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Abstract

The Paris Agreement of 2015 set a goal of limiting the increase in the global average temperature to 1.5 to 2.0 degrees Celsius above pre-industrial levels. Subsequently, the Japanese government announced its policy to achieve carbon neutrality by 2050. To achieve carbon neutrality and decarbonization, carbon pricing is expected to be utilized to place a price on carbon and control emissions. This study summarizes the debate among standard-setting bodies regarding the accounting treatment of cap-and-trade schemes and the practices around emissions trading. It examines their rationale from the perspectives of decision usefulness and achievement of optimal emissions levels. In particular, the method that recognizes the obligation to return allowances at the allocation of allowances (Allocation Method) excels in terms of timeliness and faithful representation of information related to total emissions. However, if profit or loss volatility undermines the predictability of future profits, it is necessary to find ways to control volatility. On the other hand, the Allocation Method is reasonable from the perspective of achieving optimal emissions levels because reductions in total emissions result in reduced liabilities and the recognition of gains. In addition, based on empirical evidence of the relationship between emissions disclosures by firms and emissions, it can be concluded that the current disclosure system contributes to achieving optimal emissions levels.

Keywords: Cap-and-Trade Emissions Trading Systems; Decision Usefulness; Real Effects; Task Force on Climate-related Financial Disclosures (TCFD); Sustainability Disclosure Standards

JEL classification: M41

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1. Introduction

The Paris Agreement of 2015 set a goal of limiting the increase in the global average temperature to 1.5 to 2.0 degrees Celsius above pre-industrial levels. Subsequently, the Japanese government announced its policy to achieve carbon neutrality by 2050. Carbon pricing is expected to control emissions and achieve carbon neutrality and decarbonization. Specifically, schemes such as carbon taxes, emissions trading systems, and bilateral credit systems exist. Cap-and-trade emissions trading systems based on bilateral trading were introduced by Tokyo Metropolis in 2010 and Saitama Prefecture in 2011. In addition, the Ministry of Economy, Trade, and Industry (METI) established the GX League, composed of firms actively engaged in green transformation (GX), and the Japan Exchange Group began operating an emissions trading market on the Tokyo Stock Exchange in October 2023.

In 2004, the International Accounting Standards Board (IASB) issued Interpretation 3, "Emission Rights," of the International Financial Reporting Interpretations Committee (IFRIC), in line with the introduction of the European Union Emissions Trading System (EU-ETS). This was a tentative accounting treatment for emissions trading in response to requests from the business community. However, it was withdrawn mainly due to insufficient discussion of consistency with other accounting standards and a plunge in the market price of emission allowances as a result of the economic slump. Since then, there have been intermittent discussions in the "Emissions Trading Schemes" and "Pollutant Pricing Mechanisms" projects. "Pollutant Pricing Mechanisms" is still a candidate for the work plan in the Third Agenda Consultation (IASB [2021]) and has been added to the IASB's pipeline projects (reserve list). It is likely to be a large-scale project, including pricing mechanisms in addition to emissions trading systems (paras. B68-71). As for Japan, in 2004, the Accounting Standards Board of Japan (ASBJ) issued Practical Issues Task Force (PITF) No. 15, "Practical Solution on Tentative Treatment of Accounting for Emission Trades." However, the topic has not been actively discussed since that time.

Japanese firms are trying to reduce their emissions based on voluntary action plans. However, emissions trading (exemplified by cap-and-trade) may become a legal requirement in the future. As various systems have been established to achieve carbon neutrality and decarbonization, conducting research once again on accounting for emissions trading would be worthwhile. In this study, we examine the accounting treatment of cap-and-trade-type transactions for which past knowledge has been accumulated. In the Third Agenda Consultation (IASB [2021]), the topics listed are (a) how to recognize and initially measure emission allowances received from the scheme administrator for nil or nominal consideration; (b) how to subsequently measure emission

allowances held, including both those held to cover past or future emissions of pollutants and those held for investment purposes; (c) how to recognize and measure a liability to remit emission allowances to cover pollutants already emitted, including deciding: (i) whether a liability exists and when to recognize it, and (ii) how to measure the liability; (d) how to present assets, liabilities, income and expenses resulting from pollutant pricing mechanisms; and (e) how to disclose information about pollutant pricing mechanisms. While financial reporting provides useful information for investors' decision-making, accounting standards for emissions trading have emerged also from the social movement to achieve optimal emissions levels. In this context, it is interesting to consider the kinds of intentions and logic that the emissions trading accounting procedures are based on and whether they can be rationally explained in terms of decision usefulness and achieving optimal emissions levels. Consequently, we summarize the discussions among standard-setters and the state of practice regarding accounting rules and then analyze their reasonableness.

The remainder of this paper is organized as follows. Section 2 summarizes emissions trading systems and what they are intended to do. The main goal of these systems is to have emissions reach optimal levels, and a correct understanding of the theory behind such systems would be meaningful for the analysis of accounting treatment. In Section 3, in line with the Third Agenda Consultation (IASB [2021]) topics, the recognition, measurement, and presentation of financial statement components related to emissions trading are analyzed and explained from the perspective of decision usefulness and achieving optimal emissions levels. In Section 4, disclosure rules and their consequences concerning CO_2 emission are analyzed, especially from the perspective of achieving optimal emissions levels; we will demonstrate the impact of emissions disclosure on firms' emissions and evaluate the reasonableness of the disclosure system.

2. Theory of emissions trading schemes

This section describes the mechanism of emissions trading schemes to achieve socially optimal emissions levels.

(1) Significance of environmental policies

In economic theory, firms set their environmental use, $\mathbf{e_i}$, to maximize their private benefits, $\mathbf{B_i(e_i)}$.[1] The optimal amount of use $\mathbf{e_i^p}$ for a firm is the amount at which the

[1] Strictly speaking, entities act to maximize private net benefits, which are private benefits minus private costs. But assuming here that there are no private costs, private net benefits are replaced with private benefits (Maeda [2009]). Then it is assumed that private benefits to the firm are synonymous with profits.

marginal private benefit (i.e., marginal profit) $\mathbf{MB_i(e_i)}$ becomes zero; however, from a social perspective, this amount of use is not optimal. If the environmental use **e** of society as a whole is $\Sigma \mathbf{e_i} \equiv \mathbf{e}$, then the socially optimal amount of use $\mathbf{e^s}$ is the amount of use that maximizes the net social benefit, which is the social benefit **B(e)** (i.e., the sum of each firm's private benefit $\mathbf{B_i(e_i)}$) minus the social cost **D(e)** associated with the environmental use, and when the net social benefit is maximized, the marginal social benefit $\mathbf{MB(e^s)}$ equals the marginal social cost $\mathbf{MD(e^s)}$. Marginal social benefit is the incremental benefit from a one-unit increase in environmental use by society as a whole, which is equal to the marginal private benefit of each firm ($\mathbf{MB_i(e_i)} = \mathbf{MB(e)}$).[2] At the socially optimal state, the marginal private benefit of each firm is also equal to its marginal social cost ($\mathbf{MB(e^s)} = \mathbf{MB_i(e_i^s)} = \mathbf{MD(e^s)}$). In other words, if left to the free decision-making of each firm, the amount of environmental use is determined at the point where the marginal private benefit is zero; however, socially, the amount of use where the marginal private benefit is equal to the marginal social cost is desirable. In general, as the marginal private benefit is diminishing ($d\,\mathbf{MB_i(e_i)}/d\,\mathbf{e_i} < 0$) and the marginal social cost is positive ($\mathbf{MD(e^s)} > 0$), the socially optimal amount of environmental use would be exceeded if left to the free will of each firm ($0 \leq \mathbf{e_i^s} < \mathbf{e_i^p}$). This is because firms do not consider the existence of social costs when making decisions. If this situation is left uncorrected, the environmental burden will accumulate. Social benefits and costs that are not reflected in firms' decision-making and are not internalized in market transactions are said to be "externalities," and social costs are called "negative externalities." As CO_2 emission are a cause of "negative externalities" that contribute to global warming and cause subsequent environmental problems, the same argument can be made as above by reading "environmental use" as "CO_2 emission."

The significance of various means of environmental policy is to compensate for the effects of "negative externalities" to achieve socially optimal conditions. Specific instruments include voluntary agreements and action plans, direct government emissions regulations, and economic instruments (including carbon pricing) that internalize social costs as decision-making factors for each firm. The emissions trading scheme, which is the subject of this study's analysis, is an economic instrument, and to clarify its characteristics, we start with a description of other economic instruments, such as environmental taxes and subsidies.

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[2] Keeping in mind that the sum of the environmental use of each entity is the environmental use of society, a one-unit increase in environmental use by society implies a one unit increase in the amount of use by entity **i**, while holding the use of all entities other than entity **i** as constant. Hence, the social and marginal private benefits of firm **i** are equal. For the mathematical proof, see Maeda [2009], Chapter 2.

(2) Economic instruments

The idea common to all economic instruments is to achieve optimal emissions levels by internalizing social costs into market transactions. Environmental taxes, subsidies, direct negotiations, and emissions trading schemes are described along with their characteristics and differences.

Environmental taxes, subsidies, and direct negotiations

Environmental taxes are a means of internalizing social costs by taxing emission of environmentally hazardous substances. Without any regulations or policies on emissions, each firm would continue production until its marginal private benefit is zero; however, a socially optimal output is achieved when the marginal private benefit equals the marginal social cost. Therefore, if the regulator imposes a tax **T** per unit of emissions equal to the marginal social cost of firms, the total emissions will naturally reach the socially optimal level $\mathbf{e^s}$ ($\mathbf{MB(e^s)} = \mathbf{MB_i(e_i^s)} = \mathbf{MD(e^s)} = \mathbf{T}$). In practice, the regulator (1) calculates the marginal social benefits and costs, (2) sets the tax amount **T** equal to them, and (3) collects the tax at the end of the regulatory period (Maeda [2009] p. 22).

Conversely, a subsidy can be provided for each unit of emissions reduction. Receiving a subsidy **G** to reduce emissions by one unit implies that each additional unit incurs an opportunity cost **G**, which is synonymous with imposing a tax **G** on each unit of emissions. Hence, as previously discussed, the optimal subsidy **G** to reduce emissions by one unit equals the optimal tax amount **T** per unit of emissions.[3] The subsidy G is ultimately equal to the marginal abatement cost because the marginal abatement cost is nothing more than the benefit lost by reducing emissions by one unit (marginal private benefit).

Socially optimal emissions levels can also be achieved through direct negotiations between the polluters and victims. If the polluter has the right to emit pollutants, the victim pays compensation to the polluter to reduce its polluting activities. The compensation paid is equivalent to the polluter's profit lost from reducing pollutants. Conversely, if the party affected by the pollution has the right to enjoy a clean environment, the polluter must compensate the victim to operate. Therefore, the compensation is equivalent to the losses incurred due to pollutant emission. Particularly

[3] Comparing the economic effects of environmental taxes and subsidies, the short-term policy effects are equal because the taxes and subsidies amounts per unit of emissions (emissions reductions) are identical. However, environmental taxes are more favorable when firms enter and exit in the long run. This is because environmental taxes increase fixed costs, and firms in industries with a high environmental burden will have negative profits and eventually exit the market. Conversely, subsidies have the opposite effect, keeping firms in industries with a high environmental burden in the market. Environmental taxes excel in guiding an industry toward a low environmental burden (Kuriyama and Managi [2021] p. 88).

important is that assuming no transaction costs are involved in the negotiation[4], regardless of whether the environmental rights (the right to pollute or not be impacted by pollution) belong to the polluter or victim, social equilibrium is achieved via negotiations between the parties involved, a principle known as the Coase Theorem.

