ESG Investment, Green bond and SME Geen Policy

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Outline

2024-05-02

1,Climate Change and Transitional Finance

- Green bonds
- Carbon Pricing
- ESG Rating
- Carbon Tax

2, Distortion of Optimal Portfolio Allocation

3, Measurement of CO2 → No distortion

4, Fiscal Policy vs Monetary Policy and Green bonds

Current ESG investment: distort asset allocation

1, Traditional asset allocation :

two-parameter approach

(i) Rate of Return (R), (ii) Risks (σ^2)

2, ESG component is added for the asset allocation

(iii) ESG (Greenness score): multi-factor model

3, ESG criteria is different from one rating agency to another

4, Each Investor changes its' asset allocation based on specific score of ESG given by the rating agency

(1)Rate of return (R)　(2) Risk (σ^2)　(3) ESG

$$\mathrm{U}(R_t, \sigma_t^2, ESG_t) = R_t - \beta\sigma_t^2 + \gamma(ESG_t) \tag{7}$$

$$\text{s.t. } R_t = \alpha_t R_t^A + (1-\alpha_t)R_t^B \tag{8}$$

$$\sigma_t^2 = \alpha_t^2(\sigma_t^A)^2 + (1-\alpha_t)^2(\sigma_t^B)^2 \tag{9}$$

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

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

$$\frac{\partial U}{\partial \alpha_t} = (R_t^A - R_t^B) - \beta\{2\alpha_t(\sigma_t^A)^2 + 2(1-\alpha_t)(\sigma_t^B)^2\}$$

$$+ (2 - 4\alpha_t)\sigma_t^{AB} + \gamma(ESG_t^A - ESG_t^B) = 0 \qquad (6)$$

Writing equation (6) for the results in equation (7):

$$\alpha_t = \frac{\frac{1}{2\beta}(R_t^A - R_t^B) - (\sigma_t^B)^2 - \sigma_t^{AB} + \frac{\gamma}{2\beta}(ESG_t^A - ESG_t^B)}{(\sigma_t^A)^2 - (\sigma_t^B)^2 - 2\sigma_t^{AB}} \qquad (7)$$

