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Korean Companies' Understanding of Carbon Pricing and Its Influence on Policy Acceptance and Practices†

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ABSTRACT : In response to climate change, Korea is attempting to shift the paradigm of energy and climate change policies by introducing carbon pricing based on market mechanisms. While policy adoption is proceeding at a rapid pace, the introduction of carbon pricing has been faced with great opposition from industry. This study measures to what extent Korean companies understand and accept carbon pricing, using data from a questionnaire survey covering energy consuming companies in 2012, when discussions between the government and such companies about the introduction of a domestic emission trading system were active. It further identifies how preparations and practices for carbon and energy management of companies correlate with their policy understanding and acceptance. The analysis results show that the surveyed companies indicate moderate understanding of, as well as resistance to carbon pricing policies, while appreciating the economic incentives and accepting the mandatory regulations in this phase. Companies' understanding is more related to characteristics, i.e., sector, size, etc. than external pressures. This study found that the extent to which companies understand policy is the essential factor in their policy acceptance and related practices. In particular, understanding of carbon policy significantly influences their managerial practices and voluntary activities for carbon and energy practices. This study substantiates the correlation between the level of policy understanding of a company and its carbon and energy practices – something that all countries seeking to introduce carbon pricing in response to climate change should consider prior to policy actually being implemented; in other words, enhancing the understanding of major policy subjects of the new instrument is a key policy strategy that should be elaborated as it will lead to better performance of companies and smoother policy implementation.

Keywords : Carbon pricing, Energy intensive industry, Policy understanding, Policy acceptability, Korea

JEL 분류 : C1, L6, M1, Q2

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한국 기업의 탄소가격 정책에 대한 이해가 정책 수락 및 대응에 미치는 영향†

석선희*

요 약 : 한국은 시장 메커니즘에 기반한 탄소가격정책 도입을 통해 에너지 및 기후 변화 정책의 패러다임 전환을 시도하고 있다. 그러나 정책 도입이 진행되는 동안 탄소가격정책은 정책 대상인 산업계로부터의 큰 반대에 직면해 왔다. 본 연구는 국내 배출권거래제도의 도입에 대한 논의가 활발했던 2012년 초에 에너지 다소비 기업을 대상으로 실시한 설문 조사 결과를 토대로 한국 기업의 탄소가격정책에 대한 이해도와 수용정도를 측정하였다. 또한 기업의 탄소 및 에너지 관리를 위한 활동과 정책 이해 및 수용 정도와의 관계, 나아가 주요 결정요인을 분석하여 정책 시사점을 제시하고자 하였다. 분석 결과에 따르면, 한국 기업은 에너지 절약 및 온실가스 저감을 위한 경제적 인센티브 정책에 보다 우호적이며 기존의 관련 규제정책을 일부 수용하나, 탄소가격정책에 대해서는 현 시점에서 보통정도의 이해도와 낮은 수용정도를 보였다. 각 기업의 정책 이해 정도는 외부 압력보다는 기업의 특성, 즉 업종이나 규모 등과 더 관련이 있는 것으로 확인되었으며, 이는 정부 정책에 기업 특성이 고려되어야 한다는 시사점을 제시하고 있다. 한편, 이 연구는 기업의 정책 이해도는 정책 수락을 높이고 관련 활동을 촉진하는데 중요한 요소이며, 특히, 탄소 정책에 대한 높은 이해도는 기업의 탄소 관리 및 자발적 활동에 유의미한 영향을 미치고 있다는 점을 밝히고 있다. 본 연구 결과에 비추어 한국 정부는 시장 메커니즘에 대한 충분한 이해가 대상기업 전반에서 얻어지도록 지원 방안을 강구 해야 한다. 한편, 기후 변화에 대응하여 탄소가격정책을 도입하려는 국가 및 지역이 늘어나고 있는 가운데, 기업의 정책 수용과 참여를 높여 제도의 원활한 도입과 시행 그리고 본연의 성과를 거두기 위해, 본 연구의 결과는 해당 지역의 정부에게도 의미가 있는 것으로 보인다.

주제어 : 탄소가격정책, 에너지 다소비 산업, 정책 이해도, 정책 수용도, 한국

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I. Introduction

The Republic of Korea (hereinafter referred to as Korea) was the world's seventh largest CO_2 emitter in 2014 and placed sixth among the Organisation for Economic Co-operation and Development (OECD) countries in terms of emissions per capita. In particular, its greenhouse gas (GHG) emissions in 2010 stood at 136% of the 1990 figure, placing it third globally after China (256%) and India (179%) (IEA, 2016). In response to climate change, Korea embodied climate change policies by positing carbon pricing, such as carbon tax and GHG emission trading scheme (ETS), as a key measure in the fourth National Countermeasures on Climate Change established in 2008. Whilst its energy and climate policies had mainly been based on voluntary approaches, through strong governmental support, a domestic ETS was initiated in 2015. Further, starting in 2020, a low carbon car incentive scheme, or so-called 'vehicle carbon tax', will go into effect (MOEK, 2014).

The principal appeal or inherent advantage of using prices to induce carbon abatement is that this encourages emission reductions where they are cheapest, both in the sense of using the cheapest options currently available and steering innovation and investment towards lower-carbon technologies. By using carbon pricing, the Korean government expects to achieve its GHG mitigation target in a cost effective way and bring about a paradigm shift in domestic industry toward sustainable economic development. The government also puts a premium on the utilisation of carbon pricing as a way of providing incentives for companies to reduce GHG emissions.