Emissions trading schemes

Emissions trading schemes achieve socially optimal emissions levels by allocating allowances to polluting firms and allowing market trading of allowances. Firms must hold allowances equal to their total emissions by the end of the compliance period. If their total emissions fall below their initial quota, they can profit from the sale of excess allowances; however, if they exceed their quota, they must purchase allowances from the market. This is called cap-and-trade.[5] The system of regulating the overuse of resources by assigning permits, the embodiment of the right to emit, is used to control air pollution and prevent overfishing.[6]

Emissions trading schemes have the nature of taxation because the private costs of a firm increase with the number of allowances purchased. Emissions trading schemes, which establish property rights over the environment as emission allowances, originate from the Coase Theorem (Heal [2000] p. 67). For example, if allowances are issued for a fee through an auction, the issue price being equal to the environmental tax T would have the same effect as environmental taxes. Firms would purchase allowances until the marginal private benefit equals issue price **T**, resulting in socially optimal levels of emissions. However, if the goal is to achieve socially optimal emissions $\mathbf{e^s}$, it would be better to issue allowances equal to the optimal amount from the beginning. Even if the allowances are allocated free of charge, if they are allowed to be traded in the market, firms with higher marginal private benefits (i.e., marginal abatement cost) will purchase allowances from firms with lower marginal benefits. The price of allowances will balance when marginal social benefits and marginal costs are equal. To be specific, let $\mathbf{X_i}$ be the number of allowances purchased on the market and **p** be the market price for allowances;

[4] Other assumptions are also necessary, such as that the negotiating parties know each other's marginal benefits and losses and that these are not changed by changes in the allocation of rights (Kuriyama and Managi [2021] p. 95).

[5] In addition to cap-and-trade, other emissions trading schemes include baseline and credit. In this system, firms are given an emissions baseline and are granted allowances ex-post based on the reductions from that baseline. When emissions trading schemes are mentioned in policy debates, it is common to refer to cap-and-trade (Maeda [2010] p. 234).

[6] A system that attempts to maximize the gain from fishing by allocating the total allowable catch among fishing industry members and making it tradable is called an individual transferable quota (ITQ) (Arnason [2007]).

given that firms will act to maximize $\mathbf{B_i(e_i)} - \mathbf{p \cdot X_i}$, the equilibrium solution $\mathbf{e_i^m}$ can be expressed as $\mathbf{MB_i(e_i^m)} = \mathbf{p}$. At equilibrium, the quantity of allowances purchased on the market $\mathbf{X_i}$ will equal the difference between the amount of emissions $\mathbf{e_i^m}$ and the quantity of allowances initially allocated $\boldsymbol{\ell_i}$ ($\mathbf{X_i} = \mathbf{e_i^m} - \boldsymbol{\ell_i}$), and so long as $\mathbf{p} > 0$, then $\Sigma \mathbf{X_i} = 0$, or in other words, $\Sigma \mathbf{e_i^m} = \Sigma \boldsymbol{\ell_i}$. If we set $\Sigma \mathbf{e_i^m} \equiv \mathbf{e^m}$, then $\mathbf{MB_i(e_i^m)} = \mathbf{MB(e^m)} = \mathbf{p}$. As $\Sigma \boldsymbol{\ell_i} = \mathbf{e^s}$, and hence $\mathbf{e^m} = \Sigma \boldsymbol{\ell_i} = \mathbf{e^s}$, it is also the case that $\mathbf{MB(e^m)} = \mathbf{MB(e^s)} = \mathbf{p}$. Recalling that $\mathbf{MB(e^s)} = \mathbf{MB_i(e_i^s)} = \mathbf{MD(e^s)}$, it is clear that $\mathbf{p}$ is equal to the socially optimal tax rate $\mathbf{T}$ (Maeda [2009] pp. 25-28).[7]

While direct negotiations between polluters and victims could realistically incur transaction costs, an emissions trading system avoids the problem of negotiation costs and allows reductions at minimal cost (Saijo and Kusakawa [2013] Chapter 1). For the system to be successful, it is necessary to introduce concise rules for market creation, to ensure for instance that the emissions trading market is fully competitive. The regulator then (1) determines the socially optimal total emissions levels, (2) creates allowances equal to that level and distributes them to each agent, and (3) leaves the ideal distribution of allowances to free market transactions among economic agents (Maeda [2009] p. 29).[8] The system's key points are that polluters who are prohibited from emitting must hold allowances to emit and that the optimal emissions levels can be achieved regardless of the initial quota of allowances, which is evaluated as an application of the Coase Theorem (Kuriyama and Managi [2021] p. 99). According to the Coase Theorem, which states that the initial allocation of property rights does not affect the transaction's outcome, the initial allocation quantity does not affect the final market price or distribution of the allowances. Even if the distribution at the time of allocation is not optimal, through market transactions, the price of allowances equals each firm's marginal private benefit (i.e., marginal abatement cost) of each firm,[9] and the distribution becomes socially optimal

[7] Under these circumstances, it is also true that $\mathbf{MB_i(e_i^m)} = \mathbf{MB_i(e_i^s)}$, and it can be shown that $\mathbf{e_i^m} = \mathbf{e_i^s}$.

[8] The difference between environmental taxes and emissions trading schemes is whether the price or the total amount of emissions is determined first, which theoretically leads to equal consequences. However, their effects differ when there is "information asymmetry" between regulators and firms. Regardless of (whether imposing) price regulation or quantity regulation, marginal social benefits and costs need to be ascertained. However, it is difficult for a regulator to precisely analyze these values, which vary with emissions. The smaller the deviation from the social optimum, the better the regulatory instrument. In theory, price regulation (quantity regulation) is better when the price elasticity of demand concerning emissions is very small (large). It is also said that quantity regulation is easier to obtain social consensus than price regulation. A hybrid policy is currently being adopted, considering "policy" and "political" perspectives. (Maeda [2009] Chapter 7).

[9] A banking system that allows allowances to be carried over at different compliance periods could change the current spot price in response to uncertainties in the future spot price market. In addition, if the regulator sets a price cap on the allowance market, such as by imposing a penalty for emissions in excess of the allowances held, there is no guarantee that the allowance price and marginal private benefits will be equal

(Maeda [2009] p. 28).

Nevertheless, determining the initial quota cannot be ignored as a matter of fairness among firms. Free allocation by "grandfathering" is a viable method to determine an initial quota based on each firm's emissions performance. However, it has the disadvantage of incentivizing firms to increase their emissions volume. In addition, even if the same amount of allowance is allocated to each firm regardless of its past emissions reduction efforts, a firm with more (less) emissions in absolute terms will incur a loss (gain) in the year of introduction, which is hardly fair. Furthermore, free allocation based on the benchmark method in line with reduction efforts contributes to cost bearing according to the "negative externalities" caused by emission. However, it is not easy to evaluate reduction efforts (GISPRI [2009] p. 75; Kuriyama and Managi [2021] p. 104).

Now that we have explained the theory of emissions trading systems and compared them with other types of economic measures, we can analyze their accounting treatment.

3. Accounting for emissions trading

In Europe, discussions on accounting for cap-and-trade have accumulated in correlation with the EU-ETS.[10] This study examines the accounting treatment of mandatory cap-and-trade schemes. However, it may also be useful when considering the accounting treatment of other schemes (e.g., baseline and credit schemes and schemes where participation is voluntary rather than compulsory). In the past, the IASB had issued IFRIC 3, which focused on cap-and-trade, but it was withdrawn soon after. Currently, there are no accounting standards to rely on. In the absence of an IFRS that specifically applies to a transaction, the IASB has stated that management should use its judgment in applying accounting treatment considering the following: qualitative characteristics (i.e., relevance and faithful representation), the basic concepts established in the conceptual framework, and related accounting standards (IAS 8 paras. 10-12). Consequently, accounting practices for emissions trading have diverged widely.[11]

In the following, we explain the main accounting treatments for cap-and-trade and evaluate whether they are reasonable considering decision usefulness and achieving

(Maeda [2009] Chapters 6-7). While keeping these considerations in mind, this paper proceeds with the discussion assuming that the equilibrium price in the spot market equals the marginal private benefit.

[10] In Japan, the ASBJ issued 2004 Practical Issues Task Force (PITF) No. 15, "Practical Solution on Tentative Treatment of Accounting for Emission Trades." This document assumes a voluntary action plan without penalty for not meeting targets. Allowances purchased from other entities are accounted for as intangible fixed assets or investments and other assets, while those acquired free of charge are not recognized, regardless of whether they are delivered in advance or settled after the fact. In the Tokyo Metropolitan Government's emissions trading scheme, allowances issued at no cost are accounted for under the Off-balance Method described below.

[11] According to PricewaterhouseCoopers [2007], as many as 15 accounting patterns had been observed.

optimal emission levels.

(1) Accounting for assets

Asset nature of allowances

One of the issues in the IASB's Third Agenda Consultation is the recognition and measurement of allowances; the question is whether they are assets for accounting purposes and, if so, what characteristics they have.

An asset is "a present economic resource controlled by the entity as a result of past events," and an economic resource is "a right that has the potential to produce economic benefits" (IASB [2018] paras. 4.3-4.4). In general, there is a scarcity of value for allowances because some firms emit more than their allocated allowances. Even purchased allowances can be considered assets if they benefit the holding firm (IASB [2010d] para. 3). However, how an entity benefits from holding allowances–that is, the nature of allowances as assets–remains unclear.

Assets can broadly be classified into business and financial types. The outcomes obtained from business assets, where "subjective goodwill" exists, vary from entity to entity and differ from financial assets that provide objective outcomes equally to everyone. As an entity's allocated allowances can be used for value-added production activities within the scope of the allocated allowances, and the outcomes obtained differ from entity to entity, allowances can be considered business assets (Kurokawa [2018] Chapter 22). The IASB notes that allowances are similar to intangible assets and inventories, and IFRIC 3 classifies allowances as intangible assets. Furthermore, there is a view reflecting the findings of environmental economics that allowances as intangible assets are like fishing quotas in that they are consumption of the Earth's natural resources and can be quantitatively divided and captured (Kurokawa [2018] Chapter 22, IASB [2010a] para. 2.4). However, there is another view that allowances have the typical characteristics of financial assets because they can be easily traded. In addition, firms are obligated to return allowances equal to their total emissions to the scheme administrator at the end of the compliance period, and allowances are like currencies to settle the obligation (IASB [2015c] paras. 20-22). Some argue that they are de facto foreign currencies because they can be used to generate cash (IASB [2015d] para. 69).

The following discussion assumes that allowances are assets, but their wide interpretability leads to diverse accounting treatments.[12]

[12] Regarding the legal nature of allowances, the ASBJ ([2009] 1 (2)) states that they are not statutory intangible property rights but have property value. Internationally, few countries explicitly state its legal nature, but France, for example, states that it is "movable property" (Kurokawa [2018] Chapter 22). Even

Recognition and measurement of allowances

When allowances are purchased from the market, they are capitalized at the purchase cost. If allowances are allocated free of charge, there is no acquisition cost, and the question arises about how allowances should be recorded. Because no acquisition cost exists, the allowances can be valued at zero. However, accounting for the recognition and measurement of assets acquired free of charge at fair value is permitted, which also applies to allowances as assets (Business Accounting Principle 3, 5F).

Regarding the ex-post measurement of capitalized allowances, the Global Industrial and Social Progress Research Institute (GISPRI) proposed that allowances be amortized in proportion to actual emissions and added to manufacturing and marketing costs. Allowances are regarded as assets related to business investment, and amortization costs and the revenues realized through emission are matched over time. The determination of allowance expenses based on emissions is similar to the amortization of depreciable assets using the units of production method (GISPRI [2001] p. 46, Kurokawa [2001] p. 112, Kurokawa [2018] Chapter 22). However, while some firms use the write-off process, it is not a viable option (PricewaterhouseCoopers [2007]). Because allowances are not a right to produce emissions, and the value of allowances is not consumed because of emission, the allocation of costs over the compliance period does not match the realized revenues. No amortization is supported because the residual value of the allowances traded in an active market is the same as the initially measured cost (IFRIC 3 para. BC12, 21).

