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Determinants for Korean companies' carbon-oriented management responding to the emission trading scheme

IGES
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Institute for Global Environmental Strategies (IGES)

IGES is an international research institute conducting practical and innovative research for realising sustainable development and achieving a new paradigm for civilization both in the Asia-Pacific region and globally.

Its interdisciplinary research activities cover a wide range of areas such as climate change, natural resources management, sustainable consumption and production, and green economy in cooperation with international research institutes and stakeholders.

The Institute was established in 1998 with support from the Japanese.

IGES headquarters（Hayama, Kanagawa）

IGES and its Global Network

Policies toward Low Carbon Technologies Diffusion (2013-2016)

FY2016

1. Preliminary research on linking Korea-Japan carbon market
2. **Korean companies' ETS responses, and carbon management status and determinants**
3. Effectiveness and determinants of GHG reduction and investment under the Emission Trading System in Korea

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1. Introduction
2. Study purpose
3. Research method and materials
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1. Introduction

- **Climate change** and the need to reduce greenhouse gas (GHG) emissions have emerged as the defining challenges facing the world in this Century.
- **Carbon pricing** using market mechanisms, i.e. **carbon tax and emission trading scheme** has been focused as its cost-effectiveness of abatement CO_2 reduction.
- Under this policy shift, it is not just governments demanding change, but **industry** at large.
- Companies are required to develop a **carbon management strategy** that will prepare them to comply with policy transition and increase competitiveness.

- **Carbon strategy** refers to a systematic plan of action for managing carbon emissions related to production process and distribution activities.
- It also requires companies to implement business strategies utilizing their **carbon asset** for linking the economic (monetary) value and activities comprising a potentially radical innovation character.
- There are several literatures that reviews companies' response and strategies to the market mechanisms and identifies the challenges, determinant factors.
- However, in the existing studies, the activities of companies responding to the market mechanisms are limited to the existing **energy and environmental management.**

2. Study purpose

- To define carbon oriented-management as differentiated from energy and environmental management,
- To categorise its development stages and related activities,