Different Evaluation score of ESG by various Rating Agencies

E-scores

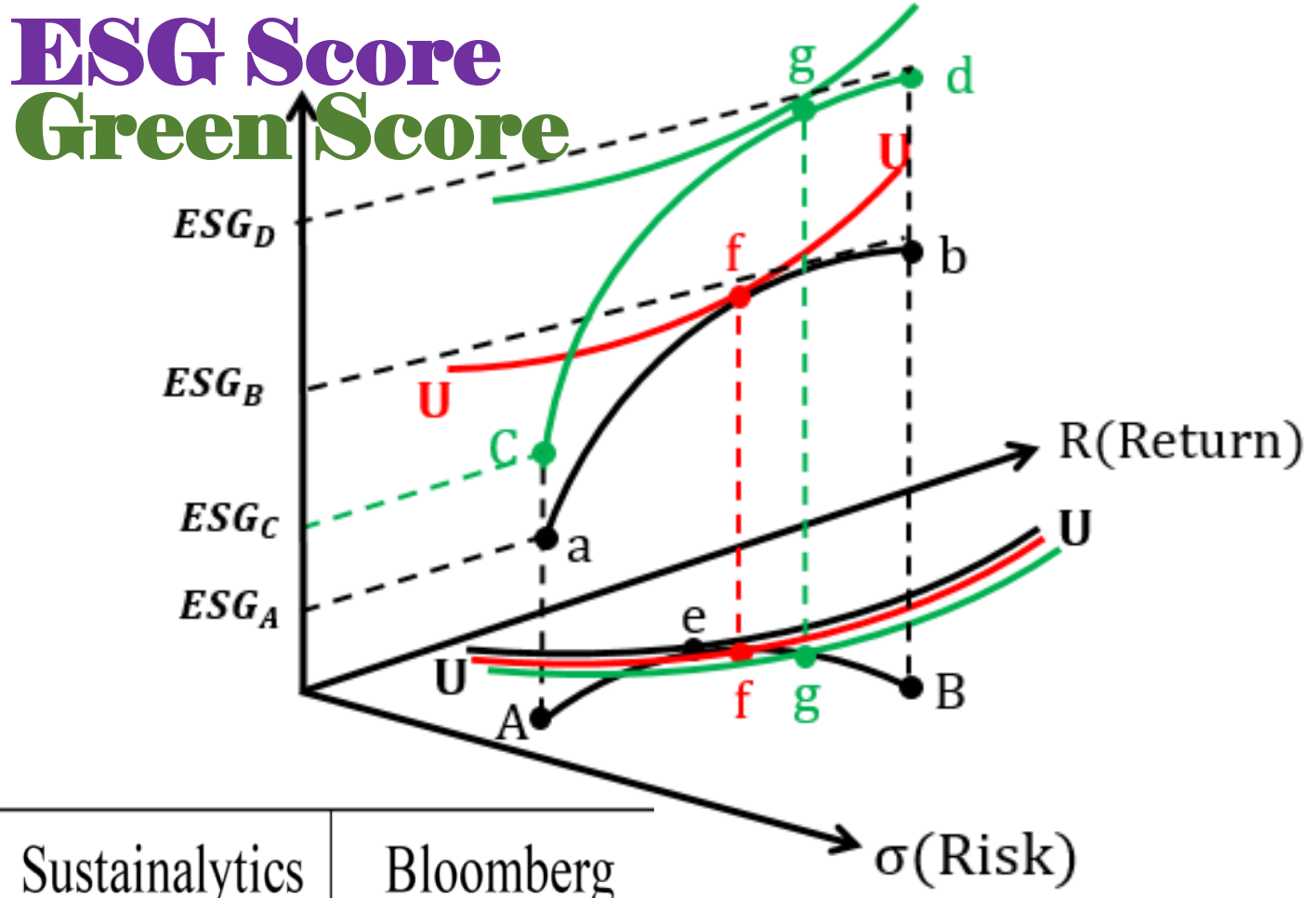
Environment

Table 1: Rating methods provided by major ESG 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.

(Source) Created by the authors after processing part of the data of Yoshino and Yuyama (2021), Yuyama (2020), and each rating agency.

Different ESG scores by different Rating agencies



ESG Score	RobecoSAM	Sustainalytics	Bloomberg
ESG score of company A	8.6	9.6	2.9
ESG score of company B	1.8	1.3	3.9
Value of α **Asset Allocation**	0.71	0.74	0.54

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

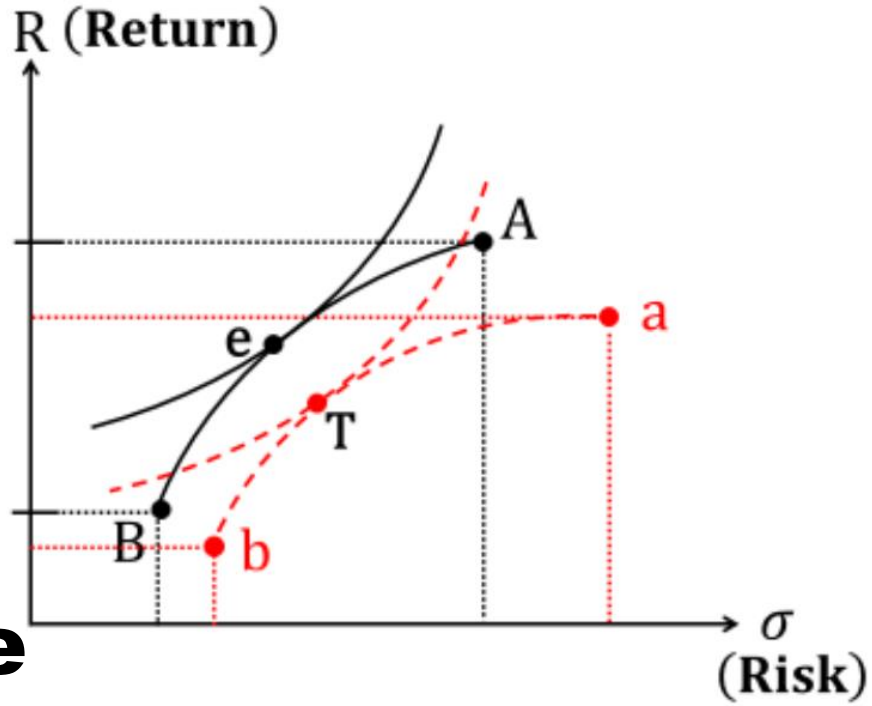
	Dependent variable : Stock volatility 2021						
	ESG score						
	bld2021	ble2021	bls2021	blg2021	blep2021	blsp2021	blgp2021
ESG score	-6.984*	-3.473	-4.302	-6.426	-3.192	-1.689	-2.223
	(0.074)	(0.115)	(0.269)	(0.124)	(0.102)	(0.361)	(0.252)
Control variabls							
Total asset	0.000	0.000	0.000	0.000	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

Net Carbon Tax

= Carbon -- Greenness Efforts

TAX (planting trees)

(setting up solar power)



Optimal portfolio allocation can be achieved by taxing on carbon emission

Company A's return after carbon tax: $\underline{R_A} = R_A - (\text{Carbon Tax TA})$

Risks After Carbon Tax: $\underline{\sigma}_A$

Company B's return after carbon tax: $\underline{R_B} = R_B - (\text{Carbon Tax TB})$

Risk After Carbon Tax: $\underline{\sigma}_B$

$$\tilde{R}_t^A = R_t^A - T_t^A \tag{11}$$

$$\tilde{R}_t^B = R_t^B - T_t^B \tag{12}$$

Equations (11) and (12) show the "after-tax rate of return" of company A and company B. The optimal allocation of assets between company A and B is computed as equations (13) and (14) that show the optimal rate of return and risk, respectively:

$$\tilde{R}_t = \tilde{\alpha}_t \tilde{R}_t^A + (1 - \tilde{\alpha}_t)\tilde{R}_t^B \tag{13}$$

$$\tilde{\sigma}_t^2 = \tilde{\alpha}_t^2 (\tilde{\sigma}_t^A)^2 + (1 - \tilde{\alpha}_t)^2 (\tilde{\sigma}_t^B)^2 + 2\tilde{\alpha}_t (1 - \tilde{\alpha}_t)\tilde{\sigma}_t^{AB} \tag{14}$$

