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Chapter 7
Equivalence of Carbon Tax, Carbon Pricing and Small and Medium-sized Enterprise Green Policies

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Abstract

This chapter examines the current landscape of environmental, social, and governance (ESG) investing by focusing on the environmental segment. We analyze discrepancies in scoring environmental, social, and governance methodologies among different rating agencies and show how these inconsistencies can lead to distorted investment decisions. To address this issue, we propose a unified approach based on net carbon pricing, which incorporates both carbon emissions and "green" corporate efforts. We address the issue that carbon trading, pricing, taxes and green bonds differ across countries. This can lead to distortions by production location as global companies relocate production based on tax rates and various fees.

We also explore the potential alignment of carbon taxes, green bonds, and carbon pricing mechanisms. We argue that by standardizing the measurement of greenhouse gas emissions, these instruments could converge to provide consistent signals for investors and policymakers. The burdens and consequences of each policy will differ, causing the relocation of global companies to places with weaker environmental regulations.

In addition, we discuss the importance of including small and medium-sized enterprises in reducing emissions, and the potential implications for central banks purchasing green bonds. We also offer key messages for Asian policymakers.

7.1 Portfolio Allocation by Considering Environmental, Social, and Governance Scores

Traditionally, investors have focused on two key parameters when deciding how best to allocate their portfolios—the rate of return and risk. This approach, originally developed by William Sharpe and Robert Martin, has been the cornerstone of modern portfolio theory. However, the growing importance of sustainability and corporate responsibility has led to the inclusion of environmental, social, and governance (ESG) factors as a third parameter in deciding where to invest. Our analysis reveals that current ESG investment scoring methods distort optimal portfolio allocation because different rating agencies use different criteria for environmental scoring. On one hand, a company receives different ESG scores depending on rating agency, while on the other, the rate of return and risks are measured using the same three metrics: (i) future profitability; (ii) profit volatility; and (iii) projected changes in stock prices (Yoshino and Yuyama, 2023).

$$U(R_t - \beta\sigma_t^2 + \gamma(ESG_t)) \quad (1)$$

$$\text{s.t. } R_t = \alpha_t R_t^A + (1-\alpha_t)R_t^B \quad (2)$$

$$\sigma_t^2 = \alpha_t^2(\sigma_t^A)^2 + (1-\alpha_t)^2(\sigma_t^B)^2 \quad (3)$$

$$ESG_t = \alpha_t(ESG_t^A) + (1-\alpha_t)(ESG_t^B) \quad (4)$$

$$\frac{\partial U}{\partial \alpha_t} = (R_t^A - R_t^B) - \beta\{2\alpha_t(\sigma_t^A)^2 + 2(1-\alpha_t)(\sigma_t^B)^2\} + (2-4\alpha_t)\sigma_t^{AB} + \gamma(ESG_t^A - ESG_t^B) = 0 \quad (5)$$

Writing equation (5) for the results in equation (1):

$$\alpha_t = \frac{\frac{1}{2\beta}(R_t^A - R_t^B) - (\sigma_t^B)^2 - \sigma_t^{AB} + \frac{\gamma}{2\beta}(ESG_t^A - ESG_t^B)}{(\sigma_t^A)^2 - (\sigma_t^B)^2 - 2\sigma_t^{AB}} \quad (6)$$

The equations above lay out portfolio analysis if we account for ESG as an additional component along with rate of return and risk. Equation (1) is the utility maximization of investors. Traditionally, investors paid attention to rate of return R_t and risk σ_t^2. However, now they must account for the ESG score as well.[1] Equation (2) is the rate of return for an organization distributing its assets into two companies, R_t^A and R_t^B. α_t represents the percentage of the assets allocated to company A, and $(1-\alpha_t)$ is the percent of the assets allocated to company B.

Neglecting the cross correlations between assets A and B, equation (3) is a simple version of the risk. Equation (4) is the total ESG score, which consists of α_t times company A and $(1-\alpha_t)$ times the ESG score of company B. Equation (5) maximizes utility equation (1) based on (2), (3), and (4). We obtain equation (6) where α_t is the optimal allocation of total assets to company A and $(1-\alpha_t)$ is the optimal allocation to company B. The equation shows that α_t depends on the ESG scores of company A and company B. This will be further corroborated through our empirical analysis.

To illustrate this, we examine the evaluation criteria of five prominent rating agencies: Bloomberg, FTSE Russell, MSCI, Sustainalytics, and Thomas Reuters (Table 7.1). Each of these agencies has developed its own scale and criteria for measuring environmental performance. For example, some rating agencies focus primarily on the degree of disclosure provided by companies, while others place more emphasis on the presence of specific environmental policies or practices. This lack of standardization can lead to a single company receiving vastly different environmental scores depending on the agency doing the evaluation.

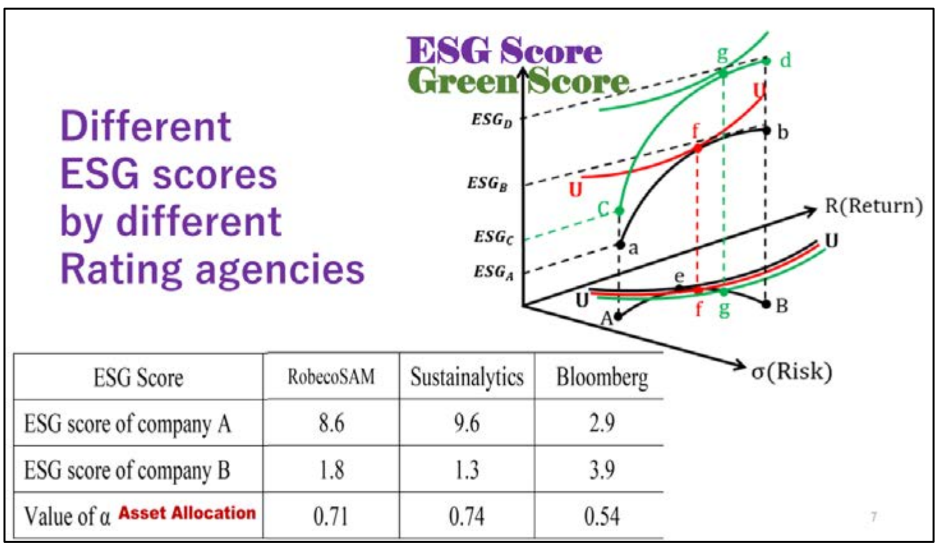
[1] ESG consists of environment, social, and governance. E, as we show, is relatively easy to measure as the amount of CO_2 and greenhouse gas emissions. However, social and governance factors are not as easy to compare because of the difficulty in ascertaining which corporate activities are good for society. There could be many measures to assess whether their governance is good or not. Thus, this chapter focuses on the environmental aspect of ESG.