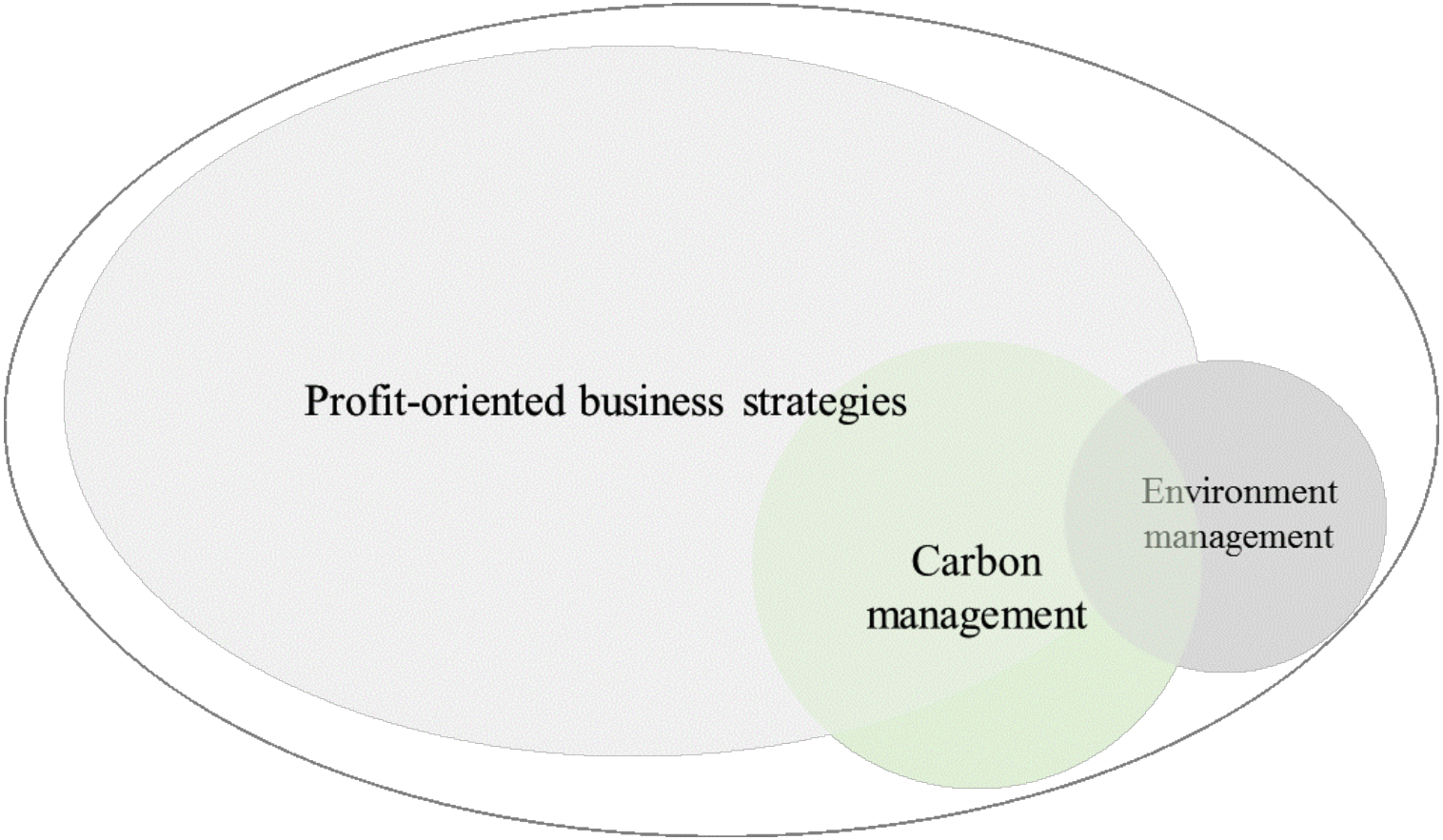
and based on such categorisation,

- To diagnose the status of Korean companies' carbon-oriented management and
- To identify the factors determining companies' proactive response.

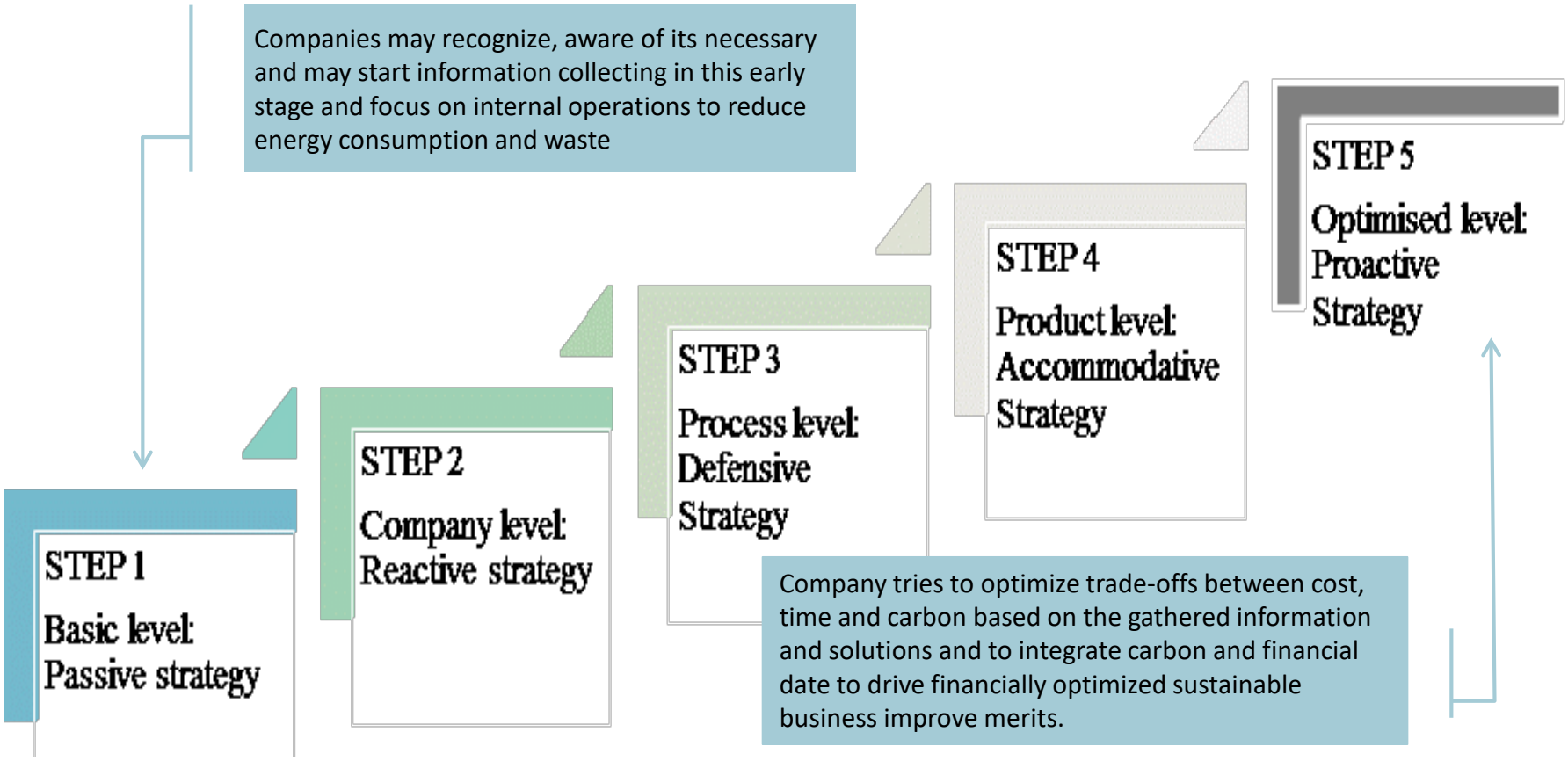
3. Research method and materials

As empirical approach, a questionnaire surveys targeting mainly energy intensive industries designated by the ETS was implemented in February 2017.