Next, to find the optimal portfolio allocation ratio between asset A and asset B, we obtain the first-order condition of the utility function for $\tilde{\alpha}$:

$$\frac{\partial U}{\partial \tilde{\alpha}_t} = (\tilde{R}_t^A - \tilde{R}_t^B) - \beta\{2\tilde{\alpha}_t (\tilde{\sigma}_t^A)^2 + 2(1 - \tilde{\alpha}_t)(\tilde{\sigma}_t^B)^2\} + (2 - 4\tilde{\alpha}_t)\tilde{\sigma}_t^{AB} = 0 \tag{15}$$

$$\tilde{\alpha}_t = \frac{\frac{1}{2\beta}\left(\tilde{R}_t^A - \tilde{R}_t^B\right) - (\tilde{\sigma}_t^B)^2 - \tilde{\sigma}_t^{AB}}{(\tilde{\sigma}_t^A)^2 - (\tilde{\sigma}_t^B)^2 - 2\tilde{\sigma}_t^{AB}} \tag{16}$$

Evidently, as in equation (16), investors do not need to consider ESG as an additional item, as shown in equation (7). Instead, investors maximize their utility based only on the rate of return and the risk after tax. The optimal portfolio allocation is as shown in equation (16). $\tilde{\alpha}_t$ indicates the optimal portfolio as shown in Figure 3.5 by point *f*. *f* is the optimal point after the adoption of the international GHG taxation scheme.

Current Carbon Tax wide variety (Source: World Bank 2023)

Iceland
The Icelandic carbon tax was increased on January 1, 2023, to match the expected inflation rate (7.7%).

Indonesia
On February 22, 2023, the Ministry of Energy and Mineral Resources (MEMR) announced the launch of a mandatory, intensity-based ETS for the power sector. The system will initially cover 99 coal-fired power plants that account for 81.4% of the country's national power generation capacity. MEMR expects to see a reduction of 500,000 tCO_2 in the sector through the ETS over the course of 2023.

Japan
In February 2022, the government announced the upcoming Green Transformation (GX) League, a baseline-and-credit system for companies expected to become fully operational in April 2023. This will build upon existing carbon trading systems such as the Joint Crediting Mechanism and J-Credit scheme. Although participation in the GX League is voluntary, compliance once formally a participant is mandatory.

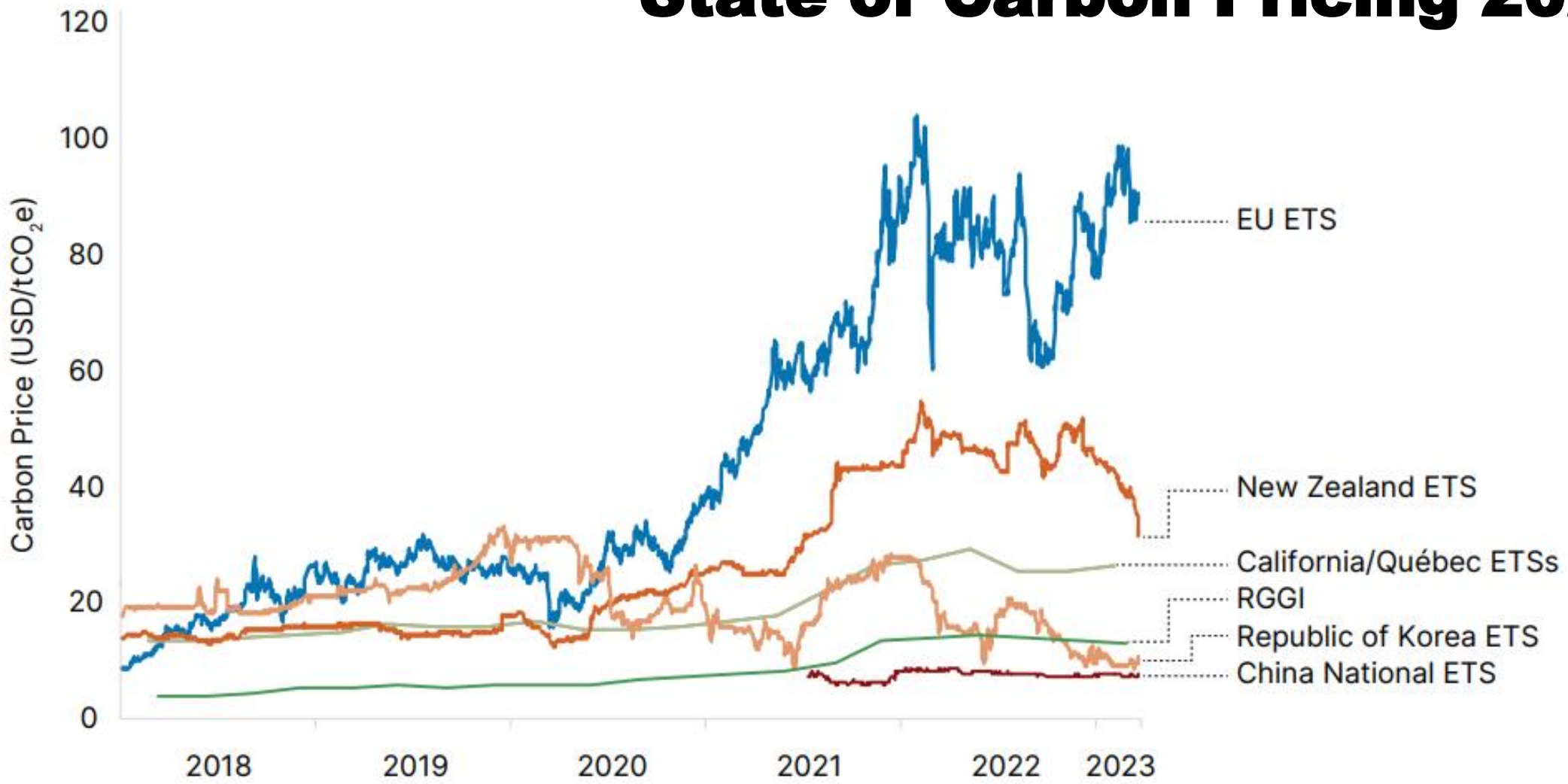
Norway
Norway increased the rates of its carbon tax by 28% for most fossil fuels in 2022 and 21% in 2023. Norway also introduced a tax on waste incineration at the rate of NOK 192 (USD 18.32)/tCO_2, as well as on natural gas and liquified petroleum gas used in greenhouses, which were previously exempt from the carbon tax, at the rate of NOK 77 (USD 7.34)/tCO_2 in 2022. The tax rate on waste incineration was increased and differentiated in 2023.