There are several patterns of this non-amortization accounting. IFRIC 3 stipulates that, by IAS 38, valuation losses are expensed, while gains should be recognized in other comprehensive income (OCI)[13] in the fair value assessment. However, it also permitted the application of the impairment test or the lower-of-cost-or-market method instead of continuous revaluation.[14] Measurement at cost may provide useful information if allowances are viewed as inventories that are input into the production process, as in the case of the ASBJ [2009]. Alternatively, if allowances are viewed as financial assets held for speculative purposes, continuous remeasurement of fair value and subsequent

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if there is no dispute that it has property value, its precise nature and characterization as property constitute a difficult question that also affects the nature of the legal remedies available (IASB [2015c] para. 25).

[13] IFRIC 3 states that changes in the value of the allowances above costs are recognized in equity, but in accordance with IAS 38, such increases would be recognized in OCI and accumulated in equity under the heading of revaluation surplus (IAS 38 paras. 85-86). This accounting treatment, in which only the revaluation loss is reflected in profit or loss, is conservative because it allows for earlier recognition of the expenses.

[14] Factors to consider when testing for impairment include the market price of allowances, their value in use (i.e., the ability to use the allowances to settle emissions liabilities), and their classification (e.g., trading, available-for-sale, or held to maturity) (IASB [2010g] para. 24).

inclusion of valuation difference in profit or loss may provide the market's assessment of future cash flows and the risks of those cash flows and faithfully represent the substance of the underlying transaction (IASB [2010 g] paras. 19-20). However, allowances may be held for speculative or settlement purposes in reality, and a uniform valuation may not provide useful information. The business approach differentiates the measurement of allowances based on the purpose for which they are held: if they are held for speculative purposes, they are remeasured at fair value, whereas if they are held for settlement purposes, they are not capitalized in the first place. Appropriate application of the business approach reflects an entity-specific intent in its accounting treatment. Nevertheless, careful definitions and objective judgments are required to determine the intent of an entity, including the possibility that the intent may change.[15] Such a judgment is difficult, may undermine comparability among firms, and may not provide useful information (IASB [2010g] para. 37, IASB [2010j] paras. 25, 42).

The deduction of accounting treatment according to the purpose of holding is logical and suggests the importance of determining the nature of allowances. Nevertheless, the accounting treatment of IFRIC 3, which considers speculative holdings and assesses them at fair value but includes the valuation difference in OCI in consideration of the business investment aspect, may be a reasonable compromise. However, the ex-post measurement of allowances needs to be considered together with the measurement of liabilities (obligation to return allowances) rather than allowances alone, as discussed in Section 3(3).

(2) Accounting for liabilities

Following the accounting treatment of allowances, the accounting treatment of liabilities for the delivery of allowances became an issue in the Third Agenda Consultation. The following explanation compares the three accounting treatments assuming free allocation. The main difference among the three accounting treatments is the timing of liability recognition: at the time of allocation (Allocation Method), at the time of emission (Emission Method), and at the time of emission in excess of the quota (Off-balance Method).[16]

[15] There are issues such as whether the purpose of holding should be classified on a portfolio basis or on an individual basis, and whether the determination of intent should be made at the reporting entity level or at the subsidiary level (IASB [2010j] paras. 26-29).

[16] Although the accounting treatments covered in this paper are based on the IASB and FASB discussions, it is necessary to consider the compatibility of those treatments with Japanese GAAP carefully. For example, the definition of liability in Japan is not limited to "present obligation." It includes obligations in a broader sense, while the threshold for the probability of an outflow of resources required for liability recognition is relatively high. For more details, please refer to Kato and Sawai [2023], which summarizes the issues related to the recognition and measurement of provisions.

Allocation Method

The Allocation Method recognizes a liability in the counterpart account of the allocated allowances by regarding the free allocation of allowances as the "obligating event." Liability is recognized as the earliest among the accounting treatments discussed in this study, and there are some arguments regarding the nature of the obligation, and recognition and measurement of liability.

Nature of the obligation

According to the IASB [2018], a "present obligation" at the time of allocation is necessary for recognizing a liability. Commonly, the obligation imposed by emissions trading schemes is "the obligation to return the allowances to cover emissions (the obligation to return)." However, there are various theories regarding the nature of the obligation imposed by the free allocation of allowances. All theories state that an unconditional obligation is created by entering into a contract with the scheme administrator at the time of allocation (IASB [2010f]), but in addition to the obligation to return allowances, there is "an obligation to reduce emissions below the quota level in order to benefit from the scheme (obligation to refrain from emitting)" and "an obligation to comply with the requirements of the emissions trading scheme (obligation to comply with the scheme requirements)." The "scheme requirements" for the scheme compliance obligation are to reduce emissions below the quota level or to return the allowances based on the amount of emissions (IASB [2010f] para. 39); therefore, the scheme compliance obligation can be interpreted as encompassing the obligation to return and the obligation to refrain. However, considering the purpose of the emissions trading scheme, the scheme's most important obligation is still to return allowances. The key point of cap-and-trade is to obtain an optimal emissions levels, where the marginal benefit equals the cap price, as long as the obligation to return allowances in proportion to emissions is imposed. Unlike direct regulations, there is no requirement to impose an obligation to reduce emissions at a specific level. The obligation to return is a suitable obligation that faithfully represents the economic substance of a scheme.

Present obligations can be categorized into "stand-ready obligations" and "obligations conditional on the entity's future actions," depending on whether the firm can control the events resulting in resource outflows. If an entity cannot control the occurrence of an event that results in a future outflow of resources, it is a stand-ready obligation. Concerning the obligation to return allowances, the event that results in the outflow of resources in the form of the delivery of allowances is emission. Emission is an event over which the firm has control; thus, the obligation to return allowances is not a stand-ready obligation. An obligation, such as the obligation to return, which depends on the entity's

future actions, becomes a present obligation when the entity has no practical ability to avoid such actions (IASB [2018] para. BC4.52).[17] To avoid the obligation to return, the entity would have to cease operations, which would be theoretically possible but impractical; thus, the obligation to return would be a present obligation.

As the purchaser does not have a present obligation because of purchasing the allowance, the Allocation Method has been criticized for making the accounting treatment of free allowances inconsistent with that of purchased allowances (IASB [2010f] para. A6). However, even if the acquisition is for a fee, it would be logical to recognize the obligation to return allowances along with the cost because the scheme still imposes an obligation on the entity.

Recognition and measurement of liabilities

Because it is difficult for an entity not to emit and altogether avoid the return of allowances, it is possible to recognize a liability for the obligation to return allowances at the time of allocation, assuming that the probability of resource outflow is high. However, the obligation to return can be distinguished into one related to the quantity of its allocation (liability for the allocation) and one related to excess emissions (liability for excess emissions). In that case, the issue is when to recognize and measure these obligations.

One approach is to measure the obligation based on the expected total emissions during the compliance period. This is like the "current exit price approach," which was considered during the publication process of International Financial Reporting Standards (IFRS) No. 15 (Revenue from Contracts with Customers). This approach does not distinguish between the liability for the allocation and the liability for excess emissions in accounting treatment. It assumes that the obligation for total emissions meets the recognition requirements and measures it at fair value independent of the allowances. This is consistent with the view that even if the probability of excess emissions is low, it should be reflected in the measurement of liability (IASB [2010c], IASB [2018]). The fair value of the obligation to return is the reasonable amount that would be paid to settle the obligation, which is the allowance price at the time of free allocation multiplied by

[17] There were two other views on the conditions under which an obligation conditional on the entity's future actions can be called a present obligation (IASB [2013] paras. 3.75-97). One view requires that the obligation be strictly unconditional and that the entity theoretically cannot avoid future resource outflows. As ceasing or changing its method of operating to avoid an obligation is impractical but theoretically possible, the existence of a present obligation cannot be recognized at the time of allocation (IASB [2015d] para. 23). One view also holds that a present obligation must have arisen from past events. However, it may be conditional on the entity's future actions. If the occurrence of the obligation is attributable to the allocation of allowances, the present obligation may be recognized at the time of allocation.

the expected total emissions (IFRIC 3 para. 8).[18] If the expected total emissions exceed the quota, the liability value will be greater than the value of the allowances at the initial measurement, and an expense may be recognized. After the initial measurement, the present value of the liability is updated by projecting scenarios for the quantity and price of allowances to be returned (IASB [2010h] para. 11). Timely reporting of the expected value of the obligation to return based on expected total emissions may be useful for investors' decision-making; if a firm purchases additional allowances from the market in anticipation of future excess emissions, recognizing excess liability in advance may be a faithful representation of its investment position (IASB [2010i] para. 48). However, there are concerns regarding the reliability of the measurement of the obligation to return.[19]

The other measurement approach is to limit the obligation recognized at the time of allocation to the allocated quota and measure it at the value of the allocated allowances, like the "original transaction price approach" currently adopted by IFRS 15. Unlike the "current exit price approach," liability for the allocation and liability for excess emissions are considered two different liabilities that should be accounted for separately (IASB [2010i] para. 12). A firm may emit up to the quantity of its allocation based on historical emissions; however, the recognition requirement for excess liability is not met because the probability of resource outflow is low. In contrast to the "current exit price approach," the probability of resource outflow is not reflected in the measurement but is a recognition requirement. Although no gain or loss is recognized at the allocation, after the initial measurement, there are several accounting treatments concerning the timing of excess liability recognition. First, it is assumed that excess liability gradually meets the recognition requirements as the entity operates and that excess liability is recognized and measured in proportion to the amount of emissions.[20] However, because reasonable

[18] In practice, it is possible that the firm may pay a penalty without returning the allowances. As a rational manager would choose the lower of fulfilment or cancellation cost, the allowance price may not be the best input to the liability measurement. Furthermore, a fixed amount penalty is equivalent to capping the price of allowances, and depending on the amount, the total emissions could exceed the cap. In this regard, Phase 1 of the EU-ETS imposed a penalty of 40 euros per ton of CO_2 on firms that did not purchase insufficient allowances. However, the penalty payment did not relieve them of the obligation to return the allowances, so it cannot be said that there was a real cap on the allowance price.

[19] According to IFRS 15, contracts with customers give rise to rights and obligations that are enforceable by the entity, namely the right to receive consideration from the customer and the performance obligation to transfer goods or services to the customer. Under the "current exit price approach," which measures these rights to receive consideration and performance obligations at fair value independently, the value of the right exceeds the value of the obligation by the amount of the costs and margins involved in obtaining the contract and a gain can be recognized at the time of contract. However, this approach was rejected due to the incompatibility of recognizing gain before an entity transfers goods or services, the costs and complexity involved in estimating fair value, and the difficulty of verification (IFRS 15 para. BC25). This feature is partially applicable to emissions trading schemes.

[20] For example, suppose that the quantity of allocations is 600 and that 1,000 emissions are expected during

estimates of future scenarios and probabilities of emissions are required, there are concerns about the reliability of the measurement, including recording expenses based on an expectation that may change over time, possibly causing the entity to reverse those expenses in future periods (IASB [2010i] para. 61). There is also a method that recognizes and measures the excess liability when it is "more likely than not" that the total expected emissions will exceed the quota, i.e., when the probability of excess emissions exceeds 50%, as in IAS 37 (Provisions, Contingent Liabilities and Contingent Assets) (IASB [2010g] para. 56). Finally, another method recognizes and measures excess liability only when it is "virtually certain" that emissions will exceed the quota (IASB [2010i] para. 55). Although the reliability of measurement is relatively assured in accounting treatments that require a considerable probability of recognizing excess liabilities, there are criticisms that costs are biased toward later periods and do not faithfully represent economic substance, despite the fact that excess emissions are expected to occur during the compliance period (IASB [2010i] paras. 43-44).

Similar to the discussion on the timing of the recognition of provisions, the timing of the recognition of liabilities for excess emissions is a matter of exploring the most useful accounting treatment, considering the trade-off between providing relevant information with timeliness and measurement reliability. If the total emissions were expected to be less than the allocated amount, the liability would be derecognized, and the gain would be recognized. The timing of when the obligation is (partially) exempted and the firm no longer has a current obligation is an issue (IASB [2018] para. 5.26(b)); however, for the moment, it would be reasonable to treat symmetrical to the excess emissions case.