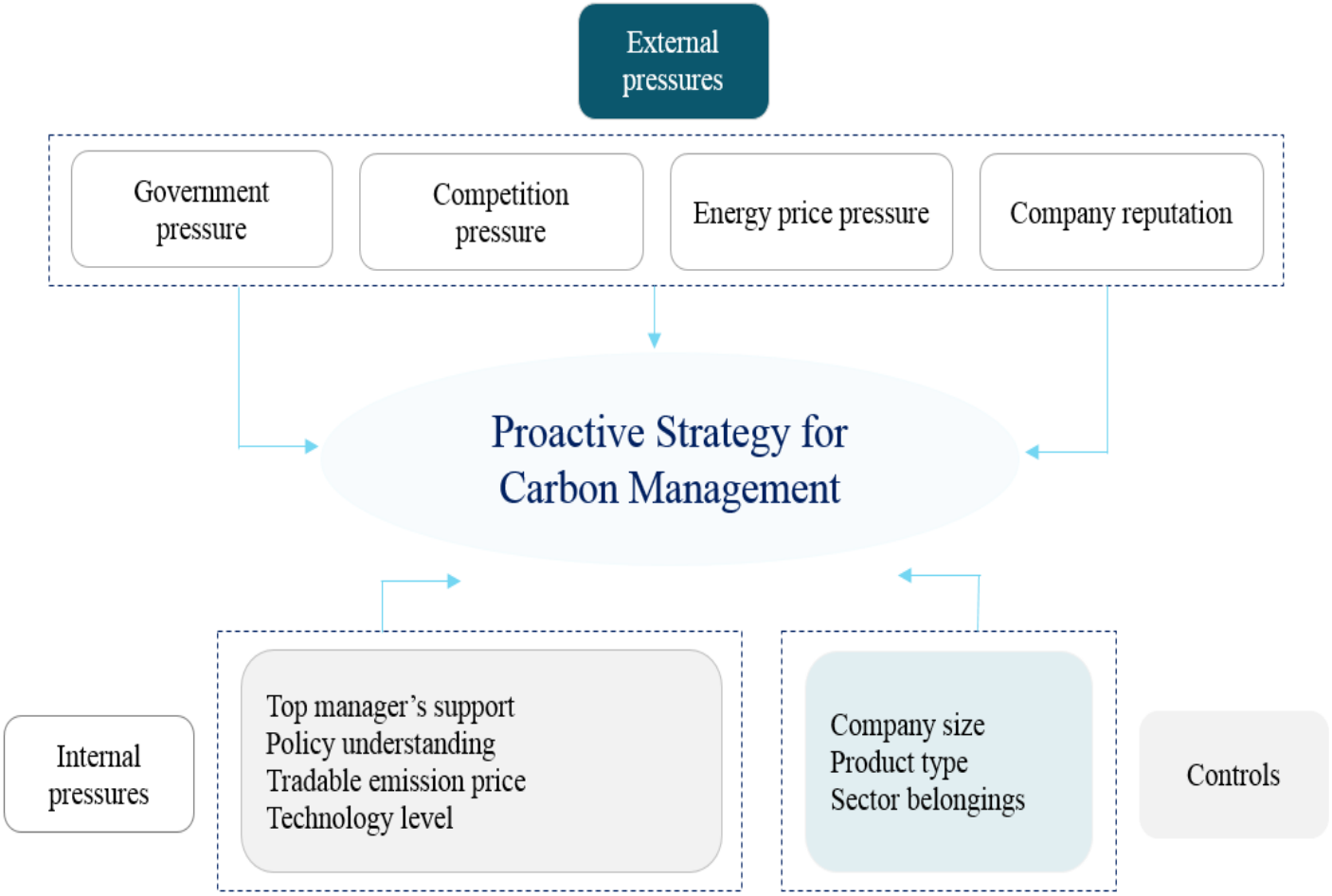
3.1 Companies' sustainable management and carbon management