Portugal
The carbon tax rate was frozen at 2021 levels in response to extremely high energy prices. The price changes planned for the start of 2022 were delayed through the end of March 2023.

Republic of Korea
In November 2022, the government announced several near-term changes to the Korean ETS. These include increasing incentives to reduce emissions and facilitate low-carbon investment by issuing more free allowances to the most efficient covered entities; encouraging trading and mitigating price volatility by opening up the ETS to more financial firms and increasing the allowance holding limit; facilitating the conversion of international offset credits to Korean Credit Units; strengthening MRV; and increasing support for small businesses and new entrants.

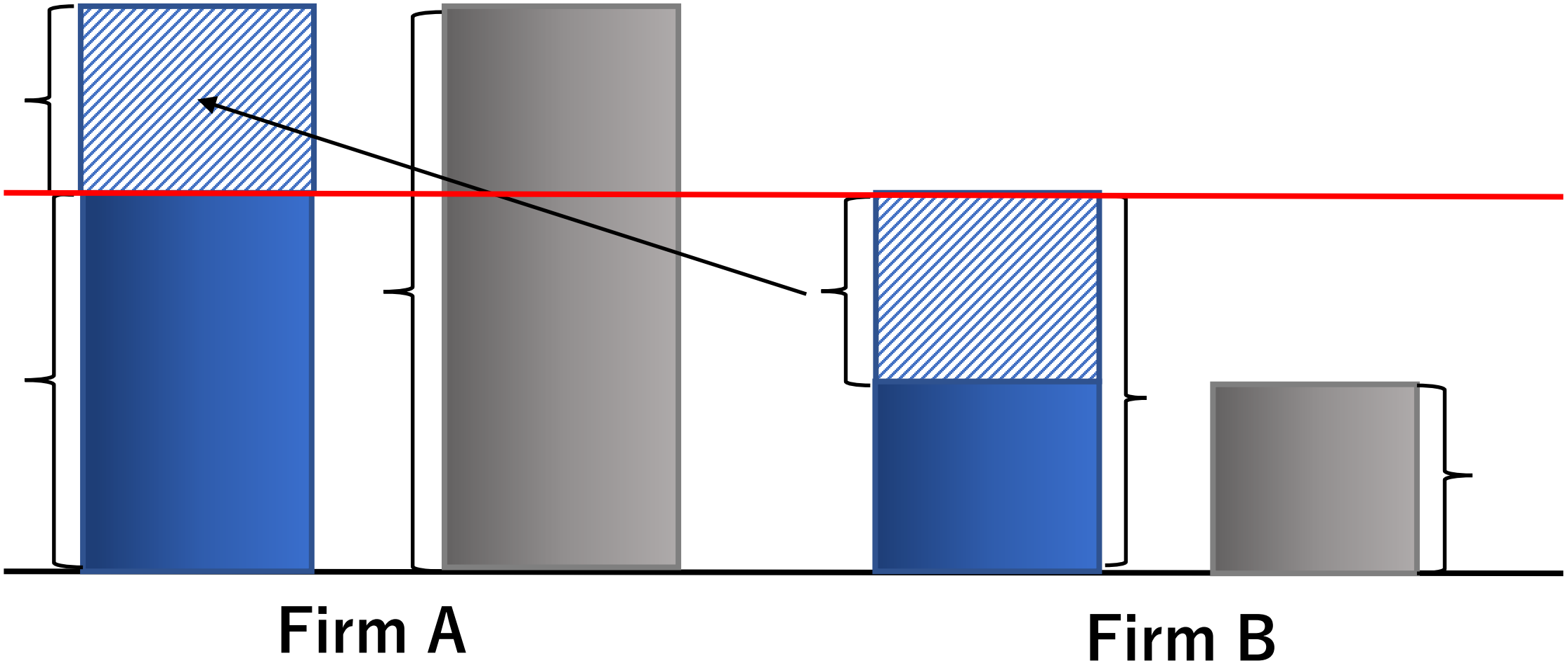
(Source) World Bank: State of Carbon Pricing 2023