However, the government's intentions and expectations on carbon pricing have been met with heavy resistance from domestic industry, which has delayed or watered down the proposals – domestic ETS was revised twice and the low carbon car incentive scheme, initially due to start in 2013, was pushed back to 2015 and then again to 2020. Industry mainly argued that the weight of the restrictions will mean the aforementioned inherent advantages of market-based policies will not be realised, and that industrial

competitiveness will be weakened due to lack of sufficient readiness (FKI, 2015).

Given the accountability of industry regarding energy consumption and GHG emissions in Korea, acceptance of policy and related practices on the part of companies is essential for successful policy implementation and goal realisation. Therefore, the response of companies to policy shifts in climate change using market mechanisms is an issue that has drawn much attention in the academic field of environmental economics. World literature has identified and discussed a variety of determining factors that both stimulate and hinder companies' proactive environmental management and strategy (González-Benito and González-Benito, 2006). Nevertheless, clarification is lacking as to why companies do not welcome carbon pricing, which is thought to be more advantageous than existing regulations, as has been emphasised by governments.

Usually, in order to draw up business strategies and practices in response to new governmental policy, companies first need to undergo a procedure of recognition, understanding and acceptance of such policy. When it comes to carbon pricing, however, a clear and thorough understanding of such policy is even more critical since companies need to proactively apply their collective business acumen to take full advantage of any available incentives by trading as a respected player in the carbon market. In Korea, discussions surrounding the introduction of carbon pricing and its actual introduction came about very suddenly, which means any given company may have lacked the necessary time for full comprehension and for preparing the requisite systems. Some studies have covered this lack of ability to deal with sudden shifts in policy (Suk et al., 2013, Hong, 2010), and from a certain perspective it could be considered natural that in the absence of full understanding of such policies, companies would perceive carbon pricing as a mere regulatory measure and react to such in knee-jerk fashion.

To be able to grasp the level of perception of policies among companies and how such affects their performance is a key factor in and prerequisite to addressing improvements to the related policies and system, and eventually to successful policy implementation and further practices. In our previous studies we measured awareness and acceptability

of market-based instruments among companies in China and Japan (Liu et al., 2013, Liu et al., 2014). However, such studies contained several grey areas – such as precisely how a company's understanding of policy actually affects its behavior, when based on the premise that company awareness did not necessarily influence their policy acceptance. Consequently, the decision to measure them individually was taken.

Therefore, by expanding on the previous studies, this study sets as a premise that companies with better understanding of carbon pricing may adopt corresponding strategies via their policy acceptance. In other words, a company's acceptance and behavior may reflect their understanding, or further still, the choices it makes in response to internal and external stimuli. In this context, the purpose of this paper is to reveal the levels of understanding and acceptance of carbon pricing of Korean companies, and clarify how they are related with pre-classified determinants. It also aims to identify to what extent a company's understanding of policy leads to its acceptance and actual carbon and energy practices. This paper is organised as follows. Section 2 provides an overview on the Korean climate change policies targeted in this study. Section 3 explains the research method and analytical framework for regression analysis, and outlines the questionnaire survey and samples used in the study. Section 4 discusses the statistical results of companies' understanding and acceptability of carbon pricing, and the status of companies' carbon and energy performance, and the regression results of analyses of determinant factors. Lastly, section 5 concludes the study.

II. Literature review and related policy overview

1. Literature review on the determinants of companies' energy saving and GHG mitigation

This section provides a literature review on the factors affecting the companies' behavior of existing energy management. Strategic corporate responses to environmental

challenges do not seem to be the primary domain of corporate management (Aggarwal and Dow, 2012). Companies feel 'Going green' is an activity requiring extra-effort and keen managerial focus (Kock et al., 2012). However global warming and the associated increase in the requirements posed to companies brings about that, to deal with growing competitiveness and, simultaneously, to stand out on the turbulent market, a lot of them implement the concepts underlying not only the economic context of company activity but also company responsibility for the condition of natural environment (Romanowska 2004).

The green business literature usually makes a distinction between companies that are compliance-driven, and merely aim to meet legal requirements, and those that adopt more proactive environmental strategies (Schot and Fischer, 1993). For the proactive environmental management and strategy, the international literature indicates a variety of determinant factors both stimulating and hindering. The measure of a sincere environmental proactivity should not only be based on the external but also on an analysis of the environmental transformations accomplished in the operations and production system. Carrion-Flores and Innes (2010) confirmed tightened pollution targets induce environmental innovation which is an important driver of pollutant reductions. The level of energy prices affects low-carbon technology investment decisions of energy-consuming industries. (Suk, 2016).

Aggarwal and Dow (2012) revealed institutional ownership and board entrenchment seem to significantly influence climate change and environmental impact mitigation policies of large firms. Brunnermeier and Cohen (2003) found the determinants of environmental innovation of US manufacturing that are increases in pollution abatement expenditures and international competitive. Quazi et al. (2001) claim that the top management concern for the natural environment strongly discriminates between companies that have adopted the ISO14001 standard and companies that have not. Similarly, De Brio et al. (2001) find that the higher the commitment of managers and their awareness of the advantages, disadvantages and tools of environmental

management, the higher the formal importance they give to this question within the organization. Buysse and Verbeke (2003) evaluates the relationship between the level of reactiveness of environmental strategies and the importance to stakeholders using survey data from Beligian firms and found that companies adopting an environmental leadership strategy clearly view as critical a broader range of stakeholders. Cole et al. (2007) found that foreign ownership per se does not influence fuel use or total energy use but is found to increase electricity use, perhaps the cleanest form of energy used. Multinational companies tend to shape their environmental policies based on the most stringent requirements prevailing in the relevant countries in which they compete (Magreta, 1997).