3.2 STEPs of carbon management defined in this study



3.3 Analytical framework



3.4 Variables: Dependent variable

Item		Carbon Management Activities	Valuation	
			0	1
STEP 1	CMA01	Collecting information on policy related to energy savings and GHG emission reduction		
	CMA02	In-house training program for energy saving and GHG emission reduction in place		
	CMA03	Encouraging daily energy saving activities in office (turning off lights)		
	CMA04	Participating in training programs for energy saving and GHG emission reduction hold by the government/local government		
STEP 2	CMA05	Short & long-term targets for energy savings and GHG emission reduction in place		
	CMA06	Conducting analysis on energy use and GHG emissions to identify potential areas for energy savings and emission reduction		
	CMA07	Making investment to improve production process for energy savings and emission reduction		
	CMA08	Enhancing daily facility maintenance for energy saving and GHG emission reduction		
STEP 3	CMA09	Internal guidance for energy savings and GHG emission reduction management in place		
	CMA10	Establishing a unit or department		
	CMA11	Purchase new production facilities to save energy and reduce GHG emissions		
	CMA12	Installing monitoring equipment on energy consumed facilities		
STEP 4	CMA13	Enhancing optimization in transporting materials and goods		
	CMA14	Making adjustment on energy mix to use more clean energy sources		
	CMA15	Releasing sustainable reports regularly that contain data for energy consumption and GHG emissions		
	CMA16	Set up a strategic carbon management (plan-do-check-act)		
STEP 5	CMA17	Setting up a plan and allocating budget for purchasing permits and trading		
	CMA18	Establishing decision making process in relation to carbon trading (e.g., purchase, sell, price projection etc.)		
	CMA19	Establishing carbon management strategy based on regular analysis on carbon market		
	CMA20	Adopting a green or carbon management accounting system		

International Organization for Standardization (ISO)
ISO 14064
ISO 14064-1, ISO 14064-2
ISO 14067
ISO 14040/14044

Independent variable and controls

Variable		Description and abbreviation of the proxy
Independent variables		
External pressures	Government pressure	Strength of governmental requirements for carbon management (GOVERNMENT)
	Competitor pressure	Energy management level of competitors (COMPETITOR)
	Energy price pressure	
	Company reputation	(REPUTATION)
Internal factors	Top manager' support	Top manager's support to carbon management activities (TOPSUPPROT)
	Policy understanding	(UNDERSTANDING)
	Tradable credit price	(CREDITPRICE)
	Technology level	(TECHLEVEL)
Control variables		
Characteristics of the firm		Firm's size (SIZE)
		Industrial sector belongings (SECTOR)
		Production type (PRODUCT)