Table 7.1: Rating Methods of Various Rating Agencies

ESG Score	Evaluation criteria overview
Bloomberg ESG Disclosure Scores	Evaluated based on the degree of disclosure. Environmental aspects are evaluated based on the degree of disclosure.
FTSE Russell's ESG Ratings	ESG risks are evaluated based on disclosure, commitment to policy formulation and improvement, etc. In terms of the environment, in addition to disclosure, we evaluate the existence of policies and commitments to improvement.
MSCI ESG Ratings	Evaluated based on 37 key ESG issues (ESG key issues). The environment side is also evaluated by setting a key issue.
Sustainalytics' ESG Risk Ratings	Based on ESG measures, information disclosure, and the level of problems. The same is true in terms of the environment.
Thomson Reuters ESG Scores	10 items: for the Environment factor, resource use, emissions, and innovation; for Society factor, employees, human rights, local communities, and product responsibility; and on Governance, management, shareholders, and CSR strategy. Regarding the environment, evaluated based on actual carbon emissions and whether or not there is a policy.

ESG = environmental, social, and governance.
Source: Authors based on processing part of the data of Yoshino and Yuyama. 2021., Yuyama. 2020., and each rating agency.

Figure 7.1: Different ESG Scores by Different Rating Agencies



ESG = environmental, social, and governance.
Source:Authors

Figure 7.1 shows the traditional portfolio allocation with the addition of environmental score or green score as the vertical axis. The horizontal axis is the rate of return and risk. The black line AB is the portfolio frontier. U is the traditional risk-return-based utility maximization. The intersection of U and AB, E, is the maximized welfare point, or the optimal portfolio allocation that maximizes the rate of return based on the risk.

Consider a scenario where different agencies provide different ratings. If we account for two rating agencies on the vertical axis, one rating agency will evaluate its ESG score by black line ab while another will evaluate the same company's score by the green line cd. The new utility function considers not only the rate of return and risks, but also a "greenness" or ESG score. In this case, the optimal portfolio allocation will change from point E to either F or G, depending on rating agency. We analyzed three rating agencies—Robeco-SAM, Sustainalytics, and Bloomberg—and two hypothetical companies, Company A and Company B. The three rating agencies assign different scores to the companies depending on their individual criteria. If we make our asset allocation decision based on the Rebeco SAM rating, then we will allocate 71% to company A and 29% to Company B. On the other hand, this changes to 74% and 26% using Sustainalytics, and 54% and 46% with Bloomberg (Table 7.2).

Table 7.2: Empirical Analysis of the Relationship between ESG Scores and Risk/Return

Empirical analysis of the relationship between ESG scores and risk/return

- **Japan's Nikkei 225 as of December 30, 2021**

	Dependent variable : Stock return 2021						
	ESG score						
	bld2021	ble2021	bls2021	blg2021	blep2021	blsp2021	blgp2021
ESG score	0.004*	0.003**	0.002	0.003	-0.000	-0.001	0.001
	(0.051)	(0.046)	(0.330)	(0.161)	(0.939)	(0.577)	(0.264)
Control variabls							
Total asset	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.796)	(0.932)	(0.831)	(0.758)	(0.700)	(0.718)	(0.795)
ROA	0.008	0.008	0.008	0.007	0.008	0.008	0.008
	(0.211)	(0.186)	(0.223)	(0.244)	(0.213)	(0.220)	(0.244)
Equity ratio	-0.003**	-0.003**	-0.003*	-0.002*	-0.003*	-0.003*	-0.003*
	(0.047)	(0.031)	(0.058)	(0.100)	(0.056)	(0.068)	(0.059)
Constant	0.028	0.138*	0.188**	-0.033	0.280***	0.298***	0.223***
	(0.821)	(0.079)	(0.020)	(0.871)	(0.007)	(0.000)	(0.007)
Observations	223	223	223	223	195	195	195
	Dependent variable : Stock volatility 2021						
	ESG score						
	bld2021	ble2021	bls2021	blg2021	blep2021	blsp2021	blgp2021
ESG score	-6.984*	-3.473	-4.302	-6.426	-3.192	-1.689	-2.223
	(0.074)	(0.115)	(0.269)	(0.124)	(0.102)	(0.361)	(0.252)
Control variabls							
Total asset	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.540)	(0.648)	(0.553)	(0.489)	(0.721)	(0.647)	(0.767)
ROA	32.320***	31.726***	32.584***	33.244***	31.574***	31.209***	32.519***
	(0.003)	(0.004)	(0.003)	(0.002)	(0.008)	(0.009)	(0.006)
Equity ratio	6.510**	6.861***	6.334**	5.668**	6.276**	7.118**	6.667**
	(0.011)	(0.008)	(0.013)	(0.028)	(0.032)	(0.016)	(0.023)
Constant	327.761	128.131	91.275	511.782	209.148	54.832	78.085
	(0.131)	(0.352)	(0.517)	(0.151)	(0.256)	(0.706)	(0.597)
Observations	223	223	223	223	195	195	195

Sources: Yoshino, N. and T, Yuyama. 2023.

The two tables capture the respective correlations of ESG scores with rate of return and risk. Of the seven cases examined in Table 7.1, only two show a positive correlation between ESG scores and returns, while the other five show no significant correlation. Similarly, in the second table, only one of the seven cases show a positive correlation between ESG scores and risk, with the remaining six showing no significant correlation. The results underscore the lack of consistency in how ESG scores are measured by different agencies. These results underscore the lack of correlation between ESG score, rate of return, and risk.