FIGURE 1
PRICE EVOLUTION IN SELECTED ETSs FROM 2018 TO 2023



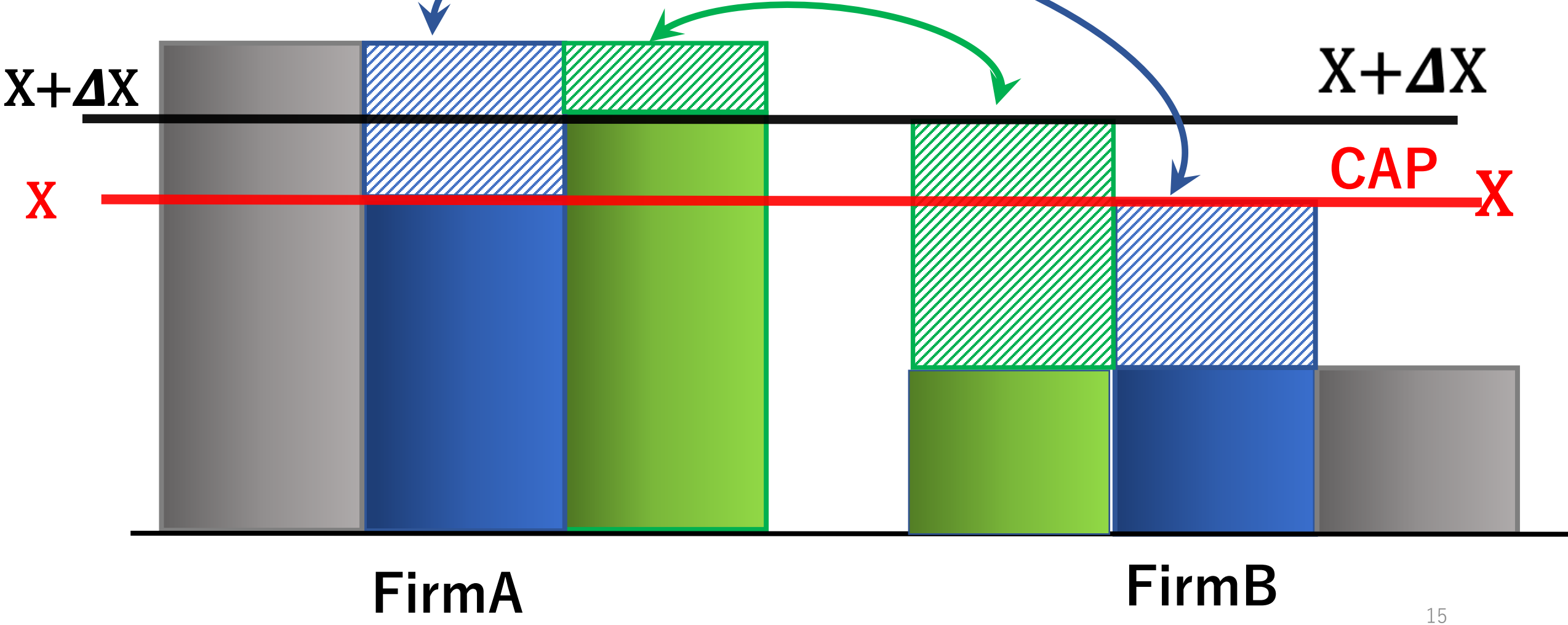
Note: Based on data from ICAP Allowance Price Explorer. Prices for the RGGI initiative and for California and Québec CaT, come from the primary market, whereas for the other systems the prices reflect the secondary market

Carbon Trading and Carbon Pricing



Carbon Pricing
Carbon Trading

$$P^{X}=(d_0-s_0)/(d_1+s_1)$$
$$P^{\Delta X}=(d_0-s_0-2\Delta X)/(d_1+s_1)$$



June 2018

Green Bond Principles

Voluntary Process Guidelines for Issuing Green Bonds

International Capital Market Association

ICMA Paris Representative Office

62 rue la Boétie

75008 Paris

France

Tel: +33 1 70 17 64 70

greenbonds@icmagroup.org

Green Bond Principles (GBP) 2018

(i) renewable energy
(ii) energy efficiency
(iii) pollution prevention and control
(iv) environmentally sustainable management of living natural resources and land use
(v) terrestrial and aquatic biodiversity conservation
(vi) clean transportation
(vii) sustainable water and wastewater management
(viii) climate change adaptation
(iX) eco-efficient and/or circular economy adapted products, production technologies and processes
(X) green buildings which meet regional, national or internationally recognized standards or certifications.