Emission Method

Liability recognition at the time of emission is an accounting method formerly stipulated in IFRIC 3. This method is characterized by the fact that the allocation of allowances is regarded as the receipt of a subsidy, and actual emission is regarded as the obligating event. Let us review the accounting treatment at the time of allocation and emission.

Recognition of grants at the time of allocation

According to IAS 20 (Accounting for Government Grants and Disclosure of Government Assistance), the purpose of government grants is to encourage firms to embark on a course of action that would not usually be taken if assistance was not

the two-year compliance period. The percentage of quota to total expected emissions (emissions coverage ratio) is 0.6. If the actual emissions in the first year are 500, the liability for excess emissions is recognized as 200, which is the actual emissions multiplied by 0.4 (= 1 − emissions coverage ratio).

provided (para. 4) and is not necessarily synonymous with subsidies as an environmental policy. Government subsidies can also take the form of transfers of non-monetary assets (para. 23). If allocating allowances at a price lower than fair value provides incentives for firms to reduce their emissions, it is consistent with the purpose of grants under IAS 20.

There are two approaches to the accounting for government grants: the capital approach considers grants to be non-repayment financing instruments and recognizes them outside profit or loss, and the income approach, under which a grant is recognized in profit or loss over one or more periods (IAS20 paras. 13-14). IFRIC 3 adopts an income approach and uses deferred income. Deferred income is recognized as revenue (or deducted from the related expense) on a systematic basis over the periods when the entity recognizes the related costs for which the grants are intended to compensate, emphasizing the matching between incurred costs and income (IAS 20 para. 12). Firms that were previously able to emit pollutants without restrictions are now subject to operational restrictions and future increases in production costs due to the introduction of the scheme. IFRIC 3 provided revenue recognition for grants over the period in which production costs were expensed to compensate for the production costs that reduced the value of the business (IASB [2015c] para. 32).[21]

Although the revenue recognition of grants is said to faithfully represent the economic substance that firms receiving allocated allowances are "better off" than other scheme participants that have not received allowances, the emissions trading schemes are regulatory policies that impose net costs on firms rather than presenting them with net gains, and the revenue recognition has been criticized as not faithfully representing the economic reality faced by firms. Unless emissions are reduced below the quantity of their allocation, the allowances must be returned to the regulator, and many firms are expected to return the allowances. There is a concern that recognizing revenue from the allocation of allowances as a grant differs from the economic substance firms face and may mislead investors in their decision-making (IASB [2010f] paras. 53-54).

Eventually, IFRIC 3 was withdrawn partly because of the on-balance of deferred credit that did not meet the definition of liability or equity. Alternatives would have been to recognize the gain immediately or to record OCI and later recycle it to profit or loss, but the IASB, in its project to revise IAS 20, favored accounting by IAS 41 (Agriculture).

[21] However, it was determined that the appropriate amortization would depend on how the participant chooses to respond to the scheme and should not specify a particular method, so in addition to systematic amortization over the compliance period, there could be amortization as emission costs are incurred (IFRIC 3 paras. BC30-31). Even if the allowances are sold, the deferred credit should not be reflected in profit or loss but should continue to be amortized. Deferred credit is not a liability and, therefore, would not be remeasured (para. BC32).

IAS 41 recognizes revenue immediately upon receipt of a government grant related to a biological asset measured at fair value if the grant is unconditional, while if it is conditional, the grant is recognized when and only when the conditions attached to the government grant (e.g., the requirement of an entity not to engage in specified agricultural activity) are met (IAS 41 paras. 34-35). This provision intends to recognize obligations until certain conditions are satisfied and revenue when they are satisfied. It is not intended to match revenues associated with expenses, as with the current IAS 20 (IASB [2010b] para. 7).[22] When applied to emissions trading, the questions are whether the free allocation imposes an obligation on the entity and whether this obligation is conditional; and, if so, what conditions are imposed. However, if the obligation is recognized at the time of free allocation, this becomes an argument regarding the Allocation Method.

Recognition and measurement of liabilities

Under IFRIC 3, which adopts the Emission Method, the allocation of allowances and recognition of emission costs are considered separate transactions, with costs and liabilities recorded according to emissions. The obligation to return from actual emission is regarded as a provision under IAS 37 (IFRIC 3 para. 8), but the outflow of resources is certain when the obligation is recognized. For the obligation to return to being recognized as a present obligation, it is not enough for the situation to be practically unavoidable; it must be strictly unavoidable. For example, IFRIC No. 21 (Levies) does not recognize a present obligation if it is theoretically avoidable, even if corporate action (stop operating) to avoid payment of the levy is impractical (para. BC18). Although the accounting standard for the levy itself does not apply to liabilities for emissions trading (para. 6), the accounting treatment of recognizing a return obligation on actual emission is consistent with the accounting treatment of the levy. Recognizing an emissions liability is also compatible with recognizing an asset retirement obligation as a provision. Under the current standard, an asset retirement obligation is recognized as a liability at the time of acquisition of a tangible fixed asset at the present value of the total estimated expenditure; however, if hazardous substances are released in response to use, allocating removal costs in the form of provisions is a reasonable option (Daigo [2008] p. 242). In fact, under the US accounting standards for decontamination obligations for nuclear power facilities, the operator of a nuclear power facility assumes legal responsibility for the decontamination of that facility upon receipt of the license to operate it. However, there is no obligation to

[22] Government grants are listed as potential projects in the Third Agenda Consultation (IASB [2021]). There, it is stated that IAS 20 is based on matching costs with income rather than satisfying performance obligations identified in a grant and that matching costs with income is not an objective of the Conceptual Framework (para. B40).

decontaminate until the facility begins operation and contamination occurs. Contamination, not the receipt of a license, constitutes an obligating event (Accounting Standard Codification (ASC) 410-20-55), like the Emission Method concept.[23]

Because the recognized obligation is settled by allowances, the best estimate is still to be measured at the market price (fair value) of allowances. The cost for each period, calculated by multiplying the actual emissions by the market price of the allowances, is theoretically equal to the amount of taxes paid if environmental taxes are imposed, and the obligation to return the allowances is equal to the amount of taxes payable.[24] As confirmed in Section 2, the theoretical allowance price in a perfectly competitive market is equal to the socially optimal tax rate that can be paid to achieve the optimal level of emissions. In this way, the Emission Method can represent the substance of the taxation aspect of the emissions trading scheme, whereby the amount of taxes to be paid on emissions is exempt from the number of allowances granted. IFRIC 3 states that the important features of cap-and-trade are the ability of participants to trade allowances and emissions taxation over the cap (para. BC12), indicating that they were aware of the system's taxation aspects.[25]

Off-balance Method

The Off-balance Method does not require accounting when allowances are allocated. Allowances are capitalized once purchased, and the liability for excess emissions is recognized only when emissions exceed the quota.

Even if allowances are assets, they can be valued at zero because their allocation is free of charge. However, it is difficult to value allowances at zero because of the absence of an expended amount, as fair value capitalization is allowed in gift transactions. While IAS 20 is based on the fair value measurement of transferred non-monetary assets, it allows for "reduction entry" to deduct grants from non-monetary assets. One interpretation is that the Off-balance Method is an example of its application; however, it is a matter of bookkeeping technique.[26] Rather, the Off-balance Method reflects the

[23] Asset retirement obligations can arise from using an asset and its acquisition, construction, or development. Depending on multiple obligating events, the phase of recognizing the liability may be multi-layered (SFAS No. 143 para. 10, ASBJ [2007] para. 9).

[24] Note that the allowance price is also equal to the marginal abatement cost and the marginal social cost. However, these costs are an increasing function of the quantity of reductions and emissions. Therefore, the value obtained from multiplying the marginal abatement cost or the marginal social cost by the amount of emissions does not represent the total cost of reducing those emissions or the social cost of those emissions.

[25] If the scheme's substance is a tax on excess emissions, then the Off-balance Method described below could be used. However, this provision indicates that allowances are capitalized to faithfully represent market transactions of allowances.

[26] In IFRIC 3, the reduction entry is dismissed as inconsistent with the purchased allowances and not a faithful representation (IFRIC 3 para. BC27).

intent of firms not to trade their allocated allowances during the compliance period but to hold them until they eventually settle their deficiency (or surplus) allowances. There is no change in the economic substance that firms face until excess emissions occur, and the emphasis is on maintaining financial statement consistency before and after the scheme's introduction. Even if it is assumed that the same amount of allowances and obligations to return are incurred at the time of allocation, if both expire simultaneously, there will be no net assets or liabilities, and profit or loss should not be affected. The logic is that net obligations arise only when a firm's emissions exceed its quota (IASB [2007] para. 12). Alternatively, it can be explained by focusing on the taxation aspect of the system and representing the fact that tax costs are exempted up to the quantity allocated, and only excess emissions are taxed.

The Off-balance Method, which recognizes liability on a net basis only when the quota is exceeded, is criticized for ignoring the fact that the emission obligates the firm to return allowances (IFRIC 3 para. BC23). Relatedly, the consistency of capitalizing allowances acquired for a fee and the pros and cons of not recognizing emission costs have been questioned (Kurokawa [2003] pp. 87-88). In addition, when allowances are sold during this period, a gain equal to the sale price is generated from off-balance assets (MOE [2007] p. 8). The assumption of the Off-balance Method that there is no change in economic substance before and after the scheme's introduction until the firm's emissions reach the quota is incorrect from an economic-theoretical standpoint. In other words, it is conceivable that investment behavior will change after allocation, as firms determine their production output by comparing marginal profits with the price of allowances (IASB [2007] para. 76, Cook [2009] p. 459). Off-balancing allowances would not faithfully represent production activities that could change with the scheme's introduction and the strategies of firms in response to changes in marginal profits and market prices.

(3) Accounting for assets and liabilities

Thus, we have analyzed the accounting of assets and liabilities individually; however, emissions trading requires an integrated discussion of assets and liabilities. One of the reasons why IFRIC 3 was withdrawn was the problem of the "profit/loss mismatch" related to the revaluation of assets (allowances) and liabilities (obligation to return allowances). The cause of the profit/loss mismatch is the fact that assets and liabilities are accounted for independently, and questioning the pros and cons of such accounting is a matter of discussing the "unit of account."

Profit/loss mismatch

Allowances capitalized under IFRIC 3 are subject to revaluation at fair value as

intangible assets under IAS 38. If the carrying amount increases, OCI is included in the equity; a revaluation loss is incurred if it decreases. In contrast, the obligation to return allowances is subject to revaluation as a provision under IAS 37. However, the valuation difference is included in profit or loss (IFRIC 3 para. 8), resulting in an asymmetric treatment of assets and liabilities. Even if the allowances held and the obligation to return are equal in quantity, only the loss arising from the obligation to return is reflected in profit or loss when the fair value of the allowances increases, which may result in a profit/loss mismatch (para. BC16).[27] It is counterintuitive that the loss arising from the obligation to return hurts profit, even though the market price of the allowances has increased (IASB [2007] para. 79). This financial consequence could also occur under the Allocation Method. Because the Allocation Method recognizes a relatively large obligation to return at the time of allocation, the volatility of profit or loss resulting from the profit/loss mismatch would be greater.

The background to the mismatch problem is that quantitatively equal portions of allowances and obligations should not generate profit or loss because matched portions are not exposed to the risk of market price fluctuations. To avoid a mismatch, the IASB considered amending IAS 38 to include the valuation difference of allowances as well as that of the obligation to return in profit or loss (IFRIC 3 para. BC18). Another idea was to amend IAS 39 (Financial Instruments: Recognition and Measurement) to classify allowances as financial instruments to recognize the valuation difference related to allowances in profit or loss (IASB [2007] para. 56).[28] In addition, the revaluation difference for the obligation to return could be recorded in the OCI, like the valuation difference for allowances and recycled when the allowances expire. The asset and liability could be valued at cost, or the Off-balance Method could be adopted.[29] The IASB criticizes artificial mismatches (IASB [2015a] para. 23); however, as the allocation of allowances and the recognition of emission costs are considered separate transactions under the Emission Method, the profit or loss volatility caused by the differences in the treatment of valuation differences between assets and liabilities is not artificial. Some believe that this volatility "tells it as it is" for the impact of changes in allowance prices

[27] When the fair value of the allowances has fallen below the fair value at the time of allocation, the loss arising from the allowances and the gain arising from the obligation are both reflected in profit or loss, and so there is no profit/loss mismatch for the matched portion of the quantity between allowances held and obligations.