7.2 Carbon Pricing to Regain Optimal Portfolio Allocation

To address the distortions created by inconsistent ESG scoring, we propose implementing a net carbon pricing system. This approach would provide a more objective and standardized measure of a company's environmental impact, which could be directly incorporated into the investment decision-making process. Mathematically, the net carbon pricing would be calculated as follows:

net carbon price = carbon price – greenness efforts

This equation will help us calculate the net carbon emissions for each company after accounting for its greenness efforts—such as planting trees or setting up solar panels on their factories. This net carbon pricing would then be incorporated into rate-of-return calculations as follows:

Company A's return and risks after carbon pricing:

$$R_A = R_A - P_A$$

$$(\sigma_A)^2 = E(R_A - \overline{R_A})^2$$

Company B's return and risks after carbon pricing:

$$R_B = R_B - P_B$$

$$(\sigma_B)^2 = E(R_B - \overline{R_B})^2$$

We also compute the risk associated with post-carbon pricing rate of return. Equation (11) and (12) show the post-carbon pricing rate of return of company A and company B.

$$R_A = R_A - P_A (11)$$

$$R_B = R_B - P_B (12)$$

Equations (13) and (14) show the optimal rate of return and risk, respectively.

$$R_t = \alpha_t R_A + (1-\alpha_t) R_B (13)$$

$$(\sigma)^{213} = (\alpha_t)^2 (\sigma_A)^2 + (1-\alpha_t)^2 (\sigma_B)^2 + 2\alpha_t (1-\alpha_t)\sigma_{AB} (14)$$

$$\frac{\partial U}{\partial \alpha_t} = (R_A - R_B) - \beta\left[2(\alpha_t)(\sigma_A)^2 + 2(1-\alpha_t)(\sigma_B)^2 + (2-4\alpha_t)\sigma_{AB}\right] = 0 (15)$$

$$\alpha_t = \frac{\frac{1}{2\beta}(R_A - R_B) - (\sigma_B)^2 - \sigma_{AB}}{(\sigma_A)^2 - (\sigma_B)^2 - 2\sigma_{AB}} (16)$$

Next, to find the optimal asset allocation between company A and B, we obtain first order differentiation of the utility function for $\widetilde{\alpha_t}$ (Equation 15). Solving this, we get equation (16). Evidently, as in equation (16), investors do not need to consider ESG as an additional item. Instead, investors maximize their utility based just on the rate of return and the risk after carbon pricing. In other words, once we consider the net carbon pricing of each company and measure the post-carbon pricing rate of return and after-tax risks, we obtain the optimal portfolio allocation $\widetilde{\alpha_t}$, which does not depend on ESG scores because it is already accounted for by carbon pricing.

7.3 Diversified Carbon Pricing

Carbon pricing is the way to tackle global warming. Current carbon pricing mechanisms vary significantly across regions, leading to inconsistent incentives for companies operating in multiple jurisdictions (Table 7.3 and Figure 7.2).

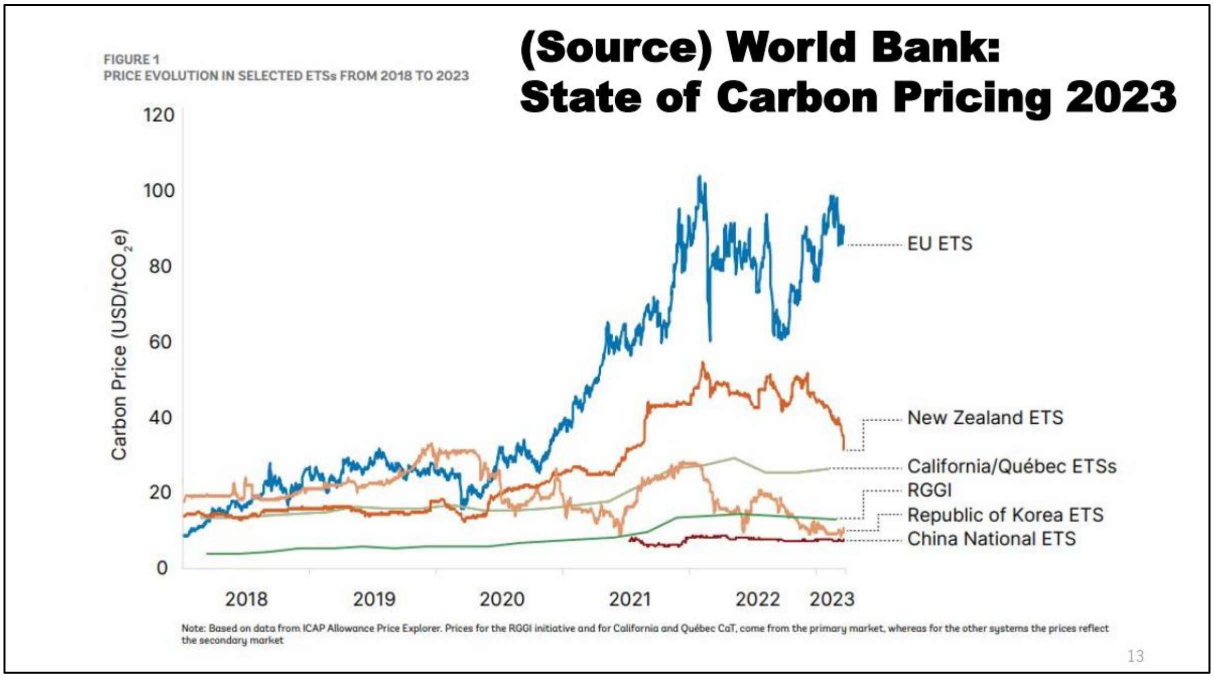
Table 7.3: Carbon Price (in $/tCO2e)

Country	**Carbon price**
People's Republic of China	12.57
India	0[2]
Indonesia	0.61
Japan	20.9[3]
Republic of Korea	6.3
Kazakhstan	1.06
European Union	61.3
Germany	48.37
United States	21.03[4]

$/tCO2e = US dollars per metric ton of carbon dioxide equivalent.
Sources: OECD, World Bank Carbon Pricing Dashboard, Nomura Research Institute, RGGI database