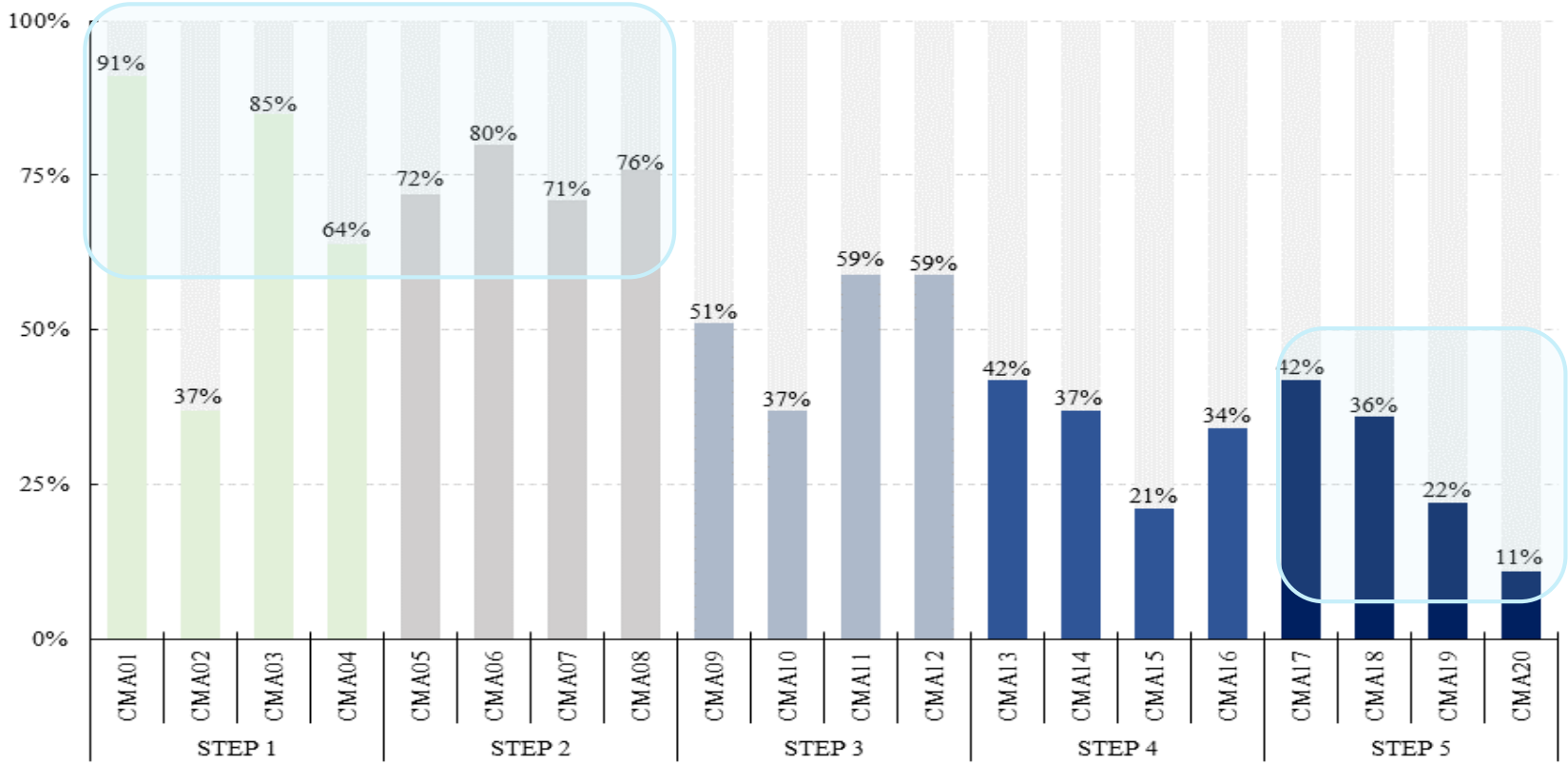
3.5 Questionnaire survey and samples

Classification criteria		Number of respondents	Percentage (%)
Sector	Petrochemical	16	**16**
	Cement	6	**6**
	Steel & iron	14	**14**
	Paper	11	**11**
	Non-ferrous	10	**10**
	Machinery	5	**5**
	Refining	2	**2**
	Electronics	7	**7**
	Others	29	**29**
ETS	Targeted	83	**83**
	Non-targeted	17	**17**
Size	Large	6	**6**
	L-medium	36	**36**
	Medium	35	**35**
	Small	23	**23**
In total		**100**	**100.0**

4. Survey results and discussion

4.1 Korean companies' carbon management status
4.2 Statistics of the independent and control variables
    4.2.1 Companies' tradable price of emission credit in the market
4.3 Determinant factors for Korean companies' carbon management
4.4 Statistics of the supplementary survey questions
    4.4.1 Companies' evaluation of the impact of carbon management to business
    4.4.2 Difficulties for promoting carbon management
    4.4.3 Supportive policy for carbon management

4.1 Korean companies' carbon management status



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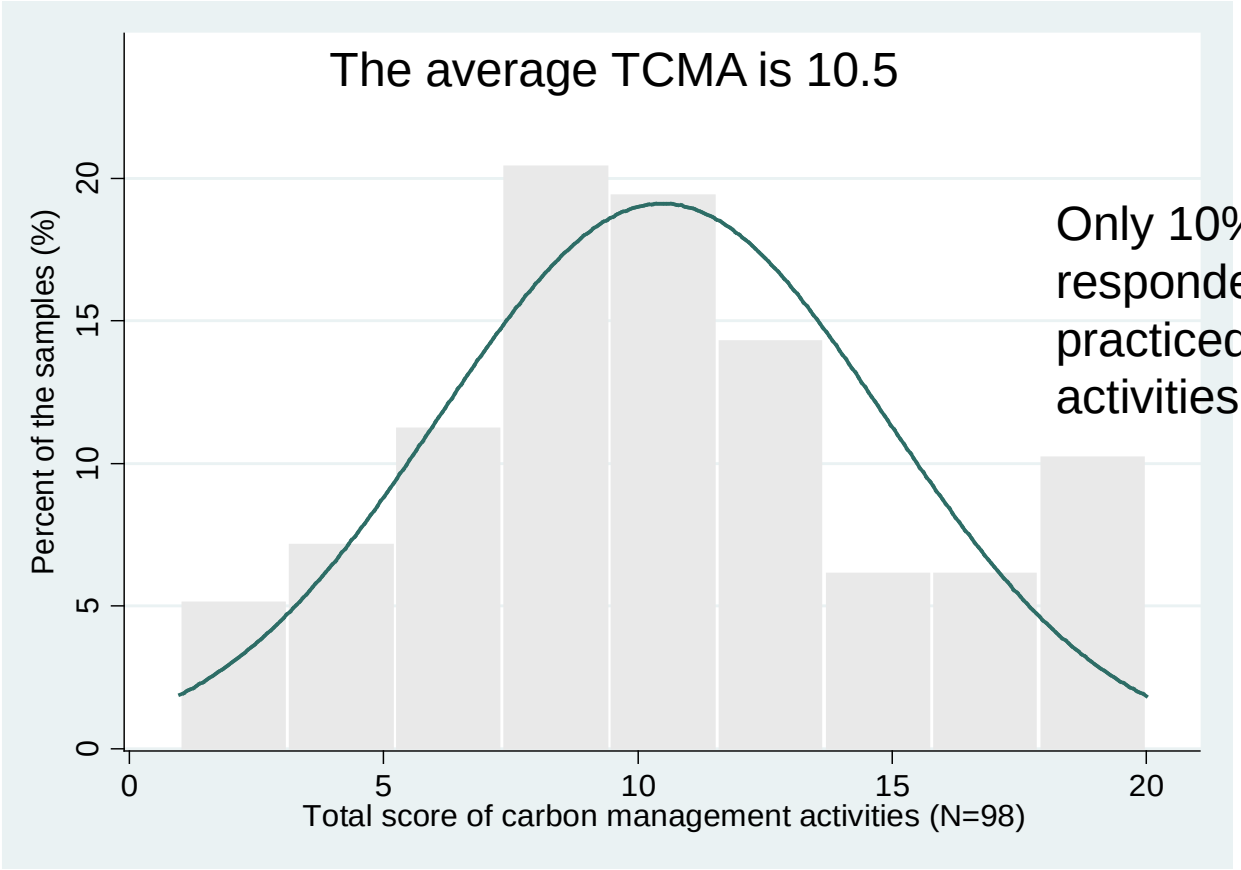