[28] The IFRIC held that allowances do not meet the definition of a financial asset because they are neither equity instruments nor contractual rights to receive cash or other financial assets (IFRIC 3 paras. BC14-15).

[29] Technically, allowances and grants could be recognized at the time of allocation, and then the allowances could be amortized, and the same amount of grants reflected in profit or loss. In such a case, no liability would be recognized for emissions. This accounting treatment is one proposal presented by EFRAG which is negative on profit/loss mismatch (EFRAG [2003]).

on the portfolio of allowances held and on the obligation to return (IASB [2007] para. 63).

Unit of account for recognition and measurement, and presentation

The pros and cons of profit/loss mismatch question the degree to which the recognition and measurement of assets and liabilities should be consistent; in other words, how the unit of account in the financial statements should be. The unit of account is "the group of rights, the group of obligations or the group of rights and obligations, to which recognition and measurement requirements are applied." (IASB [2015b] para. 4.57). Contracts create a series of rights and obligations for entities, and the unit of account determines whether the entity accounts for that package as a single asset or liability or as separate assets and liabilities. In other words, it is a question of the level of accounting aggregation, and the optimal level of aggregation should be selected based on qualitative characteristics, such as relevance and faithful representation (IASB [2013] para. 3.12).

Although the rights and obligations arising from a given contract can be separated, they are not necessarily separate units of account; they can be included as a single unit of account. If having rights and obligations as a single unit of account increases usefulness, this is because they (i) are less likely to be the subject of separate transactions, (ii) are less likely to expire in different patterns, (iii) are used together to produce cash flows in business activities, or (iv) have similar economic characteristics and risks (IASB [2015b] paras. 4.60-62). For example, rights and obligations under enforceable executory contracts constitute a single unit of account because they are interdependent and inseparable. If such rights and obligations have the same value, the net assets or liabilities are recognized and measured at zero.

However, the unit of account is not guaranteed to be the same in each accounting phase (recognition, measurement, and the units of account can be aggregated or disaggregated depending on the situation (IASB [2015b] para. 4.59).[30] Additionally, offsetting rights and obligations and presenting them as a net is not synonymous with treating a set of rights and obligations as a single unit of account. Offsetting merely brings together rights and obligations for presentation purposes that have already been identified as separate units of account (IASB [2015b] para. 7.13). Based on these considerations, we analyze the relationship between emissions trading accounting and the unit of account.

Unit of account for allowances and obligations

Under the Emission Method, the allowances and obligations to return arise from different transactions and are separate units of account. The Allocation Method

[30] For example, even if the initial recognition of a fixed asset is done on an individual asset basis, the impairment loss may be measured by a different cash-generating unit, which is a grouping of multiple assets.

recognizes and measures them as separate units of account, even though the allowances and obligation to return arise from a single contract between the scheme administrator and the entity. However, based on the "original transaction price approach," the measurement approach initially measured allowances and obligations in an integrated manner. The initial measurement, conducted as if the asset and liability are a single unit of account, is like the accounting treatment of a lessee recognizing the right-of-use asset and the obligation to pay rentals at the same amount. The accounting treatment at the inception of the lease reflects the view that rights and obligations arise from the same lease contract and generally do not exist independently of each other (IASB [2009] paras. 5.5-5.6). An approach that links not only the initial measurement but also the subsequent measurement was also proposed. However, this approach was rejected because the right-of-use asset and obligation to pay rentals were linked at the inception of the lease, but the link was broken after inception. The impairment from the right-of-use asset does not change the rental payments owed by the lessee; conversely, any change in the rental payments is not linked to the value of the right-of-use asset (Ibid. [2009] para. 5.12(c)). This is like the sale of allocated allowances in the market does not affect the obligation to return them.

The Off-balance Method differs from other accounting treatments in that it recognizes and measures assets and liabilities in a single unit of account. If we assume that allowances are used to settle the obligation, the right and obligation expire simultaneously and should be recognized and measured as a single unit of account. This is consistent with IFRS 15, which considers the net position of the remaining right to receive consideration in the contract and the performance obligations to deliver goods or services as the unit of account (IASB [2008] para. 2.27). The rights and obligations arising from the contract are interdependent because the right to receive consideration depends on the performance of the obligation, and the entity’s performance of the obligation depends on the customer’s payment (IFRS 15 para. BC317). If the "original transaction price approach," in which the asset and liability are treated as a single unit of account and the performance obligation is initially measured at the transaction price, is adopted in order to faithfully represent the contract with the customer, no net asset (or liability) is recognized at the contract's inception. No asset or liability is recognized after contract inception unless there is a change in the net position, such as the performance obligation is determined to be onerous. This is similar to the Off-balance Method, in which net liability is recognized only when excess emissions exist. As the unit of account for assets and liabilities is selected considering the accounting treatment of related income and expenses (IASB [2015b] para. 4.58), it can be said that the Off-balance Method treats the allowances and

the obligation to return as a single unit of account to avoid the profit/loss mismatch. However, as there are ways to avoid profit/loss mismatch while keeping the allowances and obligations as separate units of account and as the sale of allocated allowances breaks the interdependence with the obligation, it does not seem reasonable to treat the two as a single unit of account.

Presentation of allowances and obligation to return

Presenting allowances and the related obligation to return is also an issue (IASB [2010k] para. 9). Because the Off-balance Method, which treats allowances and the obligation to return as a single unit of account, leaves no other option but to present them on a net basis, the subject of discussion will be the Allocation and Emission Methods. The question then arises as to whether allowances and obligations to return, which are different units of account, can be offset in the balance sheet.

According to IAS 32 (Financial Instruments: Presentation), to offset a financial asset and financial liability, an entity must currently have a legally enforceable right to set off the recognized amounts, and that right must not be contingent on a future event. In addition, the entity must intend to either settle on a net basis or realize the assets and settle the liabilities simultaneously. When the two offsetting requirements are met, the entity effectively has a single financial asset (or financial liability) on a net basis, and presenting the asset (or liability) on a net basis appropriately reflects the amount, timing, and risk associated with expected future cash flows (IAS 32 para. 42, 46, BC94).

Although offsetting provisions for financial assets and liabilities cannot be directly applied to allowances and obligations to return, the IASB has made several observations. First, some prohibit offsetting allowances and obligations, particularly IFRIC 3, which states that allowances and obligations to return arise from separate transactions and that there is no right of offset between them. There is also no debtor/creditor relationship between the scheme administrator and the entity, which makes offsetting inappropriate (IFRIC 3 para. BC12). In addition, even if an entity intends to use allowances to settle its obligation to return, it can change its intention at any time and sell the allowances; thus, offsetting may not faithfully represent the substance of the transaction (IASB [2010k] para. 29). On the other hand, one view in favor of offsetting is that, because allowances and the obligation in principle satisfy the criteria for offsetting in IAS 32, an entity should be allowed to offset both. As allowances are the only method that can be used to satisfy the obligation in the scheme, the entity's right to offset is always considered to exist (IASB [2010k] para. 14). Another view is that if an entity intends to offset, it should present the related obligation as an indirect deduction from the allowances, which is like the "linked presentation" for the lessor's "performance obligation approach" considered

in the lease accounting. Although an asset (the right to receive lease payments) and a liability (the lease liability) do not satisfy the offsetting requirements, it is meaningful to show their interdependence (IASB [2010e] para. BC148). It can be applied to the relationship between allowance and obligation to return.

(4) Current status and rationale for accounting for emissions trading

The "Pollutant Pricing Mechanisms" project takes the approach of exploring the accounting treatment that best reflects the economic substance of emissions trading without being restricted by existing standards or past efforts or analysis (IASB [2015c] paras. 1-2). However, the IASB and the Financial Accounting Standards Board (FASB) tentatively decided in favor of the Allocation Method after the withdrawal of IFRIC 3, preferring, among other things, the initial measurement of the obligation to return based on the "original transaction price approach." The IASB preferred the gross presentation of assets and liabilities on the balance sheet. At the same time, the FASB stated that the "linked presentation" was preferred when an entity intended to use allowances to settle its obligation to return (IASB [2014] Appendix B). Without a formal standard to rely on, a survey conducted on firms using the EU-ETS found that 76% of the responding firms had adopted the Off-balance Method (PricewaterhouseCoopers [2007]).

Although standard-setters have shifted from the Emission Method to the Allocation Method, the Off-balance Method is preferred in practice. We attempt to explain the rationale for the tentative decision by standard-setters and practice from two perspectives: decision usefulness and achieving optimal emissions levels.

Accounting for emissions trading and decision usefulness

The Emission Method, which the IASB withdrew, regarded the allocation of allowances and the incurrence of obligations as separate transactions. The Emission Method is characterized by the recognition of grants for the allocation of allowances and the recognition of obligations associated with emissions. The cost and obligation, measured by multiplying the amount of emissions by the market price of allowances, are theoretically equal to the amount of tax paid when environmental taxes are imposed. This can be evaluated as a faithful representation of the taxation aspect of the emissions trading scheme. However, the deferral of grant revenue to reduce the impact of the incurred costs on profits is not consistent with the reality of the scheme. In reality, profit is not generated over time.

The Allocation Method, which recognizes the obligation to return allowances at the time of allocation, is a faithful representation of the reality of a scheme that seeks to achieve optimal emissions levels by requiring allowances to be held based on emissions. The IASB and FASB support the measurement of allocated allowances and obligations

at the same amount, which could be interpreted as a concern that the initial measurement of obligations analogous to the "current exit price approach" would be unreliable and reduce decision usefulness. There is a broad time range for recognizing the costs associated with excess emissions and the gains associated with emissions reductions, and the most appropriate treatment should be selected considering its relevance and reliability. The Allocation Method could exacerbate the profit/loss mismatch problem associated with the revaluation of allowances and obligations, and increase the volatility of profit or loss because large amounts of liabilities are recognized early. When an entity holds allowances to settle obligations, the profit/loss mismatch arising from the quantitatively matched portion of the allowances and the obligations is not a faithful representation of the transaction substance.[31] When fair value increases, the losses that can arise unilaterally from the obligation are reversible and temporary, are not approximated as the final cash flow, and increase profit or loss volatility . Investors evaluate enterprise value by projecting residual income and future cash flows based on profit or loss, and the volatility in profit or loss caused by a profit/loss mismatch can undermine the sustainability and predictability of profits, thus inhibiting decision-making usefulness. If this is the case, for quantitatively matched portion of allowances and obligation to return, i.e., the portion not exposed to the risk of market price fluctuations, it is thought that coordinating the measurement of both and avoiding a profit/loss mismatch will contribute to improving decision usefulness. As for presentation, a gross presentation is more logical than offsetting it because allowances and obligations are considered separate units of account. However, considering an entity's intention to hold allowances to settle its obligation, there are advantages to the linked presentation that reflect the interdependence of allowances and obligations.