Meanwhile, the relationship between stakeholder pressures and environmental strategy tends to vary with size of companies (Darnall et al., 2010). Large European companies have established management systems and processes necessary to respond to regulations and reduce GHG emissions (Sullivan, 2009); meanwhile, small, finance-constrained companies are more susceptible to economic incentives than their larger and financially less-constrained counterparts (Skuras et al., 2006). González-Benito and González-Benito (2006) reviewed determinant factors of environmental proactivity and found that managerial attitude and motivations, and strategic attitude have been considered as relevant for the selection of environmental strategies.

2. Climate change policies and measures in Korea

Korea has promoted energy and climate change policies through various policy instruments, including market based instrument (MBIs), command and control regulations (C&Cs) and voluntary approaches (VOAs). Among them, representative policies are listed in the survey in order to comprehend the degree of a company's understanding and acceptance. For the MBIs, six existing incentive-based MBIs and two carbon pricing MBIs (ETS and carbon tax) are included. For the C&Cs and VOAs, three

main policies for each are selected.

The descriptions and abbreviations of policies in this survey are listed in Table 1.

〈Table 1〉 Descriptions and abbreviations of policies covered in this survey

Category	Description	Abbreviation
Command and control (C&Cs)	GHG-energy target management system	C&C01
	Energy use reporting system	C&C02
	Energy audit requirement	C&C03
Voluntary approaches (VOAs)	Voluntary agreement on energy saving	VOA01
	Training for energy managers	VOA02
	Green company designation	VOA03
Market-based instruments (MBIs)	Subsidies for maintenance, improvement and replacement of energy saving facilities	MBI01
	Soft loan for investment in energy saving facilities	MBI02
	Soft loan for installing high-efficiency production facilities and equipment	MBI03
	Grant for high energy-efficiency products	MBI04
	Soft loan for energy saving companies (ESCO) projects	MBI05
	Tax reduction for investment in energy-saving facilities	MBI06
	Carbon tax	MBI07
	GHG emission trading scheme	MBI08

Command and control regulations (C&Cs)

C&C01 is a GHG-energy target management system (TMS), started in 2011, and which controls large energy consumers by capping their GHG emissions and energy consumption. TMS is the preparation system for GHG ETS introduction. C&C02 (Energy use reporting system) is a mandatory requirement for companies and buildings consuming over 2,000 toe (tonnes of oil equivalent) annually to report their annual energy consumption, energy savings, investments in facilities and production to the government. C&C03 (Energy audit requirement) requires business sites to assess their energy consumption status and saving potentials and make plans for improving energy

efficiency by receiving consulting services.

Voluntary approaches (VOAs)

In 1998, the Voluntary Agreement (VA) system (VOA01) was adopted based on the 'Energy Use Rationalisation Act' to accelerate companies' voluntary energy saving activities. The system initially targeted business entities with an annual energy use of 5,000 toe or more, but has since reduced this figure to 2,000 toe to broaden the number of industries targeted. The government provides training courses (VOA02) targeting energy managers within companies to provide them with information on energy efficiency improvements, climate change conventions and renewable energy, and so on. Green Company Designation (VOA03) is a system that certifies a company that radically reduces its pollutants, resource use or energy consumption for environmental improvement as a "Green Company".

Market-based instruments (MBIs)

The Korean government provides financial support for companies investing in energy saving facilities to cover a portion of project costs in the form of a subsidy, grant, or long-term, low-interest loan under the funding system of energy use rationalisation. The scale of the government's budget is about 350 billion KRW per year, and this amount is trending down. Under this scheme a company seeking project funding submits an application to Korea Energy Management Corporation (KEMCO). Categories of projects eligible for financial support in the form of soft loans are as follows: Energy saving companies (ESCO); investment projects (MBI05); approx. six categories of projects (covering energy-saving facility replacement, insulation renewal/maintenance, IT-based energy saving, new/renewable energy facilities, GHG reduction installations, and miscellaneous energy efficiency improvements); Energy-saving facility installation projects, for example, energy management system (EnMS), heat cogeneration facilities, compressors, etc. (MBI02, Soft loan for investment in energy saving facilities); and,

