for companies to analyze their own carbon footprints but for their carbon footprints across their entire supply chain as well. As stated by Hertwich and Wood (2018), economic input-output analysis increases industrial carbon footprints of the global economy by 84% from Scope 3 while these contribute more than direct emissions to industrial carbon footprints in industrial and building industries in specific. Jain (2024) further alludes to how in the cement industry alone, Scope 3 emissions contribute approximately 17% of all emissions further emphasizing industry-specific reduction efforts. He alludes to emission hotspots while reiterating that collaboration with suppliers, technology innovation, and awareness of risks play crucial roles in enabling success in the long term.

The financial sector is a leading cause of global carbon emissions through investment portfolios. Brans and Peters (2024) reassert that finance institutions have higher risks of legal liability for carbon emissions of companies in their investment portfolios. Mejia and Kajikawa (2024) determine that lack of data poses a severe challenge in estimating carbon emissions of scope 3 from investments, thus resulting in poor carbon responsibility estimate in investment portfolios. Popescu et al. (2023) estimate carbon risks in carbon-exposure of sustainable investment funds and conclude that if carbon emissions of scope 3 are included in their measurement, these funds have carbon risks of 2 to 3 times more than traditional indices of markets. Pasiouras et al. (2024) further analyze financed carbon emissions (Scope 3) in relation to cost of equity of publicly listed banks in 35 countries. They conclude that financed carbon emissions have statistical significance in their correlation with cost of equity, implying that financed carbon emissions raise cost of equity. Two factors drive their finding that financed carbon emissions of higher magnitude increase cost of equity: (i) high-emission portfolios expose banks to risks of climate finance, and (ii) investors demand higher compensation for these risks in terms of higher cost of equity. The research further depicts that economic level of regulation preparedness moderates this impact since banks in countries that have tighter regulation of climate finance have lower cost of capital despite having higher carbon emissions of scope 3.

Two primary approaches to computing investment-linked Scope 3 emissions have been delineated by Wang et al. (2024) as involving ownership proportion allocation of investee firm Scope 1 and Scope 2 emissions to investor level. As noted by Xia and Cai (2023), where figures for direct emissions cannot be located, average data method is used to estimate investor-allocated emissions by applying industry-based emission factors. Downie and Stubbs (2013) analyze companies' processes of reporting their Scope 3 emissions in Australia and determine that discrepancies across industries have been substantial while advocating for integrated reporting approach.

Scope 3 emissions have not only become more relevant from environmental sustainability but from profitability as well as from risks of regulation. Panjwani et al. (2023) determine that credit markets reward companies that publish Scope 3 emissions by decreasing their cost of borrowing by approximately -20 basis points on average. Consistent with that determination, Pasiouras et al. (2024) further determine that Scope 3 emissions have become more embedded in price mechanisms in capital markets so that now it has become a crucial determinant of financial solidity for banks.

The European Union and other worldwide regulation bodies have begun to demand finance industry investment-related emissions to be reported on. Borghesi et al. (2025) explain how rules of the EU on non-financial reporting impact global investing by stating that these rules represent a crucial milestone for green finance practice. Tian et al. (2025) provide empirical evidence that rules of the International Sustainability Standards Board for disclosures of Scope 3 emissions have a beneficial impact on United States manufacturers' valuations in the markets.

The effects of Scope 3 emissions vary widely from industry to industry. Jain (2024) alludes to the fact that in the cement industry, Scope 3 emissions stem largely from material transport and sourcing, hence causing further challenges to sustainability. He alludes to harmonized processes of reporting to further improve measurement of emissions as well as reduction measures. Ellram et al. (2022) allude to the fact that logistics play a large part in global carbon footprints but that companies significantly shy away from transport-based emissions reduction in their supply networks. Kenway et al. (2023) unveil that Scope 3 emissions account for 90% of all greenhouse gas emissions in the water industry, alluding to carbon footprints of city water use having to be taken into account in order to counter their effects on global carbon footprints.