Even if the Allocation Method favored by the FASB and IASB is an accounting treatment that improves decision usefulness, the Off-balance Method is preferred in practice. Assuming that allowances are held to settle the obligation to return, it is justifiable to consider assets and liabilities as a single unit of account. If we focus on investors' tendencies to evaluate enterprise value based on sustainable profit or loss, the Off-balance Method which does not create a profit/loss mismatch can be reasonable. However, there is no guarantee that allowances and obligations will expire simultaneously, and the assumptions supporting the rationality of the Off-balance Method

[31] The portion of the obligation in excess of the quantity of allowances held is exposed to the risk of market price volatility, but this risk can be managed through the firm's efforts to reduce emissions and purchase additional allowances. Therefore, remeasuring the excess portion at fair value and including the valuation difference in profit or loss reflects the risk exposure and provides useful information (IASB [2010g] para. 25).

are sometimes unrealistic. In the first place, if the purpose of holding allowances is limited to settling the obligation, there is no room for fair value measurement of allowances as financial assets. Theoretically, after introducing the scheme, firms determine their production (emissions) by comparing their marginal profits to the prices of allowances, and trade allowances in the market. Once allowances are traded during the compliance period, gains equivalent to the sale price are generated from off-balance assets, and the sustainability of profit or loss is impaired. When the underlying premise is broken, the Off-balance Method does not have relevance or representational faithfulness and lacks decision usefulness. This raises the question of why the Off-balance Method is preferred in actual accounting practice. An explanation different from decision usefulness perspective would be required.

Among the options for accounting treatment, the fact that the Off-balance Method is preferred manifests a firm's intention to avoid recording expenses and liabilities, and the volatility of profit or loss arising from profit/loss mismatch. Decreased profits due to increased expenses and swelled liabilities could worsen financial indicators such as the debt-to-equity ratio, ROA, and EBITDA, leading to violations of financial covenants and lower management compensation. Increased profit or loss volatility also increases the likelihood of violating financial covenants. In a world of incomplete contracts, it is difficult to rewrite contracts in response to changes in accounting standards. Even changes in accounting standards that do not affect cash flows may increase the cost of capital due to deteriorating financial indicators if investors fail to see the impact (Beatty [2007] p. 70). Firms may dislike these costs and prefer the Off-balance Method, in which no expense or liability is recognized until excess emissions occur.[32] The FASB, while tentatively supporting the Allocation Method, insists on the linked presentation of allowances and obligations to return. The linked presentation reduces obligations' impact on financial statements. Indeed, proponents of offsetting or linked presentation are critical of the impact of the obligation covered by the allowance on financial ratios such as an entity's debt and current ratios (IASB [2010k] para. 25).

Accounting for emissions trading and achieving optimal emissions levels

If accounting treatment changes a firm's situation regarding stakeholder decisions and contracts, it can also guide its investment behavior in a particular direction. The impact of a change in accounting standards on stakeholder decision-making is called "economic consequences." However, the real impact on corporate decision-making and resource allocation is sometimes referred to as "real effects (REs)" (Kanodia and Sapra [2016]). If

[32] This is similar to their past preference for operating lease treatment, which avoids recognizing obligations, and the pooling of interest method, which avoids recognizing goodwill amortization expense.

accounting treatment contributes to achieving optimal emissions levels, it is tempting to consider it.

There is substantial evidence that when changes in accounting standards result in increased costs, liabilities, and earnings volatility, firms change their investment behavior to mitigate these effects. For example, restraints on R&D investment to avoid lower profits due to lump-sum expensing of R&D expenditures (Horowitz and Kolodny [1980], Elliott et al. [1984], Selto and Clouse [1985])[33] and a reduction in health care benefits to mitigate the increase in unfunded obligations due to accrual-basis recognition of post-retirement medical benefit obligations (Mittelstaedt, Nichols, and Regier [1995]). In addition, banks that are required to consolidate variable interest entities (VIEs) that issue asset-backed commercial paper (ABCP) reduced ABCP activity and restructured their conduits in order to avoid an increase in their debt ratios due to the consolidation of such VIEs (Bens and Monahan [2008]).[34] Zhang [2009] found that increased earnings volatility caused by the fair value measurement of derivatives made speculative firms more prudent in their risk management and reduced their cash flow volatility and risk exposure.[35] Although the effects of these changes in investment behavior on firms' long-term profits and social benefits vary, objective evidence of the existence of REs due to increased earnings volatility, liabilities, and expenses provides a hint for considering accounting treatments that contribute to achieving optimal emissions levels.

The Off-balance Method, which only accounts for excess emissions once they occur, is unlikely to curtail corporate emissions. Under the Emission Method, which recognizes costs and liabilities as emissions occur, REs, which reduce emissions to avoid lower profits, financial covenant violations, and negative capital market valuations, could be generated.[36] However, when allowances are allocated under the grandfathering method, the allowances allocated are determined based on the amount of emissions in previous years; therefore, the more emissions a firm has, the larger the grant revenue. On the other

[33] Conversely, Oswald, Simpson, and Zarowin [2022] reported that the switch from UK GAAP to IFRS required capitalization of R&D expenditures, which led to an increase in R&D for firms that had previously expensed R&D expenditures.

[34] Specifically, it is the issuance of new securities to third parties who agree to absorb credit losses so that banks themselves do not become the primary beneficiaries.

[35] While all these studies assume that a standard change will affect transactions relating to that standard, Shroff [2017] notes that a particular standard change that adversely affects financial statements may reduce investment in risky assets for a broader range of transactions. For example, the requirement to recognize postretirement benefit obligations under Statement of Financial Accounting Standards (SFAS) No. 106 (Employers' Accounting for Postretirement Benefits Other than Pensions) has reduced capital investment and R&D investments.

[36] As presented in Section 4, it has been demonstrated that increased emissions have a negative impact on stock prices. Given this, a negative correlation is also expected between the obligation recognized and the stock price, and REs that reduce emissions to decrease their obligations could occur.

hand, the Allocation Method would increase liability as the quota and total emissions increase. Conversely, emissions reductions would lead to a decrease in liability and recognition of gains, which may create incentives to reduce emissions. The same logic can be applied to the presentation method, with the gross presentation of allowances and obligations being the most desirable. The volatility of profit or loss caused by the revaluation of the obligation can also be controlled by reducing the obligation through emissions reductions, but this may also encourage firms to engage in unnecessary hedging activities. If this is the case, taking also into account the perspective of achieving optimal emissions levels, it may be desirable to devise a way to avoid profit/loss mismatches for the quantitatively matched portion of allowances held and obligations.

Summary

The IASB and FASB moved toward the Allocation Method after IFRIC 3 was withdrawn. The accounting treatment that recognizes a present obligation (obligation to return) at the time of allocation of allowances and a gain when emissions are kept below the allocated amount faithfully represents the economic substance of the scheme. The usefulness of accounting information would be enhanced if it could reflect the expected total emissions in a timely manner while paying attention to the reliability of the measurement. Standard-setters' support for the Allocation Method may lie in trying to approximate net assets to enterprise value. However, the profit or loss volatility due to the profit/loss mismatch will be worse than with the Emission Method because the obligation to return based on expected total emissions is recognized at allocation. If the disadvantages of lack of sustainability and predictability concerning profit or loss are serious enough to cancel out earlier advantages, the overall usefulness will be impaired. Therefore, it is difficult to say the Allocation Method is particularly superior from the perspective of decision usefulness; however, it is reasonable from the perspective of achieving socially optimal emissions levels. Compared to the Emission Method, which could recognize a large grant income based on actual emissions, the Allocation Method may incentivize firms to reduce emissions as liability decreases and a gain is recognized as emissions are reduced. According to this logic, the method of presentation that encourages emissions reduction is the gross presentation compared with other presentation methods. In cases where the assumption that allowances are held to settle obligations does not hold, the Off-balance Method was evaluated as not providing useful information for decision-making and as relatively inferior in achieving optimal emissions levels. However, as long as this assumption is maintained, the accounting treatment does not have an adverse effect on financial statements and can explain why it is preferred in practice.

Additionally, when allowances and obligations are balanced, it is meaningful from both perspectives of decision usefulness and achieving optimal emissions levels to devise a way to avoid a profit/loss mismatch for the quantitatively matched portion of allowances held and obligations.

4. Examining the impact of emissions disclosure on emissions

Emissions trading systems use the prices of emission allowances to internalize social costs as private costs. However, what is traded and measured in these systems are limited to direct emissions (Scope 1), which do not include other indirect emissions (Scope 2 and Scope 3). Because measuring indirect emissions is difficult, only direct emissions are traded and subjected to accounting treatment. Nevertheless, many firms are currently disclosing indirect emissions along with their direct emissions, and the International Sustainability Standards Board (ISSB) discusses the possibility of requiring firms to provide a detailed disclosure of emissions by scope. Actually, in the Third Agenda Consultation (IASB [2021]), the final topic was how to disclose information related to emissions trading schemes.

We have already explained the debate and practice surrounding the accounting treatment of emissions trading from the perspectives of decision usefulness and achievement of optimal emissions levels. This section explains the rationale for emissions disclosure from the same two perspectives although not necessarily regarding emissions trading systems as a premise. In recent years, a great deal of research has been published on CO_2 emissions by firms; most studies have focused on decision usefulness, such as examining the relationship between a firm's CO_2 emissions and its performance. For instance, according to Matsumura, Prakash, and Vera-Muñoz [2014], increased carbon emissions negatively affect enterprise value; however, voluntary disclosure mitigates this negative impact. In addition, Aruga, Goshima and Chiba [2021] demonstrated that lower CO_2 emissions are associated with better corporate performance and lower cost of capital. However, relatively few studies have focused on achieving optimal emissions levels (i.e., the relationship between disclosure systems and CO_2 emissions). Even if the purpose of financial reporting is solely to provide information that contributes to investors' decision usefulness, with the social goal of carbon neutrality, it would be worthwhile to direct our attention to the REs of disclosure on firms' emission behavior. As Leuz and Wysocki [2016] states, the idea of encouraging (discouraging) desirable (undesirable) behavior through mandatory disclosure, instead of explicitly regulating certain behaviors, is practiced in areas such as product quality, consumer protection, conflicts of interest, environmental policy, and healthcare. Christensen *et al*. [2017] reported that mine owners'

mandatory disclosure of safety records reduced mining-related accidents and injuries. Firms consider the impact of disclosure on stakeholders' decision-making. Concerning climate change information disclosure, if stakeholders react negatively to increased emissions, it is expected that REs for reducing emissions will occur. Furthermore, Fiechter, Hitz and Lehmann [2022] viewed the requirement since 2017 that listed firms in Europe report on corporate social responsibility (CSR) as a policy measure, demonstrating that this reporting requirement produced REs; for example, firms engaged more actively in CSR.[37]

This section examines the relationship between the mandatory disclosure of CO_2 emissions and corporate CO_2 emissions for Japanese firms.[38] In Section 3, we examined CO_2 emissions primarily from the perspective of financial information. In this section, we treat the disclosure of CO_2 emissions as a type of non-financial information and empirically analyze whether a relationship exists between emissions and the disclosure system. In Japan, the disclosure of CO_2 emissions is not currently required by law or accounting standards; therefore, firms consider such disclosure voluntary.[39] However, in response to the growing worldwide concern over climate change issues in recent years, firms listed on the Tokyo Stock Exchange's Prime Market must disclose their CO_2 emissions in their corporate governance codes since 2022.[40] In addition, the Task Force

[37] In addition, regarding the potential economic effects of mandatory corporate disclosure concerning CSR and sustainability, Christensen, Hail and Leuz [2021] surveyed the existing literature and collated the results from a wide range of perspectives, including the effects on capital markets, on non-investor stakeholders, and on corporate behavior.

[38] Regarding the impact of emissions trading systems on firms' CO_2 emissions, Arimura [2022] presented many previous studies from the viewpoint of environmental economics, so the reader should consult that work as necessary. According to Arimura [2022], many previous studies concluded that emissions trading systems have reduced CO_2 emissions.