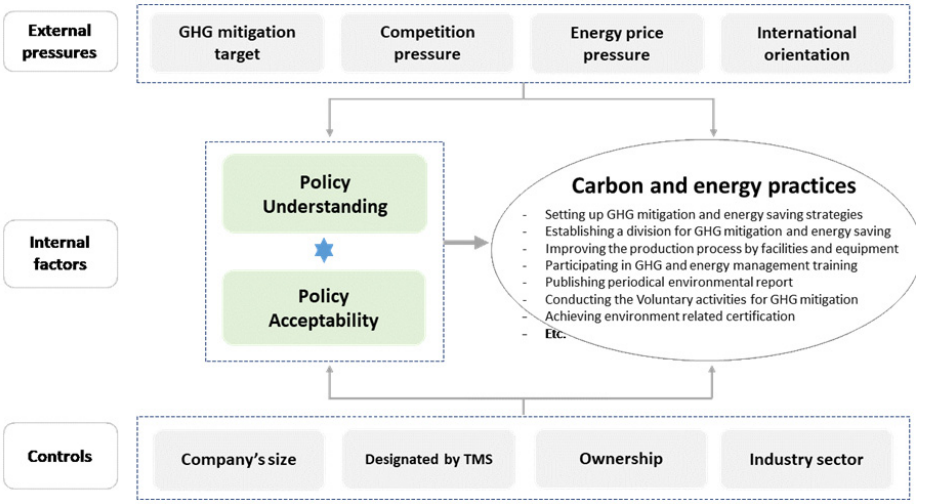
Manufacturing facility installation projects of small and medium-sized enterprises (SMEs) for products with the highest efficiency ratings (MBI03, Soft loan for installing facilities and equipment for high-efficiency production). Companies designated under the TMS can apply for the MBI01 (Subsidies for TMS companies for maintenance, improvement and replacement of energy saving facilities) for introducing or replacement of energy saving facilities. MBI04 (Grant for high energy-efficiency products) is a grant for companies installing high energy-efficiency equipment and products, e.g., LEDs, inverters, transformers and freezers. MBI06 (Tax reduction for investment in energy-saving facilities) is a preferential tax policy to promote business competitiveness through energy saving by providing a 10% corporate income tax deduction in accordance with level of energy saving achieved by a company. As for carbon pricing, carbon tax and GHG ETS are included in this study. It should be noted that at the time of the survey (25 January to 10 February 2012), while other MBIs (MBI01-06) had already been introduced, carbon pricing had not. For the carbon tax (MBI07), Korea Institute of Public Finance (KIPF) proposed a low tax rate (approx. 3 USD/CO_2-t) for the initial stage with a tax revenue equating to 2% of Korea's GDP in 2010 (Kim and Kim, 2010), which became the basis of the carbon tax proposals in Parliament in 2012. MBI08 is the GHG ETS, and at the time of the survey, introduction of ETS in Korea was a heavily debated topic. Since then, in May 2012 the Korean National Assembly approved the 'Greenhouse Gases Emissions Allocation and Trading Act', which led to the formal introduction of domestic ETS from 2015.

III. Research Method and Materials

1. Analytical framework

Expanding on the previous study of Suk et al. (2013), the analytical framework of this study is developed based on the institutional theory shown in Figure 1.

〈Figure. 1〉 Analytical framework of this study



Instigating a shift in business strategies and practices may not be realised ahead of broad-based awareness and understanding on the part of companies of such new policies or social norms. Based on this precept, a company's acceptance of certain policies would naturally be determined according to how they impact on its comparative competitiveness, either experienced or perceived (Liu et al., 2013). In other words, preceding a company's understanding and acceptance of the need to implement environmental management is the need for an institutional behavioural transformation within the industry at large. Although the former does not automatically follow as a consequence of the latter, it may factor in to a certain extent. Or in other words, the practices of carbon and energy management may be determined by whether or not a company understands and accepts the related policy.

The 'policy understanding' mentioned above refers to how companies comprehend the contents of the target policy. 'Policy acceptability' is defined as the quality of being acceptable in this study. Both are used as the internal factors in the analytical framework.

Meanwhile, the external factors and company characteristics that may be associated

with a company's CEPs are selected and included in the framework – regulation, competition pressure, energy price and international orientation – which are classified as external pressures. External governance pressures through regulation can have a significant influence on a company's strategies and actions in terms of adoption of various carbon and energy practices (Sullivan and Gouldson, 2016). In this study, the GHG mitigation target is considered as an external pressure to compel companies to take action. The GHG mitigation goals for iron & steel, petrochemical and cement industries set by the government are respectively 6.5%, 7.5% and 8.5%, compared with BAU levels, which are together designed to realise a national GHG mitigation target of 30% from the BAU scenario by 2020 compared with 2005 levels.

There is some truth to the belief that market competition works as a driver pushing companies to obtain strategic information (De Groot et al., 2001). The price of energy is a principal driver that affects companies' decisions to invest in low-carbon technology for improving the energy efficiency of companies (Prindle, 2010; and Suk et al., 2016). The energy and environment-related standards, certification, technical regulations and non-tariff barriers are becoming increasingly intensified at global and intergovernmental levels in response to climate change, which implies there is a relationship between a company's environmental strategies and its level of exports. Given that Korea's economic growth relies heavily on international trade, businesses need to take heed of such trends and act accordingly. In this sense, international orientation functions as an external push for companies to actively acquire relevant information on policy and technology.

Company size, sector belongings, ownership type and so on are the structural variables that appear to influence the implementation of environmental practices. Therefore, as control variables, company size, sector belongings, ownership type and involvement status of GHG/energy target management (TMS) are used to identify differences in policy understanding and acceptability as well as carbon and energy practices. Company size is an important variable and influences environment management

and response to climate change policy in the areas of energy-saving and GHG mitigation. TMS is a mandatory scheme targeting companies with high energy consumptions and GHG emissions, which are required to set GHG and energy reduction goals and be subject to monitoring, reporting, and verification. Following Porter and Van der Linde's (1995) argument that environmental regulation of an industry can boost its competitiveness through accelerated innovation, strengthened GHG mitigation caps under the TMS will drive companies to collect related information and respond to such measures.

2. Econometric approach

As the main analysis method, the econometric approach is used. The variables and models are introduced below.