In the context of industry, Buchenau et al. (2025) analyze CDP data of over 4,000 companies to determine that even for large corporations within the same industry, Scope 3 carbon footprints vary widely from each other, thus underscoring that industry-specific guidelines for reporting would be needed. Butt et al. (2025) demonstrate that actions such as building rapport with suppliers, providing consistent feedback, and structuring incentive mechanisms have a crucial impact in reducing Scope 3 carbon footprints.

From an energy industry perspective, Li et al. (2020) believe that global carbon reduction targets must reduce Scope 3 by 50–67% in the energy, transport, and industry sectors. Sadhukhan (2022) reiterates that net-zero targets must be achieved through implementation of life cycle assessment (LCA) models with companies choosing to implement reduction measures in preference to carbon offsetting alone.

The literature has established that measurement, reporting, and scope 3 emissions' management have daunting challenges that must be addressed. Mejia and Kajikawa (2024) believe that full-life-cycle emission calculations must be implemented to advance carbon risks' measurement of investment funds. Schmidt et al. (2022) opine that economic input-output analysis together with advanced machine learning models would enhance predictability in scope 3 emissions.

3. Conceptual Framework and Example Scenarios

From the finance accounting of GHGs, finance investments have four general categories of analysis that include Managed Investments and Client Services, Project Finance, Debt Investments, and Equity Investments. They offer general categorizations that make it easy for finance institutions and investors to calculate and report their indirect and direct greenhouse gas (GHG) emissions that stem from their operations. Notably, indirect emissions from its investment portfolio contribute significantly to finance industry contribution to emissions in relation to direct operations' emissions. Each of these categories of investments has varying risks and responsibilities that demand varying methodical approaches in carbon accounting processes.

Equity Investments include situations where investors own companies through ownership in their own right. Investors in these investments have the potential to influence companies' strategic processes of decision-making as well as guide companies towards sustainability objectives. Similarly so, accounting for GHGs in equity investments is not only accounted for in terms of ownership level but by how much of investee companies' activity-generated emissions actually have to be managed.

Table 1 illustrates the appropriate scope of reporting (Scope 1, Scope 2, or Scope 3) for investments in equities' GHG emissions and prescribes appropriate methods of calculation. Subsidiaries' investments qualify for inclusion in Scope 1 and Scope 2 where financial control is exercised while in associations and joint ventures where full control is not exercised, their inclusion is in Scope 3. Financial control or substantial influence not being present in investments makes their inclusion in Scope 3 in full while in ownership of less than 20% in investments, companies have scope to determine their own thresholds for reporting in accordance with their own guidelines. As for methods of calculation, in cases of present financial control, the Investment-Specific Approach is employed while in cases of absence of control or low stakes in ownership, Average-Data Approach is employed

Table 1. Emission Reporting and Calculation Methods for Equity Investment*

Investment Type	Scope 1 and Scope 2	Scope 3	Calculation Method
Subsidiaries	Reported if the investor company holds more than 50% ownership and has financial control	Not applicable	Investment-Specific Method
Associate Companies	Generally not included unless the investor company has full financial control	Reported when the investor company owns between 20% and 50% but lacks full control	Investment-Specific or Average-Data Method
Joint Ventures	Reported if the investor company has control	Reported if the investor company does not have control, included in Scope 3 proportionally	Investment-Specific or Average-Data Method
Investments Without Financial Control or Influence	Not applicable	Must be reported under Scope 3	Average-Data Method
Investments with Less Than 20% Ownership	Not applicable	Companies may define a threshold to determine Scope 3 inclusion	Average-Data Method

World Resources Institute & WBCSD. (2013). *Technical guidance for calculating Scope 3 emissions (Version 1.0): Supplement to the corporate value chain (Scope 3) accounting & reporting standard.* Greenhouse Gas Protocol, pp, 136 – 152. *Table 1 has been compiled by the author based on the review of Category 15 of the report, specifically pages 136 to 152, and synthesizes the key insights regarding emission reporting and calculation methods for different investment types.