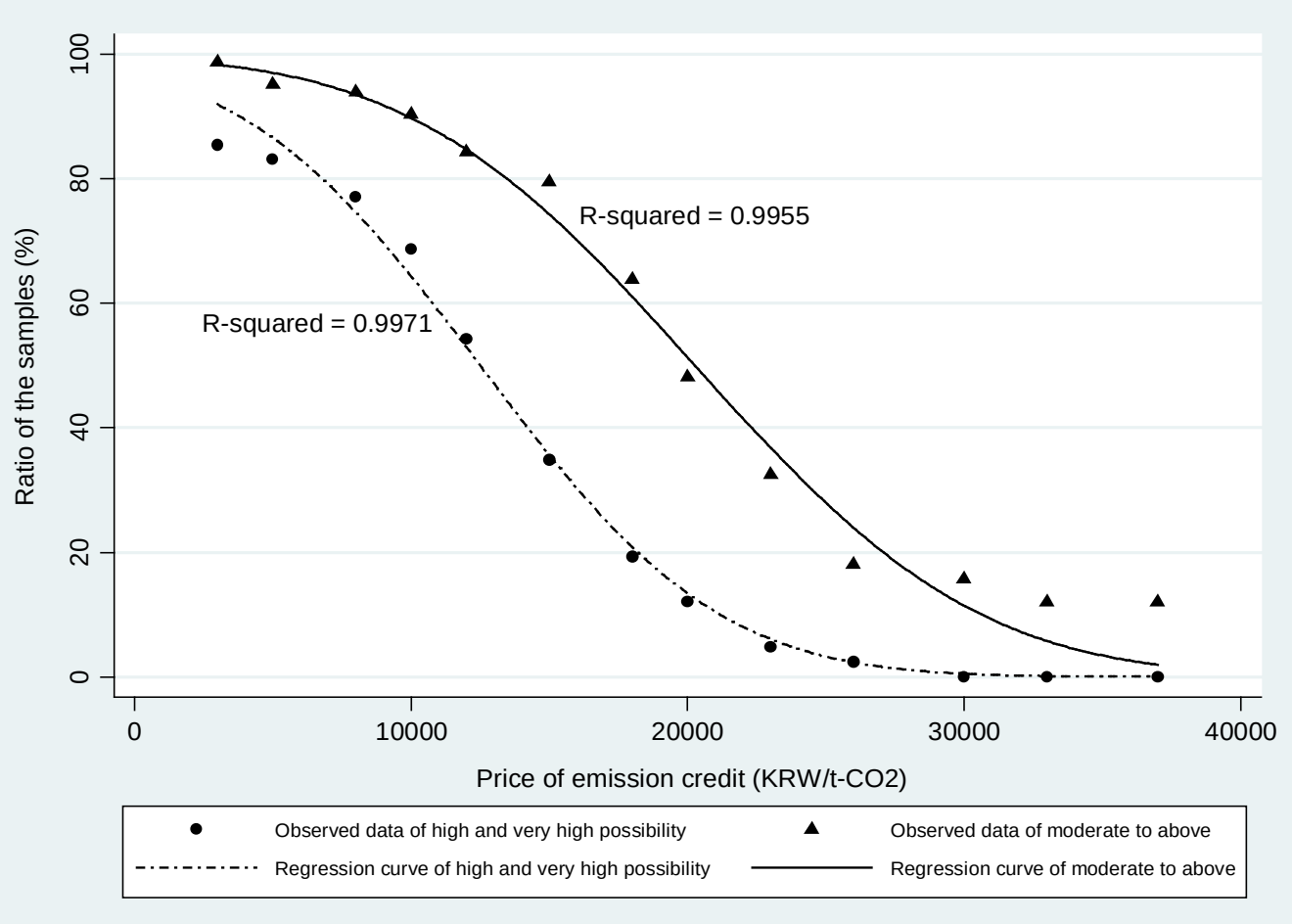
Distribution of overall scores of carbon management activities (n=100)