1) Valuation of the variables

The abbreviations, descriptions and valuations of the variables are listed in Table 2.

A five-point scale was applied to evaluate three of the four external pressures, SECTORTARGET, COMPETITION and EN_PRICE, with '5' = very high; '4' = relatively high; '3' = moderate; '2' = relatively low; and '1' = very low. The main market of the product, EXPORT, is used as the proxy of a company's international orientation, in which products for the local market are appended with the value '0' and export-oriented companies, '1'.

A similar approach was used for the internal factors, UNDERSTAND and ACCEPTABILITY as regards policy understanding, with '5' = 'very clear'; '4' = 'clear'; '3' = 'moderate understanding'; '2' = 'don't know well'; and, '1' = 'completely unknown'. The scales for the policy acceptability are: '5' = fully acceptable; '4' = relatively acceptable; '3' = moderate acceptance; '2' = hardly acceptable; and, '1' = completely unacceptable.

Company size, SIZE, is classified into small, medium, large-medium and large,

individually named SMALL, MEDIUM, LMEDIUM and LARGE. Company sector belongings, SECTOR, have three types: iron & steel, cement and petrochemicals, presented as STEEL, CEMENT and CHEMICAL. Ownership consists of two types, domestically private and foreign-funded, abbreviated as DOMESTIC and FOREIGN. The status of TMS involvement is indicated as 'TMS' for TMS target companies and 'non-TMS' for the others.

〈Table 2〉 Abbreviation, description and valuation of the variables

Abbreviation		Description	Valuation					
			0	1	2	3	4	5
External	SECTORTARGET	GHG mitigation target by sector						
	COMPETITION	Competition degree of the company's sales market						
	EXPORT	Main market of the products						
	EN_PRICE	Perception of domestic energy price levels						
Internal	UNDERSTAND	Company's understanding of MBIs						
	ACCEPTABILITY	Company's acceptability of MBIs						
Control	SIZE	Company's size						
	SECTOR	Industrial sector belongings of the company						
	OWNERSHIP	Ownership status						
	TMS	TMS involvement						

2) Empirical models for econometric analysis

The regression capturing the relationships between the company's policy understanding, UNDERSTANDING, and the classified determinants can be constructed as Eq. (1), where ε represents the error term and β_0 is the constant.

$$\begin{aligned} &UNDERSTAND \\ &= \beta_0 + \beta_1 SECTORTARGET + \beta_2 COMPETITION + \beta_3 EXPORT + \beta_4 EN\_PRICE + \beta_5 SIZE \\ &\quad + \beta_6 SECTOR + \beta_7 OWNERSHIP + \beta_8 TMS + \varepsilon \end{aligned} \tag{1}$$

The regression identifying the relationships between the company's policy acceptability, ACCEPTABILITY, and the classified variables can be established as Eq. (2), where ζ represents the error term and λ_0 is the constant.

$$\begin{aligned} &ACCEPTABILITY \\ &= \lambda_0 + \lambda_1 UNDERSTAND + \lambda_2 SECTORTARGET + \lambda_3 COMPETITION + \lambda_4 EXPORT \\ &\quad + \lambda_5 EN\_PRICE + \lambda_6 SIZE + \lambda_7 SECTOR + \lambda_8 OWNERSHIP + \lambda_9 TMS + \xi \end{aligned} \quad (2)$$

The regression estimating the relationships among variables, internal factors, external pressures, and control with the companies' activities for CEP, can be constructed as Eq. (3), where η represents the error term and α_0 is the constant.

$$\begin{aligned} &CEP \\ &= \alpha_0 + \alpha_1 UNDERSTAND + \alpha_2 ACCEPTABILITY + \alpha_3 SECTORTARGET + \alpha_4 COMPETITION \\ &+ \alpha_5 EXPORT + \alpha_6 EN\_PRICE + \alpha_7 SIZE + \alpha_8 SECTOR + \alpha_9 OWNERSHIP + \alpha_{10} TMS + \eta \end{aligned} \quad (3)$$

Ordered logistic regression was employed in this study since ordinal dependent variables are used.

3. Outline of questionnaire survey and samples

A survey was implemented targeting three energy-intensive sectors – iron & steel, cement and petrochemicals – as they are major CO_2 emitters and accounted for over 75% of emissions from the manufacturing industry in Korea (MOEK, 2011). A questionnaire was designed based on the main objectives of this study and consisted of four major components: general information of company; the status of energy consumption and CO_2 emissions; understanding and acceptance degree of various policy tools; and status

of CEP.

Data was collected by a faxed or emailed questionnaire survey sent to 205 companies in the cement, iron & steel and petrochemical sectors from 25 January to 10 February 2012. Of the above, 130 were targets of TMS, with non-TMS accounting for the remainder. The questionnaire was directed at environmental and energy managers at mid-management level. Responses from 58 TMS target entities were collected and confirmed valid, which included 34 petrochemical, 14 iron & steel and 10 cement companies, or 43.6%, 41.2% and 55.6% of the total TMS target entities in each sector, respectively. Therefore, the respondents of this survey may be taken as representative of half the TMS targets in the three energy-intensive sectors. The distribution of the samples by company characteristics is summarised in Table 3.