Figure 7.2: Price Evolution in Selected Emissions Trading Systems from 2018 to 2023

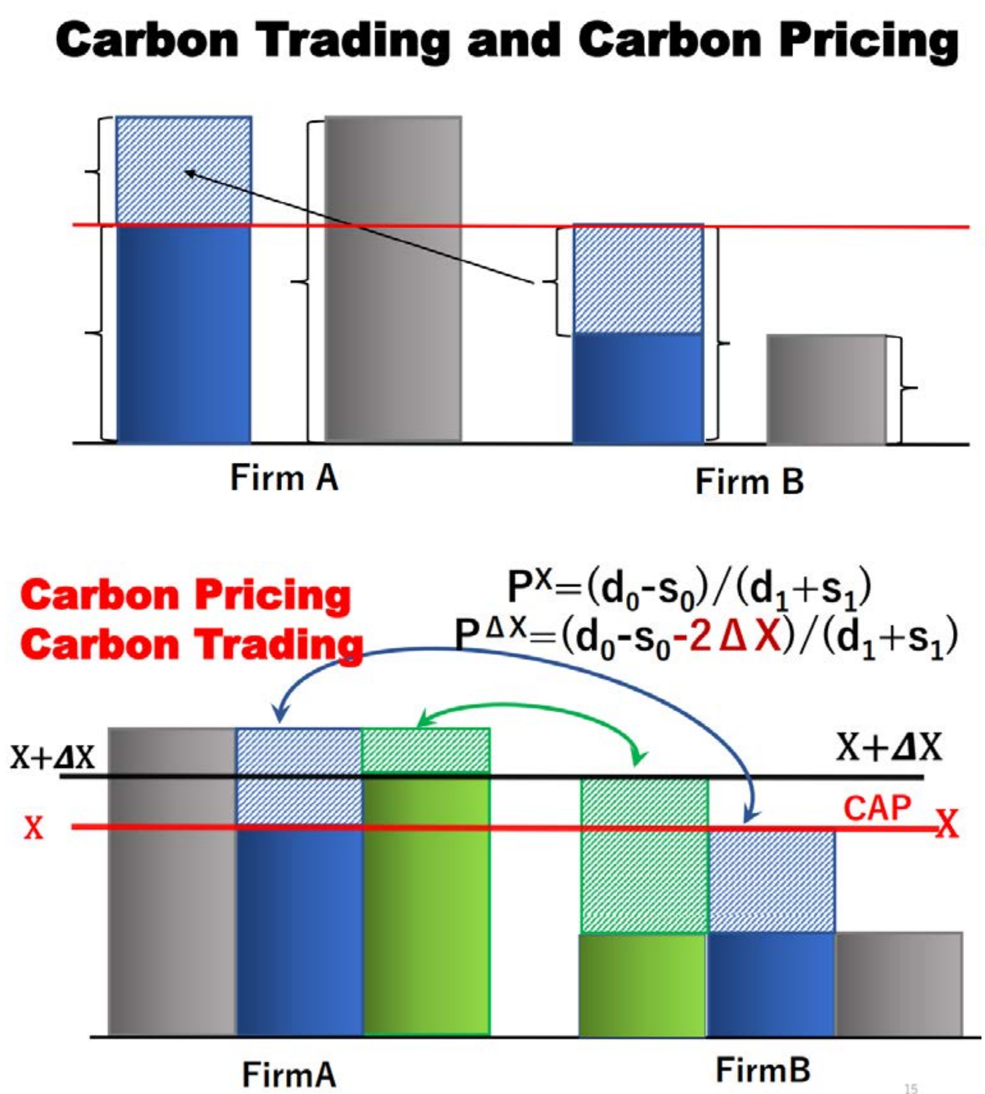
[2] An emissions trading system for India is being discussed but has yet to be implemented.
[3] J-credit price in 2023.
[4] Regional Greenhouse Gas Initiative clearing price on 5 June 2023XXX



ETS = Emissions Trading System.
Source; World Bank. 2023.

Different carbon pricings are the result of different carbon caps (or CO_2 emissions limits) used in various regions. This mechanism can be illustrated through a simple two-firm model (Figure 7.3). Consider Firm A, which exceeds its allocated CO_2 emission ceiling, and Firm B, which operates below its emission limit. In a carbon trading system, Firm B can sell its unused emission allowances (represented by the area below the red emission ceiling) to Firm A, which requires an additional allowance to cover its excess emissions. This trading activity generates the carbon price. The stringency of the emission cap directly influences the carbon price. As the cap becomes more restrictive (represented by a lower emission ceiling in the bottom figure), the supply of available allowances decreases, resulting in higher carbon prices. Conversely, a more lenient cap (represented by a higher emission ceiling) increases the allowance supply, leading to lower carbon prices.

Figure 7.3: Impact of Emissions Limit on Carbon Pricing



Source:Authors

Supply depends on the carbon price and gap between “cap” carbon emissions minus “actual” carbon emissions (equation 17). Demand depends on the carbon pricing and gap between the actual emissions minus the cap CO_2 emissions (equation 18). The equilibrium price depends on the gap between the cap price and actual price of carbon emissions (equation 19). If the carbon emission cap is high, ΔX is small so the carbon price lowers. On the other hand, when the carbon emission cap is low, ΔX is large and the carbon price becomes high.

$$S = s_0 + s_1 P + \Delta X \, (17)$$

$$D = d_0 + d_1 P - \Delta X \, (18)$$

$$P = \frac{(d_0 - s_0) - 2\Delta X}{(s_1 + d_1)} \, (19)$$

$$\Delta X = 'CAP' \, carbon \; emission - 'Actual' \, carbon \; emission (20)$$

7.4 Green Bonds

The Green Bond Principles, initially published in 2018 by the International Capital Market Association and subsequently revised in 2022, provide a framework for issuing green bonds. They outline 10 eligible categories for green bond issuance, including renewable energy and energy efficiency (for example, energy-efficient buildings). However, their current implementation presents significant challenges in quantifying the environmental impact of green projects. For instance, in a field study conducted in Japan, we interviewed construction companies responsible for green buildings in Tokyo. When questioned about the specific reduction in CO_2 emissions compared with traditional buildings, the companies acknowledged the blower carbon emissions, but were unable to provide precise figures such as whether emissions were reduced by 20% or 30%. This lack of specificity extends to other green bond categories like renewable energy projects. The actual CO_2 reduction from solar or wind power installations can vary significantly depending on factors such as equipment efficiency and environmental conditions (for example, wind strength or sunshine intensity). While the Green Bond Principles provide clear criteria for green bond issuance, they do not set any standardized method for quantifying greenhouse gas (GHG) emission reductions. Consequently, the credit ratings of green bonds are not directly tied to their environmental impact as measured by reduced GHG emissions.