4.2 Statistics of the independent and control variables

Variable		Obs.	Mean	Std. Dev.	Min.	Max	Skewness coefficient	Kurtosis coefficient
Independent	GOVERNMENT	100	3.77	0.709	2	5	-0.97	2.51
	COMPETITION	100	3.86	0.853	2	5	-0.49	2.23
	ENERGY_PRICE	99	3.71	0.693	2	5	-1.26	2.79
	REPUTATION	99	3.62	0.681	1	9	2.32	4.41
	TOP_SUPPORT	100	3.44	0.891	1	5	-1.89	2.90
	UNDERSTANDING	100	3.52	0.915	2	5	-1.57	2.15
	CREDIT PRICE	73	16905.78	5907.634	3000	33184.97	-2.76	6.94
	TECH_LEVEL	100	2.50	0.718	1	4	-2.09	2.68

4.2.1 Companies' tradable price of emission credit in the market

The range of the emission price on the part of 50% of the samples corresponds to about 12,500~20,000 KRW (11.2~17.6USD)/t-CO_2



4.3 Determinant factors for Korean companies' carbon management

Variables			STEP1			STEP 2			STEP 3		
			Model1	Model2	Model3	Model1	Model2	Model3	Model1	Model2	Model3
External pressure		GOVERNMENT	-0.351	-0.438	-0.646	-0.675 [b]	-0.713 [b]	-0.632	-0.510	-0.491	-0.803
		COMPETITION	0.277	0.244	0.618	0.012	-0.004	-0.039	0.137	0.187	-0.243
		ENERGY_PRICE	-0.094	-0.091	0.177	-0.442	-0.451	-0.422	-1.012 [a]	-1.056 [a]	-1.160
		REPUTATION	-0.050	0.013	0.166	0.202	0.148	0.165	0.135	0.098	-0.828
Internal factors		TOP_SUPPORT	0.604 [b]	0.667 [b]	0.645	0.953 [a]	0.959 [a]	0.898	1.552 [a]	1.623 [a]	2.217
		UNDERSTANDING	0.433	0.387	0.588	-0.051	-0.027	0.146	0.123	0.166	-0.214
		CREDIT PRICE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		TECH_LEVEL	0.731 [c]	0.723 [c]	0.816	0.507	0.302	0.148	0.323	0.258	0.435
Control	Production type	RAW		-0.458			0.699			-0.281	
		INTERMEDIARY		-0.380	-0.226		0.706	-0.572		-0.424	-0.316
		FINAL			0.168			-1.245			0.543
	Size	SMALL		-0.645	-19.830		1.116	0.783		1.075	1.298
		MEDIUM		-1.305	-20.924		0.396	0.135		0.933	0.054
		L_MEDIUM		-1.114	-20.288		0.587	0.496		1.413	-0.025
	Sector	CHEMICAL			20.439			-20.163			-25.505
		CEMENT			-1.197			-21.524			-25.306
		STEEL			20.179			-20.911			-21.889
		PAPER			21.424			-19.752			-20.705
		NON-FERROUS			20.906			-20.826			-22.505
		MACHINERY			21.150			-18.518			-23.179
		ELECTRICS			22.496			-20.993			-23.473
		OTHERS			20.798			-19.666			-23.235
Number of obs.			71	71	71	71	71	71	71	71	71
LR chi2(8)			19.7 [b]	22.66 [c]	40.55 [b]	23.17 [a]	25.64 [b]	32.56	38.73 [a]	41.09 [a]	65.14 [a]
Pseudo R2			0.108	0.124	0.223	0.128	0.142	0.180	0.178	0.189	0.299