The emission accounting methods and requirements in Table 1 give investor companies adequate accounting for their finance investment in relation to greenhouse gas (GHG) emissions. Most notable in the context of equity investments is adequate accounting scope (Scope 1, Scope 2, or Scope 3) that is determined based on the type of investment. At determination of these aspects, factors to consider include investor company ownership proportion of

the investment, degree of investor company control over operations of investee company, and investor company influence on investee company operations..

Furthermore, investor companies have differing approaches to estimate GHG emissions from their investments. Where control by finance is exercised, the Investment-Specific Approach is employed through investee company direct emissions. However, where figures of direct emissions cannot be located or where ownership stakes are low, the Average-Data Approach through sectoral emission factors is employed. Table 2 illustrates the chief approaches to estimate GHG emissions from equity investments and how these approaches work.

Table 2. Calculation Methods for GHG Emissions in Equity Investments

Method	Calculation Formula
Investment-specific method	∑ (Scope 1 and Scope 2 emissions of equity investment × share of equity (%))
Average-data method	∑ (Investee company total revenue ($) × emission factor for investee's sector (kg CO_2e/$ revenue) × share of equity (%))

World Resources Institute & WBCSD. (2013). *Technical guidance for calculating Scope 3 emissions (Version 1.0): Supplement to the corporate value chain (Scope 3) accounting & reporting standard.* Greenhouse Gas Protocol, pp, 136 – 152.

The calculation of investor green-house gas (GHG) emissions is based on two chief methods: the investment-specific method and the average-data method, as described in Table 2. They offer a methodical way of computing the investor's proportion of ownership-based or control-based emissions. Notably, the investment-specific method is used where the investor has immediate access to the investee's Scope 1 and Scope 2 emissions figures. Through it, more specific allocation of emissions by investor's proportion of ownership is possible where detailed figures of emissions are accessible.

The following scenarios illustrate how the investment-specific approach is employed in differing structures of financial control. Scenario 1 illustrates how the investor company has financial control of the investee and discloses related emissions in Scope 1 and Scope 2. Scenario 2 illustrates how in situations where the investor has no financial control, the emissions have to be reported in Scope 3 as investment-related emissions. The scenarios illustrate how financial control has implications for reporting of emissions and how responsibilities for GHG emissions that are direct or indirect vary.

Scenario 1: Investor Company Has Financial Control (Reported Under Scope 1 & Scope 2)

An investor company holds a 70% equity stake in a wind energy company operating in the renewable energy sector and has financial control over it. Financial control typically applies when an investor owns more than 50% of the shares or has decision-making authority over the investee company.

The wind energy company's annual direct and indirect emissions are as follows:

- Scope 1 emissions (fossil fuel use from maintenance activities): 5,000 tons CO_2e
- Scope 2 emissions (indirect emissions from purchased electricity): 10,000 tons CO_2e
- Total Scope 1 and Scope 2 emissions: 15,000 tons CO_2e

Since the investor company has financial control, it must report these emissions directly under Scope 1 and Scope 2. The calculation is as follows: 15,000 tons $CO_2e \times 0.70 = 10,500$ tons CO_2e. Thus, the investor company reports 10,500 tons CO_2e directly under Scope 1 and Scope 2.

Scenario 2: Investor Company Lacks Financial Control (Reported Under Scope 3)

In cases where an investor company holds a minority equity stake in a company but does not have financial control, the treatment of greenhouse gas (GHG) emissions differs significantly. For instance, consider an investor company that has acquired a 30% equity stake in a wind energy firm, but does not participate in its decision-making processes or direct financial control.

According to the GHG Protocol, when an investor company lacks financial control, it cannot account for the investee company's emissions under Scope 1 or Scope 2. Instead, the emissions associated with its investment must be reported under Scope 3, specifically Category 15 – Investment-Related Emissions. This approach reflects the investor's indirect responsibility for emissions rather than direct operational control.