7.5 Proposed Solution to Account for Differences

To address this issue, we offer a unified approach that aligns credit ratings, carbon taxes, green bonds, and carbon pricing mechanisms based on a standardized measurement of CO_2 emissions. The proposed framework would function as follows:

1. Green credit rating: the system would be based on the quantity of CO_2 or GHG emissions. Companies with very low emissions would receive the highest rating (AAA), with ratings decreasing as emissions increase.
2. Carbon tax: the tax would be calculated by multiplying the tax rate by the amount of GHG emissions. As emissions increase, the tax burden would proportionally increase.
3. Green bonds: the credit rating of green bonds would be directly tied to the issuing company's GHG emissions. Companies with minimal emissions would receive the highest rating (AAA), with ratings declining as emissions increase.
4. Carbon pricing: by setting appropriate emission ceilings, carbon pricing can be aligned with the carbon tax rate, ensuring that the economic incentives across different policy instruments are consistent.

Figure 7.4: Equivalence of Carbon Tax, Carbon Pricing, and Carbon Credit Rating

Green Credit Rating	Carbon Tax	Green Bond	Carbon Pricing
$\theta \times (CO_2)$	$t \times (CO_2)$	$\theta \times (CO_2)$	$P = \frac{(d_0 - S_0) - 2\Delta X}{(d_1 + S_1)}$ $P \times (CO_2)$

Measure of the Amount of CO_2 Emissions

$$\alpha \times (CO_2)$$

19

CO_2 = carbon dioxide.
Source:Authors

The key to this unified approach is accurately measuring total GHG emissions for each company.[5] In Yokohama City, Japan, CO_2 measuring and thermometers are used extensively in schools. If similar tools, costing about $60, are installed in small businesses, large buildings, and various other places, it would be possible to measure and record CO_2 emissions in real-time, allowing for the computation of monthly averages for each company or building.

For corporate GHG emissions accounting, emissions are typically categorized into scope 1, 2, and 3 as defined by the Greenhouse Gas Protocol (Table 7.4).

Table 7.4: Scope 1, 2, and 3 Emissions

	Country	Company	GHG emissions (in ‘000 tCO2e)		
			Scope 1[6]	Scope 2[7]	Scope 3[8]

[5] Here, we only focused on CO_2 emissions, which comprise about 80% of global warming. Other GHG gases such as nitrogen oxide (NOX), among others, are also harmful. However they are not so easy to measure and contribute less than 20% to global warming. Accurately speaking, a GHG tax could be defined as:
GHG Tax = w_1x(CO2)+W_2x(NOX)+w_3x(H_2O)+…………………
where w_1, w_2, w_3 are the weight of each GHG emission toward global warming. For example, w_1 should be set about 0.8 as CO_2 emissions contribute about 80% of global warming.

[6] Scope 1 emissions are direct GHG emissions from sources controlled or owned by an organization (for example, emissions associated with fuel combustion in boilers, furnaces, and vehicles).

[7] Scope 2 emissions are indirect GHG emissions associated with the purchase of electricity, steam, heat, or cooling. Although scope 2 emissions physically occur at the facility where they are generated, they are accounted for in an organization’s GHG inventory because they are a result of the organization’s energy use. This table captures market-based scope 2 emissions, or those emissions calculated based on a specific purchase contract or agreement for energy. Unlike the location-based method where everyone on the grid is treated as an average customer, the market-based method focuses on the individual organization and its contractual activity in the energy marketplace.

[8] Scope 3 emissions are the result of activities from assets not owned or controlled by the reporting organization, but that the organization indirectly affects in its value chain. An organization’s value chain consists of both its upstream and downstream activities. Scope 3 emissions include all sources not within an organization’s scope 1 and 2

Oil & Gas	Japan	Cosmo Oil	7,287	243	71,748
		Idemitsu Kosan	13,858	553	122,324
		Inpex	6,839	69	84,926
	India	Indian Oil Corporation	20,210	630	301,500
		Bharat Petroleum	10,242	715	141,175
		Hindustan Petroleum	3,342	637	116,301
	United States	ExxonMobil	92,000	6,000	540,000
		Phillips 66	24,800	6,400	354,000
		Valero Energy	24,800	4,900	NA
Pharmaceuticals	Japan	Daiichi Sankyo	86	24	2,122
		Takeda Pharmaceutical	316	0	4,462
		Chugai Pharmaceutical	48	3	1,137
	India	Sun Pharma	67	353	357
		Dr Reddy's Lab	302	166	470
		Cipla	38	187	NA
	United States	Johnson & Johnson	320	123	6,866
		Eli Lily & Co	182	345	NA
		Merck & Co	1,236	227	4,594
Automobiles	Japan	Toyota	2,370	2,870	570,490
		Honda	1,090	2,730	284,410
		Nissan Motors	661	1,435	118,828
	India	Mahindra and Mahindra	59	202	80,214
		Suzuki	420	720	19,860
		Tata Motors	60	266	3,141
	United States	General Motors		2,700	241,000
		Ford	1,108	1,355	384,120
		Stellantis	1,400	1,700	457,600