Variables			STEP 4			STEP 5			TCMA		
			Model1	Model2	Model3	Model1	Model2	Model3	Model1	Model2	Model3
External pressure		GOVERNMENT	0.199	0.308	-0.127	0.761 [b]	0.777 [c]	0.070	-0.261	-0.291	-0.677 [c]
		COMPETITION	0.058	-0.001	0.385	-0.236	-0.350	0.205	0.187	0.152	0.454
		ENERGY_PRICE	-0.100	-0.036	-0.045	-0.068	-0.006	-0.025	-0.447	-0.449	-0.391
		REPUTATION	0.237	0.030	0.537	0.784 [c]	0.710	1.768 [b]	0.518	0.430	0.658
Internal factors		TOP_SUPPORT	0.738 [b]	0.780 [b]	0.539 [c]	0.648 [b]	0.651 [b]	0.386	1.281 [a]	1.310 [a]	1.220 [a]
		UNDERSTANDING	0.465 [c]	0.562 [c]	0.532	1.040 [a]	1.159 [a]	1.414 [a]	0.636 [b]	0.707 [b]	0.800 [a]
		CREDIT PRICE	0.000	0.000	0.000	0.000 [b]	0.000 [b]	0.000 [a]	0.000	0.000	0.000
		TECH_LEVEL	0.123	-0.067	0.007	0.114	-0.314	-0.532	0.556 [c]	0.261	0.222
Control	Production type	RAW		0.231			0.881			0.463	
		INTERMEDIARY		0.756	-0.012		1.165	-0.157		0.759	-0.411
		FINAL			-0.879		2.238	-1.876 [b]			-1.104 [c]
	Size	SMALL		2.611 [c]	2.265		0.573	1.132		1.810	0.495
		MEDIUM		2.408 [c]	1.813		0.906	-1.709		0.565	-1.279
		L_MEDIUM		2.478 [c]	1.882			-1.179		0.904	-0.808
	Sector	CHEMICAL			-0.567			-1.002			-2.212
		CEMENT			-35.257			-37.644			-6.787 [a]
		STEEL			-3.321			-4.813 [b]			-3.308 [c]
		PAPER			-0.143			-1.508			-0.569
		NON-FERROUS			-2.467			-1.517			-2.331
		MACHINERY			-3.755 [c]			-40.268			-2.184
		ELECTRICS			-2.833			-2.715			-2.446
		OTHERS			-2.169			-2.937			-2.053
Number of obs.			71	71	71	71	71	71	71	71	71
LR chi2(8)			17.55 [b]	24.63 [b]	43.71 [a]	37.8 [a]	45.56 [a]	75.53 [a]	46.66 [a]	52.35 [a]	69.00 [a]
Pseudo R2			0.085	0.119	0.211	0.187	0.226	0.374	0.122	0.137	0.180

4.4 Statistics of the supplementary survey questions

4.4.1 Companies' evaluation of the impact of carbon management to business

Factors to be affected by carbon management	Mean	Min	Max
Domestic and international competitiveness	3.12	1	5
Production cost savings	3.44	1	5
Profit increase	3.00	1	5
Corporate image improvement	**3.62**	1	5
Emission reduction cost savings	3.41	1	5
Overall	3.29	1	5

Carbon management is regarded by companies as 'a means to do something nice thing' for their social image rather than a mean affecting the production cost reduction or carbon reduction cost reduction.

4.4.2 Difficulties for promoting carbon management

Difficulties of carbon management	Mean	Min	Max
Lack of understanding and support from the top management	3.28	1	5
Lack of understanding of employees	3.29	1	5
Lack of information including regulations etc.	3.12	1	5
Lack of environment friendly and low-carbon technologies	3.48	1	5
Lack of governmental policy support and funding	**3.58**	1	5

4.4.3 Supportive policy for carbon management

Supportive policies	Mean	Min	Max
Consistency and transparency of policy	3.89	2	5
Financial support (tax incentives, lending with low interests etc.)	2.44	1	5
Support mechanisms to expand low-carbon technology market	2.62	1	5
Training about tools for carbon management	2.47	1	5

It is of key importance to minimise any uncertainty over policy, as well as to maintain transparency, which together can send a clear signal to industry that investment in the system will lead to future profits.

5. Conclusions

- Majority of surveyed companies remain in the step 1-2 of carbon management, defined in this study. Only few (10%) of companies reached in the proactive level of carbon management.
- In promoting carbon management, top manager's support is the most essential determinant factor for the all steps of carbon management. For the higher level of carbon management, top manager's policy understanding, government pressure, companies' credit price level for trading are significantly related.
- Korean companies have indicated that their carbon management activities have an impact on corporate image rather than the business profit that cannot be largely deviated from existing environmental management.
- Consistency and transparency of policy was ranked as the most important aspect to be addressed in promoting carbon-oriented management for companies so as to make longer-term decisions in innovation.

Thank you for you attention.

Further comments and questions to
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