Given that the wind energy firm emits a total of 15,000 tons CO_2e annually, the investor's proportional share of emissions is calculated as follows:15,000 tons $CO_2e \times 0.30 = 4,500$ tons CO_2e. This 4,500 tons CO_2e is reported under Scope 3 emissions by the investor company. Unlike in Scenario 1, where financial control allows direct Scope 1 and Scope 2 reporting, in this case, the investor's emissions are only disclosed as part of its indirect investment footprint. This distinction is critical for corporate GHG accounting, as it prevents double counting of emissions while ensuring that investors remain accountable for the environmental impact of their financial activities.

In the accounting for, and presentation of, greenhouse gas (GHG) emissions, having or not having financial control makes a dramatic difference in how investments must be accounted for in financials and how emissions must be reported. If the investor enterprise has financial control of the investee enterprise—historically having more than 50% ownership or having control of decisions—the investee enterprise is accounted for as a subsidiary, whose accounting is wholly consolidated to that of the investor's balance sheet and income statement. All of the investee enterprise's Scope 1 and Scope 2 emissions in that scenario would qualify as parent company's direct emissions and would need to be reported as such..

Conversely, when investor corporation has not taken financial control—as in joint ventures or in cases of associates where ownership is from 20%-50%—the accounting of investee corporation is not fully consolidated. Instead of that, the investment is accounted for by the equity method so that only that proportion of net profits or net losses is included in investor corporation's income statement while the value of investment is presented as an

asset in balance sheet. According to that scenario, investee corporation's Scope 1 and Scope 2 emissions aren't reported by investor corporation but reported as Scope 3 emissions in Category 15 – Investment-related emissions. The differentiation of these two methods is shown in Table 3.

Table 3. Financial Reporting and GHG Emission Accounting Based on Financial Control

Criteria	If Financial Control Exists (Subsidiary)	If No Financial Control Exists (Associate or Joint Venture)
Balance Sheet (Assets and Liabilities)	The entire balance sheet of the investee company is consolidated.	Only the investment value is included as an asset in the balance sheet.
Income Statement	The full revenue and expenses of the investee company are included in the parent company's income statement.	Only the proportionate share of net profit or loss is included in the parent company's income statement.
GHG Emissions Reporting	Reported under Scope 1 and Scope 2 as part of the parent company's direct emissions.	Reported under Scope 3 as investment-related emissions.
Accounting Method	Full Consolidation Method	Equity Method
GHG Impact	The parent company is directly responsible for the emissions.	The parent company only reports investment-related emissions indirectly under Scope 3.

The following illustrates how Average-Data Approach is employed where investee companies' own emissions data is not accessible. As compared to the Investment-Specific Approach that makes assumptions on reported Scopes 1 and Scopes 2 emissions, Average-Data Approach makes assumptions on industry-specific factors of emissions in relation to investee company performance. The approach comes in where the investor has no control over operations in its investments, thus demanding proportionate allocation of emissions on revenues and industry averages. The example presented below illustrates how the approach is employed to estimate Scopes 3 investment-related emissions and how it comes with challenges in applying industry-specific factors in replacement of company-specific figures.

Scenario 3: Investor Company Holds Multiple Equity Stakes in Different Sectors Using the Average-Data Method

In this scenario, an investor corporation has numerous stakes in equities in numerous industries for which Average-Data Approach must be employed to estimate emissions. As investee companies themselves do not publish their own emissions figures, their investor corporation must make use of industry-specific emission factors to estimate its Scope 3 investment-related emissions.

Investor Portfolio Overview

The investor company holds the following equity stakes in different sectors:

- 25% ownership in a manufacturing company
- 40% ownership in a financial institution
- 30% ownership in an energy company (natural gas sector)

Each sector has different revenue scales and emission factors, requiring separate calculations.

To estimate investment-related emissions using the Average-Data Method, the emissions of each investee company are calculated based on their total revenue, industry-specific emission factors, and the investor's ownership stake. This approach provides an estimated allocation of emissions when direct company-specific emissions data are unavailable.