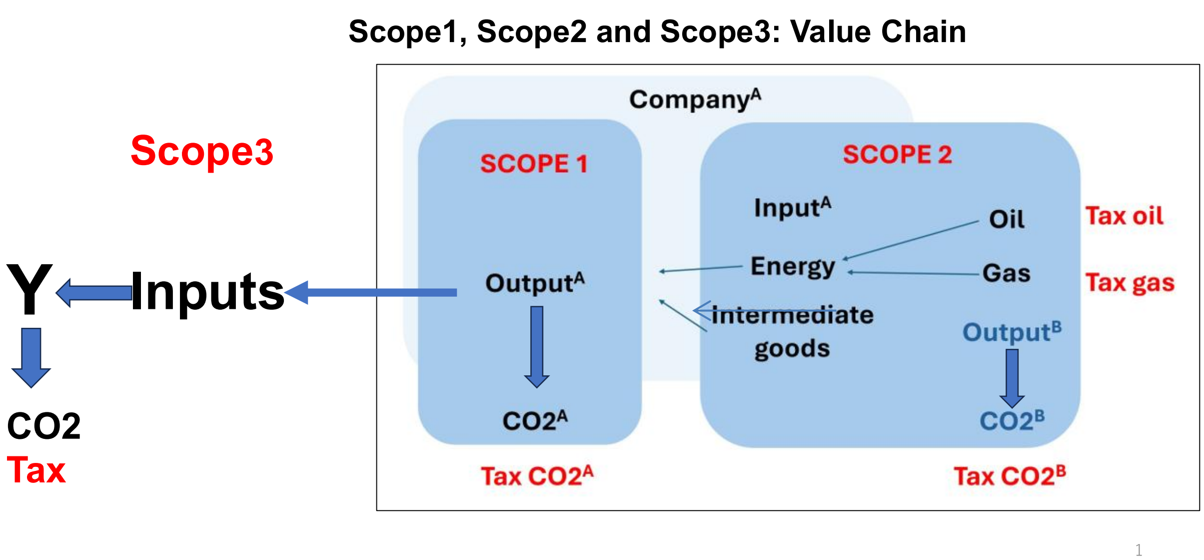
tCO2e = metric ton of carbon dioxide equivalent.

emissions. The GHG Protocol defines 15 categories of scope 3 emissions, though not every category will be relevant to all organizations.

Sources: Environmental, social and governance company disclosures.

While this comprehensive framework offers a holistic view of a company's carbon footprint, it nonetheless presents significant challenges for accurate measurement and subsequent taxation. Scope 2 and particularly Scope 3 emissions are notoriously difficult to quantify given their indirect nature and complexity of global supply chains. In addition, the current system, which holds companies accountable for emissions across all three scopes, can lead to inefficiencies in carbon pricing and taxation. It can result in multiple layers of taxation on the same emissions as they move through the value chain, potentially distorting economic incentives and complicating compliance efforts. To address these challenges, we propose a simplified approach that focuses solely on taxing Scope 1 emissions. This method would require companies to pay taxes only on the direct emissions produced in their operations. The oil and gas used by the company would be taxed at the production stage itself. Under this system, energy providers would be taxed for the emissions produced in generating output (Scope 1 emissions), rather than end-users being taxed for energy consumption (Scope 2 emissions). Similarly, emissions from the production of raw materials would be taxed at the point of production, not at the point of use by downstream manufacturers. This approach simplifies the administrative burden of emissions accounting and taxation while maintaining comprehensive coverage of all emissions. It aligns incentives more directly with the ability to control and reduce emissions, potentially leading to more effective and targeted mitigation strategies (Figure 7.5).

Figure 7.5 Proposed Taxation Mechanism



CO_2 = carbon dioxide.
Source:Authors

With this fundamental data, all four criteria—carbon pricing, carbon taxes, green bond ratings, and emission ceilings—can be harmonized, resulting in a more coherent and effective system for incentivizing emission reductions (Table 7.5). Similarly, green banking lacks clarity on where to lend, so banks often hire credit rating agencies to help reallocate their lending portfolios. As shown, measuring GHG emissions can unify credit ratings, green bonds, and carbon pricing into a single metric, allowing banks to use any of these instruments for portfolio reallocation. The tax rate must be adapted to support transition to net zero emissions. The concept has gained significant traction in recent years, with many countries and organizations setting targets for 2030 or 2050. The emissions thresholds and tax rates can be adjusted over time to reflect increasingly ambitious climate goals.

Table 7.5: Examples of Credit Scoring, GHG Tax, and Green Bonds Based on GHG Emissions

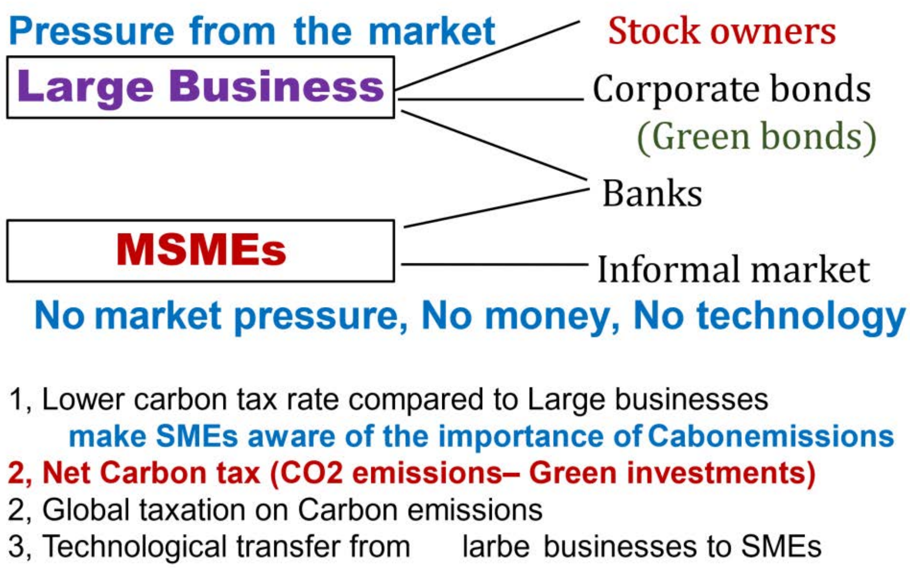
	Country	Company Name	Scope 1 GHG emissions	Emissions per million USD revenue/ sales/ income	Green bond rating	Credit rating	Carbon tax
O&G	**Japan**	Cosmo Oil	7,287	420	C	C	t*7287
		Idemitsu Kosan	13,858	236	B	B	t*13858
		Inpex	6,839	476	C	C	t*6839
	India	Indian Oil Corporation	20,210	179	BB	BB	t*20210
		Bharat Petroleum	10,242	160	BBB	BBB	t*10242
		Hindustan Petroleum	3,342	60	AA	AA	t*3342
	United States	Exxonmobil	92,000	267	C	C	t*92000
		Phillips 66	24,800	168	BBB	BBB	t*24800
		Valero Energy	24,800	171	BB	BB	t*24800
Pharmaceuticals	**Japan**	Daiichi Sankyo Co Ltd	86	11	AAA	AAA	t*86
		Takeda Pharmaceutical Co Ltd	316	12	AAA	AAA	t*316
		Chugai Pharmaceutical Co Ltd	48	7	AAA	AAA	t*48
	India	Sun Pharma	67	13	AAA	AAA	t*67
		Dr Reddy's Lab	302	101	A	A	t*302
		Cipla	38	14	AAA	AAA	t*38
	United States	Johnson & Johnson	320	4	AAA	AAA	t*320
		Eli Lily & Co	182	5	AAA	AAA	t*182
		Merck & Co	1,236	21	AAA	AAA	t*1236
Automotives	**Japan**	Toyota	2,370	10	AAA	AAA	t*2370
		Honda	1,090	10	AAA	AAA	t*1090
		Nissan Motors	661	10	AAA	AAA	t*661
	India	Mahindra and Mahindra	59	6	AAA	AAA	t*59