〈Table 3〉 Distribution of usable respondents by sector, size and TMS involvement status

Company characteristics		Number of samples				Number in total (Percentage)
		Small	Medium	Large medium	Large	
Number in total (Percentage)		2 (3.2)	27 (43.5)	20 (32.2)	13 (21.0)	62 (100.0)
Sector	Cement	2	6	2	1	11 (17.7)
	Iron & Steel	-	8	5	3	16 (25.8)
	Petrochemical	-	13	13	9	35 (56.5)
TMS	TMS	2	26	17	13	58 (93.5)
	Non-TMS	-	1	3	-	4 (6.5)

The respondents from cement, iron & steel and petrochemical sectors individually account for 17.7%, 25.8% and 56.5 % of the total. The number of large companies was 13. 27 were medium-sized companies, 2 were small. The remaining 20 were large medium-sized companies between large and medium-sized ones.

IV. Results and Discussion

1. Company's understanding of MBIs and the determinant factors

1) Statistics of company understanding of MBIs

The companies were requested to indicate their understanding of the eight MBIs listed in Table 4. The integrity of measuring this was tested by Cronbach's alpha, which gave an overall figure of 0.88 for all answers, and is over the 0.70 criteria recommended by Nunnally and Bernstein (1994), thus confirming the reliability of the survey data construct. The statistics of company understanding of MBIs are shown in Table 4.

〈Table 4〉 Statistics of company understanding of MBIs (n=62)

MBI items		Mean	Std. Dev.	Min.	Max.
MBI01	Subsidies for TMS target companies' investment in maintenance, improvement and replacement of GHG mitigation and energy saving facilities	3.21	1.01	1	5
MBI02	Soft loan for investment in GHG mitigation and energy saving facilities	3.03	0.99	1	5
MBI03	Soft loan and grant for installing high-efficiency production facilities and equipment	3.11	0.94	1	5
MBI04	Grant for high energy-efficiency products (i.e., LED, inverter, transformer and freezer)	3.31	0.86	1	5
MBI05	Soft loan for GHG mitigation and energy saving company (ESCO) projects	3.60	0.95	1	5
MBI06	Tax reduction for investment in GHG mitigation and energy saving facilities	3.27	1.03	1	5
MBI07	Carbon tax	2.93	0.83	1	5
MBI08	GHG emission trading scheme	3.31	0.74	2	5

Companies in Korea show moderate understanding of the pre-listed MBIs in general, which is consistent with the result of an empirical study covering Korea in 2010 (Suk et al. 2013) and similar to the result in China (Liu et al., 2013), while Japanese companies

were confirmed to have low awareness of market-based instruments (Liu et al., 2014). Comparatively, the respondents have a better understanding of MBI05 (Soft loan for ESCO projects), with a mean of 3.60, which mirrors the success of Korea's government-supported ESCO project. The following policies that have relatively higher company understanding are MBI04 (Grant for high energy efficiency equipment, i.e., LED, transformer and freezer, etc.) and MBI08 (GHG ETS), with the same mean of 3.31. At the time this survey was being undertaken, GHG ETS introduction from 2013 was in the public spotlight, thus energy-intensive companies would have had elevated awareness of such. As ETS was mainly focused on as regards carbon pricing, and the carbon tax was under discussion mainly within the government and academic domains, it is understandable for MBI07 (Carbon tax) to obtain a relatively low score for understanding.

2) Factor analysis of MBI items

An exploratory factor analysis was conducted on the level of understanding of the eight MBIs to cluster them into their different dimensions. Two principal component factors were extracted (Table 5). The item of 'understanding' of MBI is abbreviated as UNDERSTAND_MBIs.

UNDERSTAND_MBI01 to UNDERSTAND_MBI06 are highly associated with factor 1. UNDERSTAND_MBI07 to UNDERSTAND_MBI08 are related with factor 2. To assess the appropriateness of factor analysis, the Kaiser Meyer-Olkin (KMO) test was used. Table 5 is a matrix of rotated components and KMO values. The overall KMO value is 0.76, which indicates moderate data suitability for factor analysis to proceed.

〈Table 5〉 Rotated component matrix of factor analysis and KMO values

UNDERSTAND_MBIs	Factor		KMO value
	1	2	
UNDERSTAND_MBI01	0.790	-0.069	0.823
UNDERSTAND_MBI02	0.886	-0.232	0.762
UNDERSTAND_MBI03	0.869	-0.219	0.866
UNDERSTAND_MBI04	0.783	-0.238	0.871
UNDERSTAND_MBI05	0.522	-0.022	0.683
UNDERSTAND_MBI06	0.746	0.108	0.736
UNDERSTAND_MBI07	0.521	0.630	0.618
UNDERSTAND_MBI08	0.348	0.686	0.578

Based on the result of factor analysis, two sets of UNDERSTAND_MBI constructs may be defined. MBI items 01 to 06 are incentives such as soft loans, grants and tax benefits for investment in energy saving facilities, while MBI07 and MBI08 are carbon tax and GHG ETS. These UNDERSTAND_MBIs are thus classified into the two categories, UNDERSTAND_MBI_IN and UNDERSTAND_MBI_CP, shown in Table 6.

〈Table 6〉 Definition and valuation of the sub-category of UNDERSTAND_MBI items

Abbreviation	Description of the sub-category	Valuation
UNDERSTAND_MBI_IN	Companies' understanding on the incentive policies	Sum of scores of UNDERSTAND_MBI 01 to 06
UNDERSTAND_MBI_CP	Companies' understanding on the carbon pricing policies	Sum of scores of UNDERSTAND_MBI 07 and 08

UNDERSTAND_MBI_ALL and two variables of sub-categories are used as dependent variables for the multivariate regressions to observe their respective relationships with the predicting determinants.