Green Bond Ratings have to be based on GHG emissions

Source: The Green Bond Principles: Voluntary Process Guidelines for Issuing Green Bonds, ICMA, June 2018

Green Credit Rating	Carbon Tax	Green Bond	Carbon Pricing
$\theta \times \{0.8(CO_2) + 0.2(N_2O)\}$	$t \times \{0.8(CO_2) + 0.2(N_2O)\}$	$\theta \times \{0.8(CO_2) + 0.2(N_2O)\}$	$P = \frac{(d_0 - S_0) - 2\Delta X}{(d_1 + S_1)}$ $P = \{0.8(CO_2) + 0.2(N_2O)\}$

Measure: Amount of CO_2 and N_2O Emissions

$0.8x(CO_2)+0.2x(N_2O)$

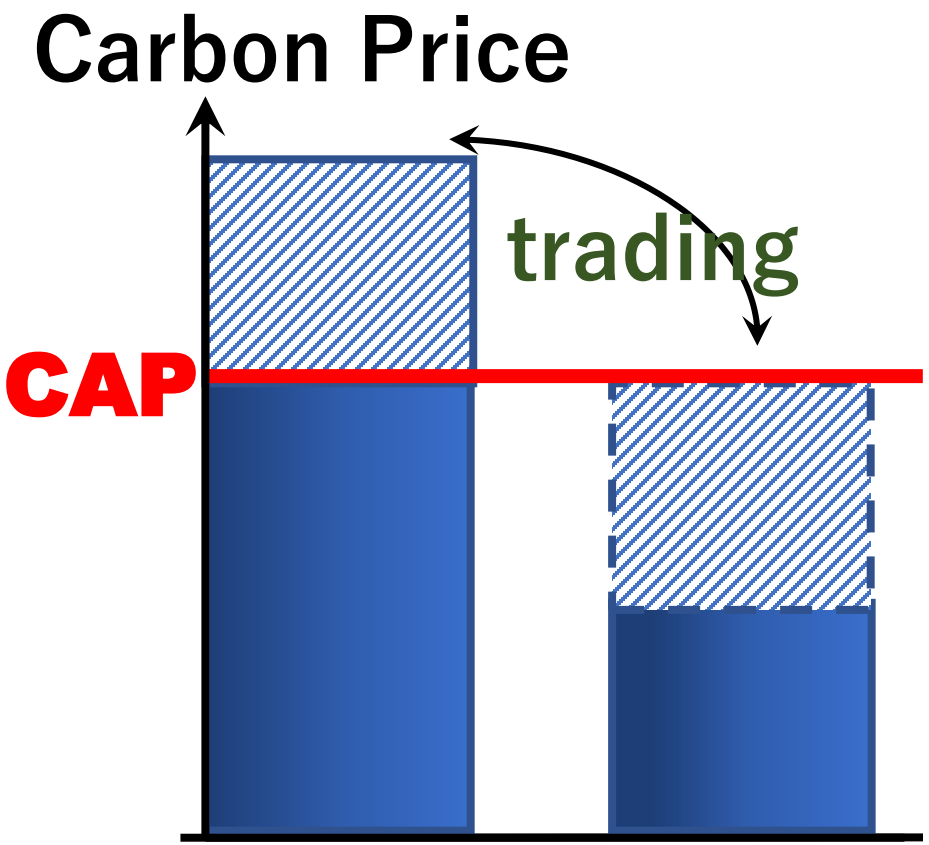
80% **20%**

Examples of Credit Scoring, GHG Tax and Green Bonds based on GHG emissions

Green Credit Rating	CO_2 Emission	N_2O Emission	Green Credit Rating	GHG Tax	Green Bond Scoring
AAA	0.0	0.0	0.0	0.0	0.0
AA	2.1	1.5	1.98	1.98	1.98
A	4.2	3.2	4.00	4.00	4.00
BBB	7.0	6.4	6.88	6.88	6.88
BB	8.3	7.0	8.04	8.04	8.04
B	9.1	8.7	9.02	9.02	9.02
C Global Warming	10.0 Weight 80%	10.0 Weight 20%	10.0 Based on GHG	10.0 0.8tax(CO_2)+ 0.2tax(N_2O)	10.0 Based on GHG

1,Carbon Trading & Carbon Pricing

$P=(d_0-s_0-2\Delta X)/(d_1+s_1)$



2, Carbon Credit Rating

Rating	CO_2 Emission Credit Scoring
AAA	0.0
AA	2.1
A	4.2
BBB	7.0
BB	8.3
B	9.1
C	10.0

3,Carbon Tax

$t \times CO_2$

t=tax rate

4,Green Bonds

Transition to Net Zero

CAP: adjustment

Scoring:adjusted

TaxRate:adjusted

All the schools at Yokohama City (West of Tokyo)

Primary Schools and Secondary Schools measure CO2 Emissions

June 2018

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Voluntary Process Guidelines for Issuing Green Bonds

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(viii) climate change adaptation
(iX) eco-efficient and/or circular economy adapted products, production technologies and processes
(X) green buildings which meet regional, national or internationally recognized standards or certifications.