		Suzuki	420	31	AAA	AAA	t*420
		Tata Motors	60	8	AAA	AAA	t*60
	United States	General Motors	2,700	16	AAA	AAA	t*2700
		Ford	1,108	6	AAA	AAA	t*1108
		Stellantis	1,400	7	AAA	AAA	t*1400

GHG = greenhouse gas.
Source: Author's calculations based on financial and sustainability reports of companies

Small and medium-sized enterprises (SMEs) play a crucial role in global economic activity and consequently in global emissions. According to Organisation for Economic Co-operation and Development studies, SMEs account for more than 50% of CO2 emissions in many countries. However, these businesses often lack the resources and expertise to effectively measure and reduce their emissions. Large businesses face considerable pressure to adhere to environmental standards due to their exposure to financial markets and scrutiny from investors (Figure 7.6).

Figure 7.6: Green Finance Policies for Small and Medium-sized Enterprises



Source:Authors

SMEs issue stocks and bonds, making them susceptible to investor sentiment regarding environmental performance. Moreover, corporate rating agencies exert additional pressure by potentially downgrading credit ratings for businesses that fail to meet environmental standards. Conversely, SMEs face fewer external pressures to reduce their environmental impact. This discrepancy arises from several factors. SMEs often lack the financial resources necessary to invest in CO_2 reduction technologies or practices, and typically do not have the capacity to develop advanced emission-reduction technologies independently. Unlike large businesses, SMEs generally do not issue stocks or corporate bonds, insulating them from investor scrutiny on their environmental performance. Instead, they predominantly rely on borrowing from smaller banks and money lenders.

As a result, SMEs continue to emit CO_2 without significant incentives or capacity to improve their environmental performance. To address this issue, we propose implementing a simplified net carbon tax system for SMEs, starting with very low rates (~0.0001%) to minimize initial financial burden. This will incentivize SMEs to reduce carbon emissions. In addition, government support must be provided for technology transfer from large corporations to SMEs, enabling them to adopt more environmentally friendly practices. This can be achieved by either providing financial incentives to large businesses for technology transfer. or utilizing carbon tax revenues to subsidize the transfer of CO_2 reduction technologies to SMEs. If the subsidies are provided by the government, large businesses will have strong incentives to transfer their technologies to reduce CO_2 emissions. Funds raised through carbon taxes or issuance of sovereign green bonds can be used by the government to finance the transfer of GHG reduction technologies from advanced companies to SMEs. However, these funds cannot be generated through carbon trading (carbon pricing) or carbon credit ratings.

7.7 Small Share of Green Bonds to Total Bond Issuance

The growing focus on green finance has led to discussions about the potential role of central banks in promoting sustainable economic practices. One proposal that has gained attention is for central banks to purchase green bonds as part of their monetary policy operations (Table 7.7).

Table 7.7: Eligible Green Project Categories

	Project Type	**Description**
1	Renewable energy	Including production, transmission, appliances and products
2	Energy efficiency	Such as in new and refurbished buildings, energy storage, district heating, smart grids, appliances and products
3	Pollution prevention and control	Including reduction of air emissions, greenhouse gas control, soil remediation, waste prevention, waste reduction, waste recycling and energy/emission-efficient waste to energy
4	Environmentally sustainable management of living natural resources and land use	Including environmentally sustainable agriculture, environmentally sustainable animal husbandry, climate-smart farm inputs such as biological crop protection or drip-irrigation, environmentally sustainable fishery and aquaculture, environmentally sustainable forestry, including afforestation or reforestation, and preservation or restoration of natural landscapes
5	Terrestrial and aquatic biodiversity conservation	Including the protection of coastal, marine and watershed environments
6	Clean transportation	Such as electric, hybrid, public, rail, non-motorized, multi-modal transportation, infrastructure for clean energy vehicles and reduction of harmful emissions
7	Sustainable water and wastewater management	Including sustainable infrastructure for clean and/or drinking water, wastewater treatment, sustainable urban drainage systems and river training and other forms of flooding mitigation
8	Climate change adaptation	Including efforts to make infrastructure more resilient to impacts of climate change, as well as information support systems, such as climate observation and early warning systems

9	Circular economy adapted products, production technologies and processes and / or certified eco-efficient products	Such as the design and introduction of reusable, recyclable and refurbished materials, components and products; circular tools and services
10	Green buildings	That meet regional, national or internationally recognized standards or certifications for environmental performance

Source:International Capital Market Associations (ICMA)

However, our analysis suggests that this approach may have unintended consequences and potentially overstep the traditional boundaries of monetary policy. Certain countries have started issuing green bonds, but they form a very small percentage of the overall bond market (Table 7.8). We argue that central bank purchases of green bonds could distort market pricing mechanisms and lead to inefficient allocation of capital. This is because these purchases would effectively allocate additional money to specific sectors (green projects), a decision that traditionally falls under the purview of fiscal policy and democratic processes. This could potentially compromise central bank neutrality and independence which are crucial for maintaining price stability and financial system integrity.