3) Multivariate analysis of company policy understanding of MBIs as dependent variables

Econometric regressions were performed to identify the determinant factors of a company's understanding of MBIs by equation (1). As this 'understanding' is an ordinal measurement, it was rational to choose the ordered logistic model. Results of multivariate regressions of UNDERSTAND_MBI_ALL, UNDERSTAND_MBI_IN and UNDERSTAND_MBI_CP listed in Table 7 are statistically significant and are thus discussed here.

〈Table 7〉 Multivariate regression results with understanding of MBIs as dependent variables

Independent variables and controls			Dependent variables: UNDERSTAND_MBI		
			MBI_ALL	MBI_IN	MBI_CP
External Pressure		SECTORTARGET	-0.152	-0.318	0.388
		COMPETITION	-0.043	-0.245	0.496
		EN_PRICE	-0.147	-0.037	-0.304
		EXPORT	-0.862	-0.607	-0.985[c]
Company's characteristics as control	Sector	STEEL	0.511	0.177	0.524
		CHEMICAL	1.612[b]	1.290[c]	1.556[c]
	Size	MEDIUM	0.570	1.149	-0.548
		L-MEDIUM	-0.663	-0.281	-0.441
		LARGE	-1.290	-1.053	-1.292
	Ownership	DOMESTIC	0.454	0.571	-0.272
		TMS	-1.952[b]	-1.949[c]	-1.167
Number of obs.			62	62	62
LR chi2(11)			18.94[c]	12.3	12.3
Pseudo R2			0.055	0.060	0.060

a significant at 1% level
b significant at 5% level
c significant at 10% level

Company sector belongings, size and TMS targets are associated with their understanding of overall MBIs, while there is no significant relationship between external factors and a company's understanding of MBIs.

The petrochemical sector indicated higher understanding of overall MBIs, especially incentives policy of MBIs than other sectors. The TMS-targeted companies show a negative relationship with understanding of overall MBIs as well as incentive instruments, which is backed up by previous research by the authors showing few TMS companies applied for the loan (Suk et al., 2013). This may be due to the low amounts of finance available for large companies, the main targets of TMS. Overall, this implies that the government should adopt an approach that considers company characteristics if it intends to increase policy understanding on the part of companies.

2. Company acceptability of energy and climate change policies and the determinant factors

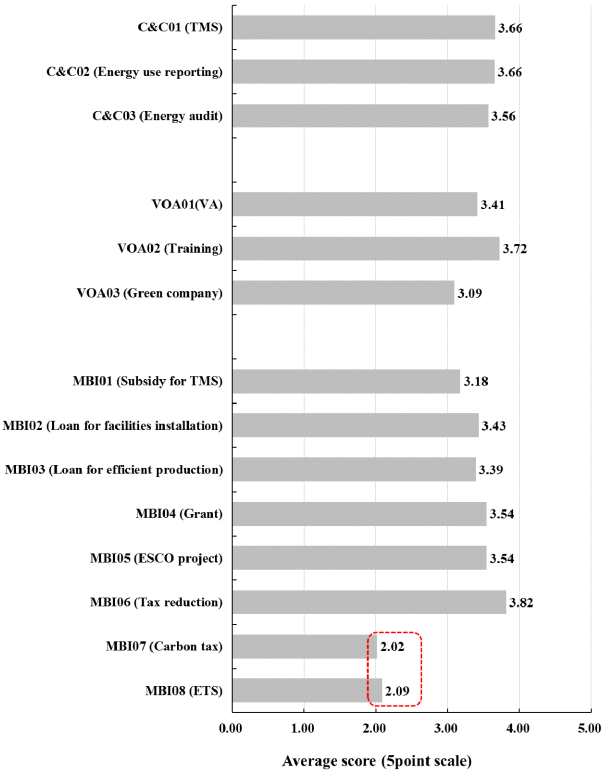
1) Statistics of company acceptability of energy and climate change policies

In this survey we asked the companies to indicate the level of subjective acceptance degree of policy measures including MBIs, C&Cs and VOAs, as listed in Table 1, to find statistical differences. The reliability of valuation results was checked via Cronbach's alpha, which produced a score of 0.80, thus confirming the data construct was valid (Nunnally and Bernstein, 1994). The average scores are depicted in figure 2.

Intuitively guessable, economic incentives are preferable and presented relatively higher scores, in particular MBI06 (Tax reduction for investment in energy-saving facilities), with a mean of 3.82. MBI02 (Soft loan for investment in energy saving facilities), MBI03 (Soft loan for installing high-efficiency production facilities and equipment), MBI04 (Grant for high energy-efficiency products, i.e., LEDs, inverters, transformers and freezers) and MBI05 (Soft loan for ESCO projects) received similar means of around 3.40−3.50. The survey confirms that voluntary approaches are

appreciated by the companies. VOA02 (Training for energy managers) achieved a high mean of 3.72, indicating the need for technical support for Korean companies. VOA01 (Voluntary agreement for energy saving) obtained a mean of 3.41. The samples indicate good acceptability to certain regulative tools, such as C&C01 (GHG/energy target management system) to C&C03 (Energy audit requirement), with similar means of around 3.56–3.66. From this it can be inferred that Korean companies as a whole exhibit broad acceptance of the need for and utility of governmental intervention in industrial GHG mitigation and energy saving (Klok et al., 2006). However, it was obvious that carbon pricing policies, carbon tax (MBI07) and GHG ETS (MBI08), are resisted by companies in Korea, as both presented the lowest score of around 2.00 (see red box in graph).