[39] Within the framework for disclosure of ESG-related information (including CO_2 emissions information), the IFRS Sustainability Disclosure Standards issued by the IFRS Foundation exist side by side with the GRI Standards issued by the Global Reporting Initiative (GRI) and the TCFD Recommendations issued by the Task Force on Climate-related Financial Disclosures (TCFD), as well as other standards. In Japan, the Sustainability Standards Board of Japan (SSBJ) has held discussions on sustainability disclosure and has considered requiring firms to include sustainability information in the information that they are legally required to disclose in their annual securities report (FSA [2022]). The January 2023 amendments to the Cabinet Office Order on Disclosure (Cabinet Office Order Partially Amending the Cabinet Office Order on Disclosure of Corporate Affairs and Other Cabinet Office Orders) made the following changes to annual securities reports: firms are now required to include a section discussing their "Philosophy and Efforts Regarding Sustainability," discussion of "Governance" and "Risk Management" has been made obligatory, and firms are required to include discussion of "Strategy" and "Metrics and Targets" if they have information in that regard that they consider important.

[40] The Tokyo Stock Exchange [2021] states that "firms listed on the Prime Market should collect and analyze the necessary data on the impact of climate change-related risks and earning opportunities on their business activities and profits, and enhance the quality and quantity of disclosure based on the TCFD recommendations, which are an internationally well-established disclosure framework, or an equivalent framework."

on Climate-related Financial Disclosures (TCFD), established to examine climate-related information disclosure and other related issues, issued a final report (TCFD [2017]) in June 2017. According to TCFD [2017], adopting TCFD recommendations is voluntary and left to the discretion of the individual firm. However, firms that adopt the recommendations must disclose detailed information on their climate change mitigation efforts, including their CO_2 emissions.[41]

Considering the growing global interest in climate change issues and the accompanying development of a corporate disclosure framework, we examine the impact of mandatory disclosure of CO_2 emissions on firms' actual CO_2 emissions. We capture the impacts by comparing Japanese firms that have adopted TCFD recommendations with those that have not.[42] As firms in foreign countries, mainly in Europe, are increasingly required to disclose information on climate change, including CO_2 emissions, some studies have analyzed the relationship between such disclosure systems and CO_2 emissions.

For example, Downar *et al*. [2021], using a difference-in-differences (DiD) approach to UK firms, concluded that mandating the disclosure of CO_2 emissions information led to an average reduction of approximately 8% in CO_2 emissions. Similarly, Tomar [2023], focusing on the disclosure of greenhouse gas (GHG) emissions made mandatory for manufacturing facilities in the US in 2010, pointed out that GHG emissions were reduced considerably after the disclosure was made mandatory. Tomar [2023] explained that this reduction was caused by benchmarking, as mandatory disclosure allowed entities to examine the information disclosed by their competitors and assess their own relative GHG emissions performance. Jouvenot and Krueger [2021], using a sample of publicly listed firms in the UK, treated the mandatory disclosure of GHG emissions in annual reports as a treatment effect and demonstrated that this requirement led to an average reduction of approximately 16% in GHG emissions. To explain these reductions, they pointed to financial motivations, such as mandatory disclosure, which increases future costs[43] for firms with high GHG emissions.

Though attributing to several different mechanisms (e.g., benchmarking effects and

[41] In TCFD [2017], the four recommended areas of disclosure are Governance, Strategy, Risk Management, and Metrics and Targets. Firms are recommended to disclose information on their Scope 1, Scope 2, and, if possible, Scope 3 CO_2 emissions. It should be noted that this information is to be disclosed in notes to the firms' non-financial information or their financial statements and, in principle, is not to be reflected in the financial statements themselves.

[42] Because firms listed on the Prime Market section of the Tokyo Stock Exchange (TSE) can be regarded since 2022 as required to disclose their CO_2 emissions, comparing these firms with a sample of firms listed on the TSE's other market sections might be possible. However, given the short sample period after the effective mandate, we judged that adequately performing such an examination would be difficult.

[43] Among the costs that they mentioned are reputational costs associated with high GHG emissions and costs due to the future introduction of taxes (such as carbon taxes) on GHG emissions.

financial reasons), the studies discussed above indicated that making disclosure of emissions information mandatory reduced emissions. Building on this previous research and taking into consideration Downar *et al*. [2021], a recent study that analyzed whether a relationship exists between disclosure and CO_2 emissions, we examine, based on equation (1) below, whether there is any relationship between a firm's disclosure and its CO_2 emissions. Our research design consists of selecting firms that have adopted the TCFD recommendations as the treatment group and firms that have not as the control group and then conducting a DiD analysis using all these firms as the sample to examine the effect exerted on firms' actual CO_2 emissions by adopting the TCFD recommendations, that is, by being essentially required to disclose information on their CO_2 emissions. Decisions regarding whether and when to adopt the TCFD recommendations are up to the judgment of the individual firm. However, we proceed on the assumption that once a firm adopts the TCFD recommendations, it is essential to begin disclosing its CO_2 emissions. Based on this assumption, we examine the relationship between mandatory disclosure of CO_2 emissions and firms' actual CO_2 emissions.

$$E = \alpha_0 + \alpha_1 \cdot Post + \alpha_2 \cdot Post * TCFD + \Sigma Controls + Fixed\ effects\ for\ firms + \varepsilon \quad (1)$$

Here, $Post * TCFD$ is a dummy variable indicating the period of time the firm has been a member of the TCFD and is the variable of most interest in our empirical analysis.[44] As for the control variables, considering previous research, we have chosen $Size$, which should have a high correlation with CO_2 emissions, $Leverage$ and $Asset\ Intensity$, which indicate the firm's basic financial condition, and $Price\_to\_Book$, a stock market evaluation metric. Table 1 lists the variables used in this study.

Table 1 List of Variables

[44] In a DiD analysis, another dummy variable (indicating the presence or absence of treatment) is added as an independent variable. However, our analysis treats it by absorbing this into *Fixed effects for firms*.

Variable	Definition
TCFD	Binary variable with 1 for firms of TCFD member and 0 for firms that are not
Post	Binary variable with 1 for the period of time after TCFD member and 0 for the period that are not
ln_emission	Logarithmic of CO2 emissions
emission/cogs	CO2 emissions divided by cost of goods
emission/sales	CO2 emissions divided by sales
Leverage	Total liability divided by total assets
Asset_Intensity	Property, plant, and equipment divided by total assets
Size	Logarithmic of market value
Price_to_Book	Market value divided by book value

With regard to the samples, the sample for the treatment group consisted of listed firms (excluding firms in the finance and insurance industry) that adopted the TCFD recommendations between 2017 and 2020 and for which CO_2 emissions data were available.[45] For the control group, we used a matching method to select firms with attributes similar to those in the treatment group from among all listed firms that have disclosed CO_2 emissions for 2016–2020, the period that this study analyzes.[46] As illustrated in Table 2, the final samples consisted of 500 firm-years for the treatment group and 1,010 firm-years for the control group, for a total of 1,510 firm-years. Given that the number of samples for the treatment group was limited, we decided to follow the lead of Downar *et al*. [2021] and include a larger number of samples for the control group to obtain more examples overall.

Table 2 Samples by industry

[45] Although the number of Japanese firms adopting the TCFD recommendations has continued to grow steadily since 2021, we have limited the sample to firms adopting before 2021 because we need CO_2 emissions data from after a firm adopts the recommendations. For reference, as of the beginning of 2023, even without counting firms in the finance or insurance industry, more than 800 firms in Japan had adopted the TCFD recommendations.

[46] Specifically, a logistic regression using a dummy variable for whether or not a firm is a member of the TCFD as the explained variable was used to select firms that are not members of the TCFD but have attributes similar to those of firms that are members of the TCFD. It should be noted, however, that at this point, the number of firms disclosing CO_2 emissions as a whole is small; therefore, we could not fully match all variables.

（Number of Firms、Firm・Year）

	Treatment Group		Control Group		Total	
	unique firms	total samples	unique firms	total samples	unique firms	total samples
FOODS	9	45	15	75	24	120
ENERGY RESOURCES	2	10	1	5	3	15
CONSTRUCTION & MATERIALS	13	65	23	115	36	180
RAW MATERIALS & CHEMICALS	14	70	38	190	52	260
PHARMACEUTICAL	3	15	9	45	12	60
AUTOMOBILES & TRANSPORTATION EQUIPMENT	4	20	14	70	18	90
STEEL & NONFERROUS METALS	4	20	11	55	15	75
MACHINERY	6	30	16	80	22	110
ELECTRIC APPLIANCES PRECISION INSTRUMENTS	19	95	29	145	48	240
IT & SERVICES, OTHERS	8	40	14	70	22	110
ELECTRIC POWER & GAS	3	15	2	10	5	25
TRANSPORTATION & LOGISTICS	5	25	17	85	22	110
COMMERCIAL & WHOLESALE TRADE	4	20	7	35	11	55
RETAIL TRADE	3	15	6	30	9	45
REAL ESTATE	3	15	0	0	3	15
TOTAL	100	500	202	1,010	302	1,510

For the data for analysis, we obtained various financial data from Nikkei NEEDS and the CO_2 emissions data manually from the individual firms' ESG reports and other voluntary disclosure materials. In addition to analyzing CO_2 emissions, we also examined whether a relationship exists between firms' disclosure and their carbon intensity (i.e., the ratio of their CO_2 emissions to their sales or their cost of goods sold) using equation (2) below. Carbon intensity indicates whether reductions (increases) in CO_2 emissions are simply due to reductions (increases) in production volume or they are due to improvements in production efficiency.[47]

$$CI = \beta_0 + \beta_1 \cdot Post + \beta_2 \cdot Post * TCFD + \Sigma Controls + Fixed\ \ effects\ \ for\ \ firms + \varepsilon \quad (2)$$

Descriptive statistics for the variables are presented in Table 3. From the table, it is clear that the important variables in this study, namely CO_2 emissions ($ln\_emission$), the ratio of CO_2 emissions to the cost of goods sold ($ln(emission/cogs)$), and the ratio of CO_2 emissions to sales ($ln(emission/sales)$), are greater overall for the treatment group than for the control group. As shown in Figure 1, in the plot of CO_2 emissions over time, emissions for the control group remained approximately constant during the period analyzed. In contrast, those for the treatment group declined gradually. Finally, in the correlation coefficient matrix for the variables illustrated in Table 4, the correlation coefficient between the variables related to CO_2 emissions and the control variables $Size$

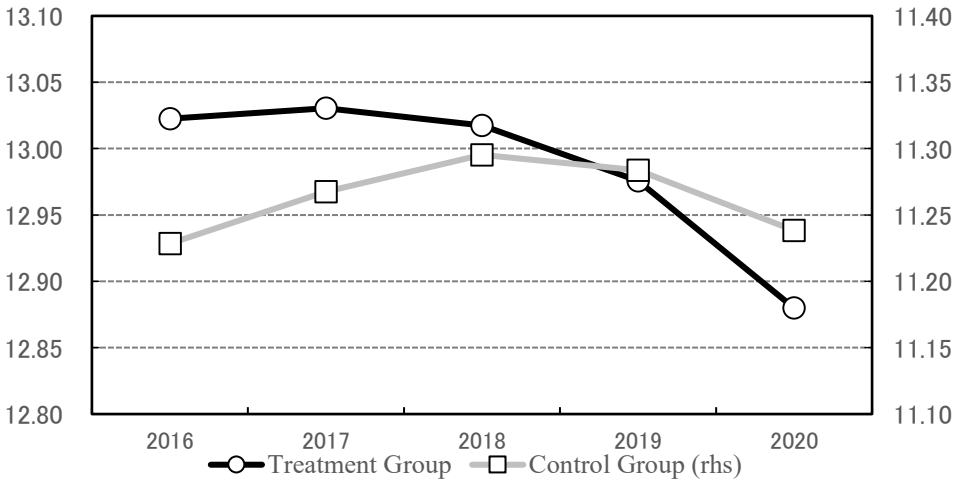
[47] The variables related to CO_2 emissions have considerable industry-to-industry and firm-to-firm dispersion, a nonlinear distribution, and estimated coefficients that could be interpreted as rates of change. For these and other reasons, we have followed the example of other researchers and converted these variables to logarithmic values.

and $ln\_emission$ is 0.71, which is relatively high.