First, for a manufacturing company with a total revenue of \$3 billion and an industry emission factor of 0.40 kg CO_2e per dollar of revenue, the total emissions are determined by multiplying these values. Given the investor's 25% ownership stake, the allocated emissions amount to $(3{,}000{,}000{,}000 \times 0.40) \times 0.25 = 300{,}000{,}000$ kg CO_2e.

Next, a financial institution with a total revenue of \$6 billion and a sector-specific emission factor of 0.05 kg CO_2e per dollar of revenue is considered. With a 40% ownership stake, the investor's share of emissions is $(6{,}000{,}000{,}000 \times 0.05) \times 0.40 = 120{,}000{,}000$ kg CO_2e.

Finally, for an energy company operating in the natural gas sector, with a total revenue of \$4 billion and a significantly higher emission factor of 2.0 kg CO_2e per dollar of revenue, the investor's 30% stake results in a substantially larger allocation of $(4{,}000{,}000{,}000 \times 2.0) \times 0.30 = 2{,}400{,}000{,}000$ kg CO_2e.

After calculating the emissions associated with each individual investment, the final step is to aggregate the total Scope 3 investment-related emissions. By summing the emissions attributed to the investor from all investee companies, the total indirect emissions from these investments can be determined.

For the manufacturing company, the allocated emissions amounted to 300,000 tons CO_2e, while the financial institution contributed 120,000 tons CO_2e. The energy company in the natural gas sector, due to its significantly higher emission intensity, accounted for 2,400,000 tons CO_2e. Adding these together, the total Scope 3 investment-related emissions attributable to the investor company sum up to 2,820,000 tons CO_2e.

This final metric captures the investor's share of emissions through its equity investments and sheds light on the environmental contribution of its investment portfolio. It reinforces how indirect operations must be considered in accounting for emissions and how disparate industries create disproportionate carbon footprints for the investor.

The results of the Scope 3 investment-linked emissions calculation have several interesting implications and points of insight for corporate carbon accounting. Inter-segmental variability plays an important part in shaping aggregate impact on emissions since natural gas industry has the largest of all investment emission factors. Having high revenues but low carbon footprints, finance industry illustrates that industry-specific varying emission intensities have carbon accounting implications.

From a regulation and disclosure perspective, these organizations have no control on their part as investor corporations, so their associated emissions must be reported in Scope 3 (Category 15 - Investments) rather than in Scope 1 or Scope 2. This classification records indirect contribution of finance investments to global greenhouses gas emissions and aligns with the Greenhouse Gas Protocol's accounting methodology for Scope 3.

For investors that have net-zero commitments, these results make clear that decarbonizing their portfolios is necessary. Active ownership of high-polluting companies—especially in industries like energy—can induce companies to make efforts to cut their emissions. Alternatively, investors might redirect their capitals to low-carbon sectors in order to lower their investment portfolio financed emissions.

However, it is equally necessary to determine Average-Data Method limitations used in these estimations. Owing to its reliance on industry averages of emission factors, it may not accurately reflect companies' performance in curbing their emissions, particularly for companies that have implemented carbon reduction steps. Direct conversations with investees and more disclosures of emissions would thus be necessary to make estimations more specific to enable more precise carbon accounting of financial portfolios.

4. Discussion & Evaluation

The findings of this research highlight the significance of finance institutions in the extended carbon accounting framework, in regard to investment-linked Scope 3 emissions in specific. Direct emissions (Scope 1) and indirect emissions from energy purchases (Scope 2) are relatively well established but lack of consistent methods for investment-linked Scope 3 emissions remains a drawback. Variation in availability of data, industry categories, and investor finance control level results in inconsistency in reported emissions. Each of these methods has inherent benefits and limitations depending on ownership structure and availability of emissions data. The investment-specific method offers more accurate account of investor finance-controlled emissions while average-data method offers pragmatic proxy where direct emissions data are not available. Application of averages from industry categories has inherent uncertainty in situations where industry-specific emission intensities of companies have widely varying levels.