Credit Rating has to be based on CO2 emissions

Source: The Green Bond Principles: Voluntary Process Guidelines for Issuing Green Bonds, ICMA, June 2018

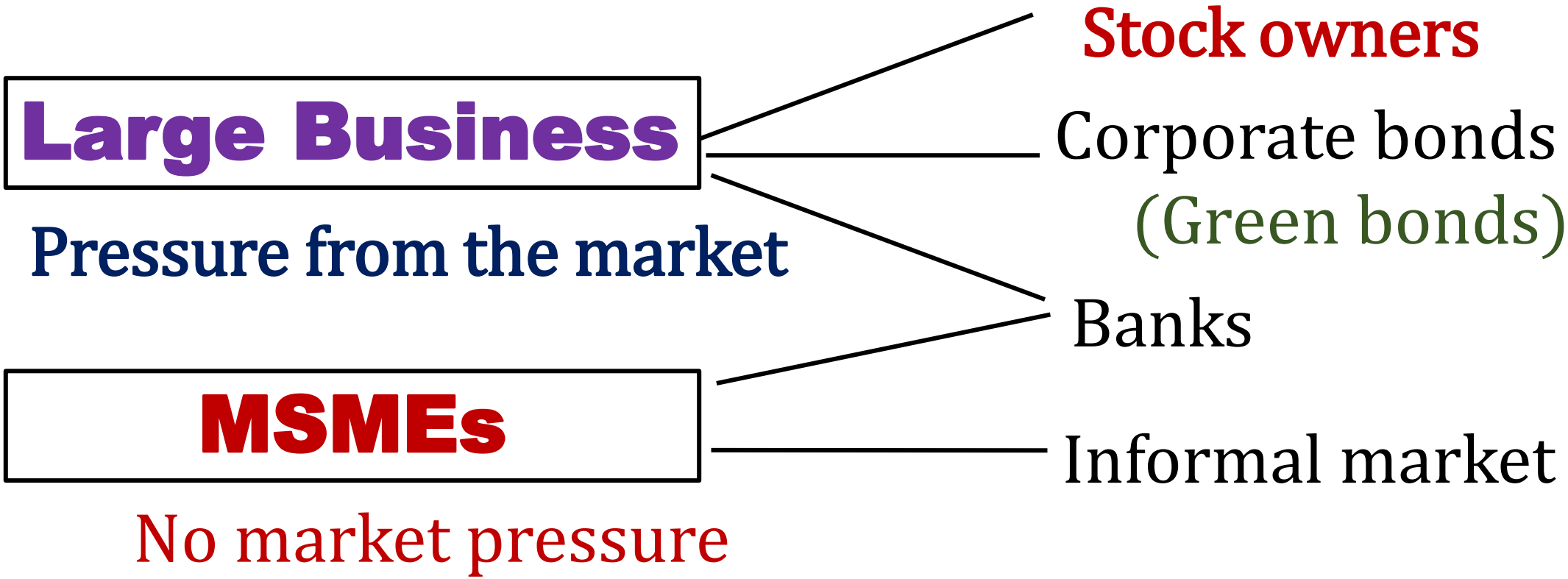
Green Banking

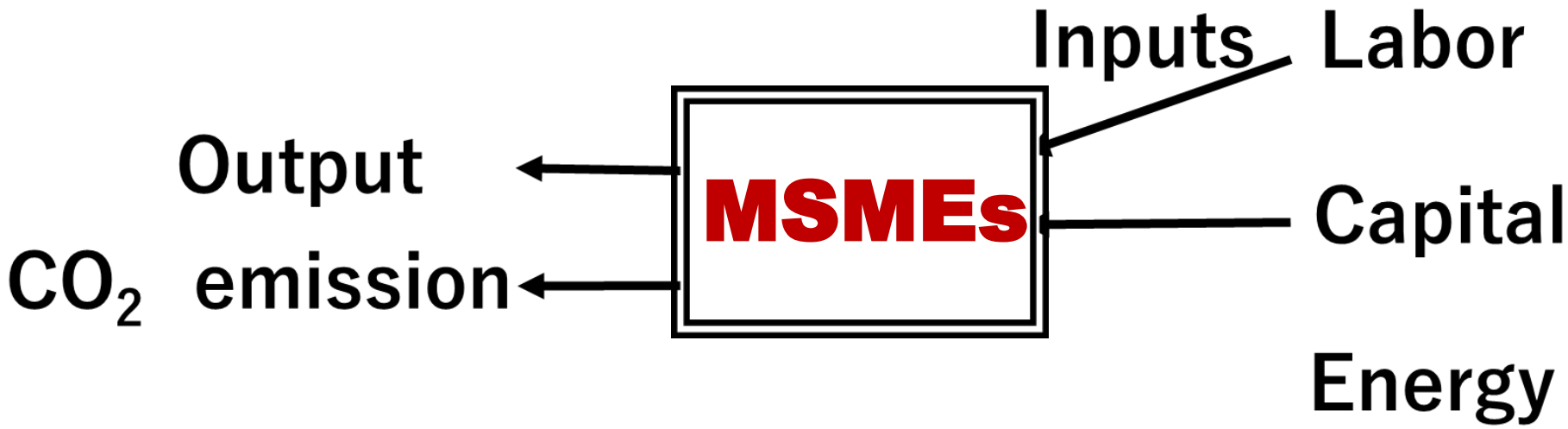
Banks are encouraged to change their credit based on Green scores

Current Green scores are diversified

Distortion of bank lending will lead to undesired economic growth

Net Carbon Tax will lead to banks in optimal credit allocation


Large Business
Stock owners
Corporate bonds
(Green bonds)
Banks
Pressure from the market
MSMEs
Informal market
No market pressure


Inputs
Labor
Capital
Energy
MSMEs
Output
CO_2 emission

Green Central Banking (Independence??)