Table 7.8: Green Bonds as a Percentage of Overall Bond Market

Country	Green Bond Market as a % of Overall Bond Market
People's Republic of China	1.17%
India	0.3%[9]
Indonesia	2%[10]
Philippines	2%[11]
Thailand	0.3%

Source: Author's calculations based on data from Green FDC, World Bank, Economic Times India, International Finance Corporation, Government of the Philippines, Government of Thailand.

7.8 Comparison of Carbon Finance Instruments: Burdens and Recipients

Table 7.9: Comparison of Carbon Finance Instruments

Carbon credit rating	Carbon tax	Carbon pricing	Private green bonds	Public green bonds
Within private	Collected by government	Within private	Within private	Collected by government
Fund supply -> recipients	Private -> Government	Excess supply -> Lower supply	Private investor -> private issuer	Private investor -> Government

[9] Accounts for sovereign bonds only.
[10] Indicates green bonds as a percentage of overall fixed income issuance.
[11] Accounts for sovereign bonds only.

The distribution of financial burden varies by fund recipient across various carbon finance instruments, including carbon credit ratings, carbon taxation, carbon pricing, and both private and public green bonds.

- Carbon credit ratings impose an indirect financial burden on the private sector through the potential impact on cost of capital and reputation. However, they do not generate direct financial flows.
- Carbon taxes place a direct financial burden on the private sector, with funds collected by the government. This represents a transfer from private entities to the government.
- In carbon pricing systems (such as cap-and-trade), the financial burden is initially borne by the private sector. However, unlike carbon taxes, the funds generally circulate within the private sector as companies trade emission allowances.
- Private green bonds involve a flow of funds from private investors to private issuers. While they create a financial obligation for the issuer, they also provide access to capital for green projects. A lower rating could imply a higher interest burden on the issuer.
- Public green bonds also involve private investors. However, the funds are directed to the government like traditional government bonds. This allows the public sector to finance green initiatives through market mechanisms.

This comparison shows that while all instruments ultimately place the financial burden on the private sector, they differ significantly in how funds are channelled. Carbon taxes and public green bonds direct funds to the government, potentially allowing for broader public investment in climate initiatives. If governments want to pursue their own environmental policies, financing for each policy is needed. Then, carbon taxes and sovereign green bonds could create new government revenue sources. In contrast, carbon pricing and private green bonds keep funds within the private sector, potentially leading to more market-driven solutions.

7.9 Implications for Asia's Policymakers

Companies in Asia face unique challenges in reducing carbon emissions stemming from the region's rapid economic growth, energy-intensive industries, and developmental priorities. First, many Asian economies, particularly in Southeast and South Asia, remain heavily reliant on coal and other fossil fuels for power generation, making the transition to low-carbon alternatives more challenging and costly. Second, a significant portion of industry in Asia comprises energy-intensive sectors like chemical, steel, and cement production, which are difficult to decarbonize (UNESCAP, 2023). Third, a unique challenge is that SMEs often lack the resources necessary for the green transition (UNDP, 2024). Finally, diverse regulatory landscapes across the region create complexities for companies operating across borders. Existing policies have often fallen short of addressing these challenges. Carbon pricing mechanisms, where implemented, have often been set too low or have insufficient coverage to drive significant change (ADB, 2023). Inconsistencies in ESG scoring methods has also led to confusion and potential greenwashing.

The policies proposed in this chapter offer tailored solutions to the unique challenges faced by companies in Asia to reduce carbon emissions. The unified approach based on a net carbon tax addresses the issue of diverse regulatory landscapes across the region, providing a more consistent framework for companies operating across borders. This approach also considers both carbon emissions and companies' green efforts, which is particularly relevant for firms in energy-intensive sectors actively investing in cleaner technologies. A global carbon tax must be introduced for countries which presently lack carbon taxes (such as India and Bangladesh). An

International Monetary Fund study indicates that the average global carbon price must reach $75 a ton by 2030 (IMF, 2021). Carbon taxes are determined by factors such as the carbon content of fuels, the point of application in the economic system, and the intended use of tax revenues. Their effectiveness depends on how they influence fossil fuel demand, promote clean energy adoption, and integrate with broader fiscal and environmental policies. This chapter asserts that the carbon tax must match net zero transition goals over the medium to long term. The standardization of GHG emission measurements can provide clearer signals for investors and policymakers in Asia, reducing confusion and potential greenwashing in the region's rapidly growing green finance market. Importantly, the emphasis on including SMEs in emission reduction efforts addresses a critical gap in existing policies, recognizing the significant role these firms play in Asian economies.

7.10 Conclusion

We have examined the current challenges in ESG investing, particularly regarding environmental scoring, and have proposed a unified approach based on a net carbon tax system. By standardizing the measurement and evaluation of companies' environmental impact, this approach holds the potential to significantly improve the efficiency and effectiveness of green finance initiatives. Unifying the measurement and rating approach across countries also avoids the distortion of production locations and provides consistent signals for investors and policymakers. There are several key findings and recommendations:

- the current ESG scoring system leads to inconsistent evaluations and potentially distorted investment decisions;
- net carbon pricing is a more objective and standardized measure of environmental impact;
- this approach can be aligned with other green finance instruments, such as green bonds and carbon tax mechanisms, to create a more coherent framework for sustainable finance;
- including SMEs in emissions reduction efforts is crucial for comprehensive climate action;
- central banks should be discouraged from issuing or investing in green bond markets; and
- while all instruments ultimately place the financial burden on the private sector, they differ significantly in how funds are channelled. Carbon taxes and sovereign green bonds could help create new government revenues.

By adopting these recommendations, policymakers and financial market participants can create a more effective and transparent system for promoting sustainable economic practices and addressing the urgent challenge of climate change. Ultimately, the transition to a sustainable, low-carbon economy will require coordinated action from governments, financial institutions, businesses, and individuals. The unified approach proposed here aims to provide a clear and consistent framework to guide these efforts and accelerate progress toward our shared environmental goals.

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