One of the more interesting takeaways from this research is how much financial control drives emissions reporting requirements. Investors that have substantial ownership stakes (commonly in excess of 50%) and control of investee companies' decision-making processes have higher likelihoods of applying the investment-specific approach, thus accounting for investees' direct emissions in their own carbon footprints. Conversely, minority owners of companies that have no control over corporate decision processes have higher likelihoods of applying the average-data approach that approximates revenues by industry and by revenues to estimate emissions. This differentiation points to the need for regulation to provide guidelines in delineating emissions allocation methods. Absent regulation to provide guidelines for delineating allocation methods for emissions, discrepancies in reported figures would remain in force that have potential to create greenwashing or carbon-exposure misrepresentation in investment funds.

Sectoral differences in emission levels complicate selecting an adequate accounting method even further. Energy and heavy industry sectors have far greater emissions than technology or finance sectors, for example. As demonstrated in hypothetical scenarios, an investor in carbon-intensive industries may have exorbitantly high reported emissions even if their investee has implemented aggressive decarbonization steps in advance. This would make carbon disclosures at the level of the portfolio questionable in their reliability and introduce potential discrepancies between net-zero commitments by finance institutions and their net contribution to reducing emissions. Employing more refined method that integrates firm-specific performance in emissions with industry averages would make accounting for emissions in investment more credible.

The study further hints at implications of investment-linked Scope 3 emissions for finance regulation and risk assessment. As global regulation of climate hardens, finance organizations have more impetus to estimate and manage their associated climate risks of their investment portfolios. Application of differing accounting methods has implications for strategic choice as well as for risk disclosure. Investors that apply the investment-specific approach may have more specific carbon exposure in their portfolio for intense dialogue with high-emission investees. Conversely, reliance on industry-average emission factors in the average-data approach may obscure mitigation at the level of the firm to result in uninformed investment decisions. This comes to have special significance in cases involving finance regulation like that of the Task Force on Climate-related Financial Disclosures (TCFD) or that of the International Sustainability Standards Board (ISSB), where more importance is given to financed emissions' transparency.

A critical disadvantage of existing methods is their reliance on investees' own reported figures for emissions. Reporting heterogeneity, inconsistent coverage of reported figures, and varying enforcement of regulation across jurisdictions create large gaps in investment-related accounting for emissions. Using economic input-output approaches and industry averages only makes these challenges worse as these methods may not reflect actions taken by specific companies to reduce emissions. To mitigate this challenge, more data visibility in the form of uniform disclosure requirements and integration of machine-learning approaches for more accurate estimations of emissions is necessary. Follow-up research has to explore possibilities for integration of investee-specific figures for emissions with industry-adjusted variables to make reported figures more accurate and consistent.

The policy implications of these results extend far beyond accounting for investment-related emissions to the broad debate on sustainable finance. Financial markets have a leading part to play in directing funds towards low-carbon investments and influencing corporate strategy towards sustainability. Effective measurement and disclosure of investment-related Scope 3 emissions are at the center of aligning finance decision-making with medium-term

climate goals. Lacking from widely agreed-on methodology for attributing emissions to investments, investors may lack clear decarbonization targets for their portfolios or how to engage with investees on their own decarbonization efforts. Regulators must make industry-specific guidelines on investment-related emissions reporting their absolute priority so that methods take account of not only of financial control structures but of firm-specific approaches to sustainability.

In conclusion, this work makes incremental contribution to the growing body of research on investment-linked Scope 3 emissions by comparing in a systematic manner two of the foremost accounting approaches and accounting for their implications for finance institutions. Implications of these findings reassert that greater methodological consistency and regulation of carbon disclosures in finance markets need to improve their credibility. Follow-on research would have to take these results further by testing for hybrid accounting methods as well as accounting for how differing structures of reporting impact investment decisions. As risks from climate further seep through finance analysis, having clear and consistent accounting of emissions will play a crucial role in allowing more transparent and more sustainable finance.