①Central Bank

Gold Ordinary Government Bond Green Bond	Monetary Base

②Central Bank

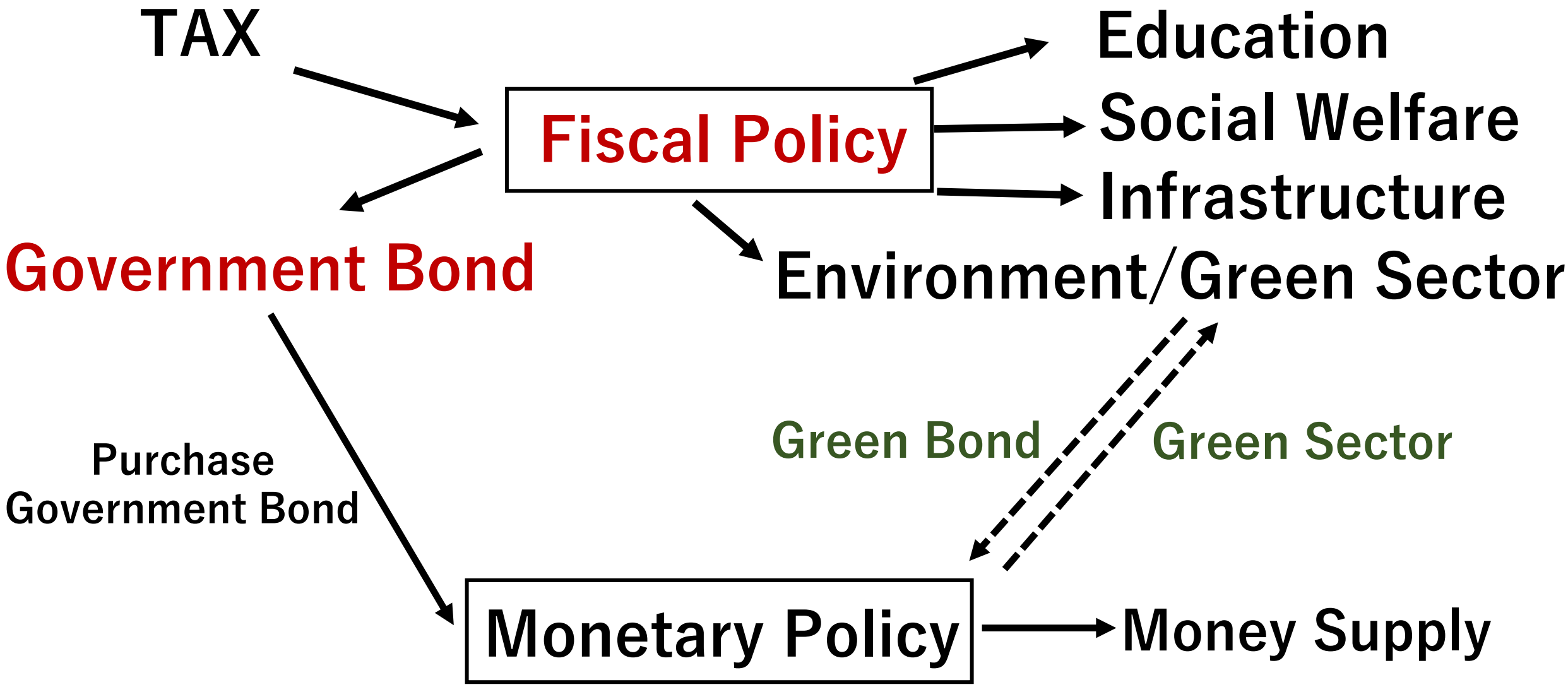
Gold **Ordinary Government Bond**	**Monetary Base**

Marvin King

Fiscal Policy

Tax Revenues
Government Bond
→ G →
Education
Infrastructure
Green Sector

2023.2.2


TAX
Fiscal Policy
Education
Social Welfare
Infrastructure
Environment/Green Sector
Government Bond
Purchase
Government Bond
Green Bond
Green Sector
Monetary Policy
Money Supply

Transmission Channel of Purchase of Green Bond

(1) $\Delta B_{green} \uparrow \Longrightarrow \overline{\Delta M_T} \Longrightarrow \Delta B_G \downarrow$

(2) $G_{green} \uparrow \Longrightarrow G_{other} \downarrow$

Low Interest rate loans by the central bank to Green sector
-→ Distortion

Sustainable Development

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SPRINGER REFERENCE

Jeffrey D. Sachs · Wing Thye Woo
Naoyuki Yoshino
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Handbook of Green Finance

Asian Economic Papers: MIT Press, 2023, Vol.22, No3. PP.81-96
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Diversified ESG Evaluation by Rating Agencies and Net Carbon Tax to Regain Optimal Portfolio Allocation*

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Covid-19 and Optimal Portfolio Selection for Investment in Sustainable Development Goals

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ESG/Green Investment and Allocation of Portfolio Assets[1]

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