Table 3 Descriptive statistics of variables

Variable	Mean	P25	Median	P75	St. Dev.
Treatment Group					
ln_emission	12.985	11.895	13.062	13.927	2.119
ln_(emission/cogs)	-0.489	-1.190	-0.428	0.297	1.792
ln_(emission/sales)	-0.895	-1.705	-0.924	-0.122	1.830
Leverage	0.513	0.401	0.517	0.638	0.163
Asset Intensity	0.282	0.175	0.264	0.360	0.147
Size	14.067	13.387	14.050	14.764	1.113
Price_to_Book	1.783	0.900	1.336	2.097	1.380
Control Group					
ln_emission	11.263	10.102	11.159	12.520	1.966
ln_(emission/cogs)	-0.602	-1.352	-0.510	0.148	1.453
ln_(emission/sales)	-0.924	-1.725	-0.891	-0.127	1.461
Leverage	0.482	0.352	0.485	0.618	0.177
Asset Intensity	0.312	0.191	0.290	0.403	0.166
Size	12.294	11.406	12.170	13.163	1.229
Price_to_Book	1.312	0.730	1.028	1.473	1.320

Figure 1 CO_2 emissions ($ln\_emission$)



Note: Mean of each sample for the treatment and control groups.

Table 4 Correlation coefficient matrix of variables

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
ln_emission	(1)		0.75	0.76	0.30	0.39	0.71	-0.05
ln(emission/cogs)	(2)	0.000		0.99	0.05	0.44	0.13	-0.14
ln(emission/sales)	(3)	0.000	0.000		0.11	0.47	0.11	-0.19
Leverage	(4)	0.000	0.043	0.000		0.32	0.27	-0.07
Asset_Intensity	(5)	0.000	0.000	0.000	0.000		0.13	-0.12
Size	(6)	0.000	0.000	0.000	0.000	0.000		0.13
Price_to_Book	(7)	0.047	0.000	0.000	0.009	0.000	0.000	

Table 5 presents the results of the analysis. First, in the regression analysis results with $ln\_emission$ as the dependent variable, the coefficient is negative and significant at the 1% level. This means that, as noted in earlier studies, mandatory disclosure of information on CO_2 emissions leads to actual reductions in firms' CO_2 emissions. Although this is no more than the financial motivation pointed out by Jouvenot and Krueger [2021] from a different perspective, in recent years, it seems that investors have been using CO_2 emissions as one of the metrics by which they evaluate enterprise value, and firms are taking such evaluations by investors into account. In other words, since firms disclose CO_2 emissions, they are considered to be endeavoring to reduce CO_2 emissions in order to improve their evaluations from investors. In addition, Japanese firms too are particularly conscious of what their competitors disclose, so the benchmarking effect identified by Tomar [2023] serves as another incentive for Japanese firms to reduce their CO_2 emissions. In short, the mandatory disclosure of CO_2 emissions by firms is one of the factors promoting the reduction of CO_2 emissions. Based on the magnitude of the coefficients, the impact of mandatory disclosure on firms' behavior seems to be considerable because, for example, firms required to disclose information on their CO_2 emissions reduced their CO_2 emissions by approximately 10% compared with firms that were not required.

Furthermore, directing our attention to the examination results for $ln(emission/cogs)$ and $ln(emission/sales)$, we see that their coefficients are also negative and significant (at 1% level) and that their carbon intensity, regardless of whether the cost of goods sold or sales is made as the denominator, declines by approximately 8%; thus, it is clear that the impact was considerable. This means that when the disclosure of CO_2 emissions information is made mandatory, there is a decline not only in CO_2 emissions but also in carbon intensity. Owing to sampling limitations, there is a slight difference in CO_2 emissions levels between the treatment and control groups at the beginning of the period, but we emphasize that $Post * TCFD$ is significantly negative even in the case of carbon intensity. Looking at the control variables, the results are not statistically

significant for any of the variables except $Size$. The sign for $Size$ is positive and significant when the dependent variable is $ln\_emission$ but negative and significant when the dependent variable is $ln(emission/cogs)$ or $ln(emission/sales)$. This can be interpreted as meaning that while the levels of CO_2 emissions shown by $ln\_emission$ increase in proportion to firm size, the decline in the ratio of CO_2 emissions to sales or the cost of goods sold reflects factors such as efficiency improvements due to greater firm size.

Table 5 Results of regression analysis

	(1)	(2)	(3)	(4)
Dependent Variables	LN_EMISSION	LN_EMISSION	LN_EMISSION_COGS	LN_EMISSION_SALES
*POST*TCFD*	-0.103***	-0.111***	-0.08***	-0.088***
POST	-0.002	-0.022**	-0.043***	-0.035***
Controls				
SIZE	——	0.285***	-0.33***	-0.358***
ASSET_INTENSITY	——	0.023	-0.23	-0.095
LEVERAGE	——	-0.037	-0.01	0.167
PRICE_TO_BOOK	——	0.043	-0.006	-0.009
Intercept	11.84***	8.193***	3.802***	3.686***
Firm Fixed Effect	Yes	Yes	Yes	Yes
N	1,510	1,510	1,510	1,510
Adj.R^2	0.994	0.994	0.988	0.989

Note: ***, **, and * indicate that the regression coefficients are significant at two-tailed probabilities of 1%, 5%, and 10%, respectively. In calculating the t-values for each variable, corrected standard errors (Two Way Cluster Robust Standard Error) are used for the firm and year clusters to account for heteroskedasticity and serial correlation in the error terms.

To summarize our empirical results,[48] the mandatory disclosure of CO_2 emissions contributes to a reduction in corporate CO_2 emissions through motivations on the part of firms that are aware of corporate valuation by investors and benchmarking effects with competitors.[49] However, as stated above, in Japan, the disclosure of CO_2 emissions is not required by law or accounting standards, and this analysis was conducted by assuming that the adoption of the TCFD is, in effect, a mandate to disclose CO_2 emissions. By choosing to use DiD analysis, we could extract as much as possible only the effects of mandatory CO_2 emissions disclosure. However, there is room for improvement, such as

[48] In addition to a logistic regression, we tried several other methods for selecting samples for the control group, including machine learning methods for solving classification problems. However, there was no significant difference in the estimation results.

[49] However, adoption of the TCFD recommendations is currently voluntary, so there may be bidirectional causality in that firms that adopt the recommendations may do so because they expect to be able to reduce their CO_2 emissions. To check for this, we tried lagging the independent and control variables by one period concerning the dependent variable and carrying out estimation under those circumstances. However, generally, similar results were obtained.

selecting the treatment group. In particular, because only a few listed Japanese firms disclose their CO_2 emissions, it is not possible to eliminate sampling bias completely.[50] In addition, in recent years, many firms have obtained third-party guarantees for the information they disclose regarding climate change (including their CO_2 emissions); however, in this study, we have not examined the relationship between such third-party guarantees and CO_2 emissions.[51] In the future, along with the development of disclosure systems for CO_2 emissions, a more comprehensive analysis should be conducted using firms' disclosure data accumulation.

5. Conclusion

In this paper, we summarized the discussions of standard-setting bodies about accounting treatment for emissions trading, and the situation surrounding practices. We examined whether these discussions and practices can be interpreted as reasonable from the perspectives of decision usefulness and achieving optimal emissions levels. It is now possible to answer the question posed at the beginning of this paper: the discussion by standard-setting bodies concerning accounting rules (including disclosure) has a certain degree of reasonableness from both perspectives, and the actual situation in accounting practice is understandable considering the relationship between accounting treatment and investment behavior.

However, several challenges remain unaddressed. Twenty years have passed since the publication of IFRIC 3, and more than ten years have passed since the IASB and FASB reached their tentative conclusions. Over this period, a body of academic and practical knowledge on carbon pricing has steadily accumulated. Thus, there seems to be a need for the accounting treatment of emissions trading to be considered systematically, considering the nature of emission allowances, the theoretical relationships with environmental taxes and other types of schemes (such as baseline and credit), and the consistency with the many accounting standards discussed in this paper.

In addition, although emissions disclosure indeed contributes to emissions reductions, it has yet to be studied how great a difference there would be in firms' emissions reduction behavior and in investors' reactions between disclosing emissions information in firms' non-financial information and recognizing and measuring emissions information as

[50] One way to deal with sampling bias might be to introduce a proxy variable such as "*Whether firm has set KPIs for reducing CO_2 emissions*" to control for firm-specific motivations regarding CO_2 emissions reductions.

[51] Quite a few firms whose data were included in our treatment group sample had obtained such third-party guarantees. It is useful to examine, for instance, whether there is any relationship between obtaining third-party guarantees and CO_2 emissions.

assets/liabilities. According to Kusano et al. [2016], who analyzed the impact of the implementation of ASBJ Statement No. 13 Accounting Standard for Lease Transactions, when firms were required to recognize lease liabilities for finance lease transactions that did not transfer ownership, the higher a firm's debt-to-equity ratio, the more the firm used operating lease transactions. This change in firm behavior seems to be aimed at lowering liabilities. However, the recognition of lease liabilities under the revised standard does not provide additional information, as the balance of future lease payments was previously disclosed in the notes. Financial covenants do not consider the information given in notes, so it can be conjectured that the deterioration of the debt-to-equity ratio in the financial statements themselves would have increased the probability of contract breach. It has been pointed out that investors may pay more attention to recognized items than to items disclosed in notes (e.g., Schipper [2007]). As for REs and the effects of providing information to capital markets, recognizing items in the financial statements themselves seems to have a more significant impact than disclosing it in the notes. If this is the case, there is no guarantee that disclosing emissions as non-financial information fully substitutes for recognizing obligations on the balance sheet. Furthermore, if the same holds for emissions information, the emissions reduction effect should be greater if the information is presented in the financial statements. However, emissions information is not currently reflected in the financial statements, so there is no way to verify this using the data. One approach might be to perform an experiment by assuming a hypothetical situation in which accounting standards for emissions exist and then examining the behavior of firms and investors.[52]

In addition to issues about individual and specific accounting rules, the pros and cons of introducing perspectives other than the usefulness of decision-making into the standard-setting process are also at issue. When there are policy goals other than decision usefulness, such as achieving optimal emissions levels, with different accounting rules appropriate for each goal, which goal should the standard-setting bodies prioritize? It cannot be denied that the concepts such as CSR, ESG, and sustainability are becoming increasingly important, firms are being asked to take on social responsibility, and executives are paying attention to a diverse range of stakeholders when running their businesses. As corporate transactions and business conditions change, the role of

[52] In addition, this study could not analyze specific types of disclosure. For example, although it is possible that investors evaluate and interpret CO_2 emissions information differently depending on which of the three scopes it refers to, we could not carry out any analysis on a scope-by-scope basis. Furthermore, even though in recent years it has become increasingly common for firms to obtain third-party guarantees regarding the CO_2 emissions information that they disclose, we were not able to investigate what impact such third-party guarantees have.

accounting still appears to be to provide information that contributes to investors' decision-making. However, there may be a view that standards should be set considering social benefits in line with changes in business conditions. There are pros and cons regarding whether accounting standards should be designed considering objectives and REs other than decision usefulness (Beatty [2007] p. 64). Is respect for social benefits permitted only if they do not interfere with decision usefulness, or should they not reduce economic benefits? Christensen *et al*. [2017] clarified that although the disclosure of mine safety records led to fewer mining-related accidents and injuries, firms' productivity declined (p. 299). The SEC is reluctant to use its securities law or mandatory disclosure powers to exert societal pressure on firms to change their behavior outside the core mission of maintaining financial system stability and protecting investors (White [2013]).

On the other hand, Kurokawa ([2018] chapter 20), approaching the issue from the long-term standpoint of the 50 years foreseen by the Paris Agreement, argued that the ideal situation is that the economic benefits of a firm that contributes to social benefits and the natural environment become large. Kurokawa ([2018] chapter 20) then discusses the need for financial reporting and the possibility of expanding accountability to help realize this ideal situation. As the economy and society change, reconsidering the purpose of financial reporting and the role of financial and non-financial information, and affirming the significance of accounting will again become important issues.

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