5. Conclusion

This study has compared approaches to computing investment-linked Scope 3 emissions to determine how ownership structure influences allocation of emissions. As shown by the results, ownership structure has determinant influence on investors' reporting obligations. Direct Scope 1 and Scope 2 emissions are reported by majority owners while minority owners must make assumptions from industry averages to account for Scope 3 emissions. Variation in investment-specific approaches to carbon accounting and average-data approaches reveal methodological uncertainties and potential discrepancies that face carbon accounting by financial institutions.

One of the more immediate implications of this research is that economic control is determinant in attributing responsibilities for emissions. Most significantly in cases where an investor has economic control of an investee enterprise, it must account for the investee’s scope 1 and scope 2 emissions. Alternatively, where economic control is not established, the emissions must be accounted for in scope 3 in the way of investment-related emissions. This distinction makes clear why more transparent and consistent carbon accounting processes must take place to accurately determine carbon risks in investment portfolios. The research further unveils that industry variability in high-polluting industries such as energy and heavy industry translates to dramatic variances in reported emissions.

The findings further reveal the primary methodological challenges that investors face in their reporting processes. The investment-specific method has more precise allocation of emissions where investors have specific emissions data at their disposal while the average-data method has to provide necessary fallback where these data are not available. Although the average-data method makes use of sectoral emission factors, it may not reflect companies' true performance in reducing their own emissions. Investors may thus over- or underestimate their carbon exposure with resultant unsynchronized sustainability strategy. Financial institutions must prioritize having companies' specific emissions data at their disposal to make carbon accounting more reliable while calling for more disclosures from investee companies.

Beyond methodological concerns, research points to the increasing importance of investment-linked Scope 3 emissions in finance risk measurement and regulation. Financial organizations have more pressure to estimate and manage finance risks linked to their investment assets that have carbon implications. Picking accounting methodology has clear implications for revelation of risks and investment strategy. Investors who implement the investment-specific approach have more visibility of their actual carbon vulnerability to make more effective high-emission investee companies' engagement. Using the average-data approach may mask firm-specific actions to mitigate their environmental performance, leading to uninformed investment decisions. As regulation like the Task Force on Climate-related Financial Disclosures (TCFD) and the International Sustainability Standards Board (ISSB) gives more prominence to financed emissions' revelation, more precise accounting methods' demand is more of an immediate need.

A critical limitation of current methods is their reliance on investees' own reported figures of emissions. Unsystematic methods of reporting, patchy coverage of figures, and heterogeneity of enforcement across jurisdictions create substantial holes in investment-linked accounting for emissions. Relying on economic input-output methods as well as industry averages further multiplies these challenges since these methods may not reflect decarbonizing actions at specific companies' level. Overcoming these challenges requires more disclosures of data in terms of uniform requirements of disclosures as well as integration of machine learning methods for more accurate estimations of emissions. Research in future work has to explore possibilities of blended methods that combine investees-specific figures of emissions with industry-adjusted figures to make their figures more precise as well as more inter-firm comparable.

The policy implications of these findings extend further than accounting for other efforts at sustainable finance. Financial institutions play a crucial role in directing finance to low-carbon investments and influencing corporate strategy on sustainability. Effective measurement and disclosure of investment-linked Scope 3 emissions is needed to align finance decisions with long-term climate goals. Lacking from widely used guidelines for attributing emissions to investments, however, investors may lack clear decarbonization target for their portfolios or to communicate to investee companies in effective way. Regulators must prioritize industry-specific guidelines for investment-linked emissions reporting that consider finance control structures as well as firm-specific methods of approaching sustainability in their work to move these objectives forward.

In conclusion, this work makes a contribution to the growing body of research on investment-linked Scope 3 emissions by comparing in a systematic manner two of the leading accounting methods and discussing their implications for finance institutions. Findings stress that

greater methodological consistency and regulation must be put in place to make carbon disclosures more credible in finance markets. Follow-up research must build on these findings by testing for hybrid accounting methods and discussing how differing accounting structures impact investment decisions. As more finance analysis comes to include climate risks, having clear and reliable accounting of emissions will play a crucial role in enabling more transparent and more sustainable finance.

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