〈Figure. 2.〉 Company's acceptability of GHG mitigation and energy saving measures



2) Factor analysis of MBI items

As with 4.1.2, factor analysis of the eight items of MBI acceptability was performed to cluster them into their different dimensions, abbreviated as ACCEPT_MBIs. The overall KMO value is 0.65, indicating moderate suitability of the data for factor analysis.

The results are shown in Table 8.

〈Table 8〉 Rotated component matrix of factor analysis and KMO values (n=62)

ACCEPT_MBIs	Factor		KMO value
	1	2	
ACCEPT_MBI01	0.696	-0.018	0.849
ACCEPT_MBI02	0.811	-0.085	0.712
ACCEPT_MBI03	0.873	0.072	0.661
ACCEPT_MBI04	0.726	0.003	0.881
ACCEPT_MBI05	0.412	0.122	0.717
ACCEPT_MBI06	0.367	-0.010	0.725
ACCEPT_MBI07	-0.035	0.939	0.390
ACCEPT_MBI08	0.036	0.947	0.390

Based on this factor analysis, two sets of ACCEPT_MBI constructs are defined: ACCEPT_MBI_IN and ACCEPT_MBI_CP. ACCEPT_MBI_ALL, and two sub-categories are used as dependent variables for the multivariate regressions to observe how they are related with the pre-listed factors.

〈Table 9〉 Definition and valuation of the sub-category of ACCEPT_MBI items

Abbreviation	Description of the sub-category	Valuation
ACCEPT_MBI_IN	Companies' acceptability on the subsidy MBIs	Sum of scores of ACCEPT_MBI 01 to 06
ACCEPT_MBI_CP	Companies' acceptability on the carbon pricing	Sum of scores of ACCEPT_MBI07 and 08

3) Multivariate analysis of company acceptability of MBIs as dependent variables

Multivariate regressions were performed using equation (2) to identify whether the company's acceptability of MBIs varies due to the variables, including policy understanding as an internal factor, external pressures and the company's characteristics. In order to prevent any bias due to the endogeneity problem of the correlation between independent variable, 'UNDERSTAND', and the residual term in the model, a statistical hypothesis test, the Durbin-Wu-Hausman test (DWH-test), was performed for investigating whether the regressors are exogenous or endogenous. As a result of the test, the p value of DWH -test was 0.48 which is greater than 0.05, meaning that the null hypothesis, the regressor is exogenous, is accepted. Regressions analyses were then performed by repeating with certain variables omitted. Three models were adopted. Model 1 is the case of including only the internal factors. Model 2 is the case of excluding the internal factors but including external pressures and control variables. Model 3 is the case of including all the variables. The regression results are listed in Table 10.

〈Table 10〉 Multivariate regression results with acceptability of MBIs as dependent variables

Independent variables and controls		Acceptability of ALLMBI			Acceptability of MBI_IN			Acceptability of MBI_CP		
		Model_01	Model_02	Model_03	Model_01	Model_02	Model_03	Model_01	Model_02	Model_03
Internal factor	UNDERSTAND_ALL	0.244[a]		0.224						
	UNDERSTAND_IN				0.300[a]					
	UNDERSTAND_CP						0.308[a]	0.572[a]		0.542[b]
External Pressure	SECTORTARGET		-0.724[c]	-0.668[c]		-0.522	-0.390		-0.991[b]	-1.223[a]
	COMPETITION		-0.238	-0.309		-0.329	-0.228		0.385	0.199
	EN_PRICE		0.271	0.326		0.338	0.324		0.013	0.213
	EXPORT		-0.032	0.346		0.234	0.685		-0.764	-0.426

〈Table 10〉 Multivariate regression results with acceptability of MBIs as dependent variables (Continued)

Independent variables and controls			Acceptability of ALLMBI			Acceptability of MBI_IN			Acceptability of MBI_CP		
			Model_01	Model_02	Model_03	Model_01	Model_02	Model_03	Model_01	Model_02	Model_03
Company's characteristics as control	Sector	STEEL		-1.086			-1.594[c]	-1.907[b]		0.834	0.756
		CHEMICAL		0.276	0.757		-0.184	-1.313		1.962[b]	1.615[c]
		CEMENT			1.277						
	Size	MEDIUM		1.307	0.595		2.104	1.846		-2.221	-2.207
		L-MEDIUM		0.141	1.064		0.770	1.421		-2.184	-2.216
		LARGE		-0.190	0.594		0.506	1.300		-2.692[c]	-2.357
	Ownership			1.026	0.540		1.349	0.872		-0.722	-0.602
	TMS			-1.088	-0.255		-0.261	1.067		-2.767[b]	-2.438
Number of obs.			62	62	62	62	62	62	62	62	62
LR chi2(12)			26.19[a]	18.26[c]	35.56[a]	29.84[a]	18.42[c]	41.54[a]	10.41[a]	23.89[b]	30.77[a]
Pseudo R2			0.072	0.051	0.098	0.085	0.053	0.119	0.048	0.109	0.414

a significant at 1% level
b significant at 5% level
c significant at 10% level

This analysis confirms that a company's acceptability of economic instruments including loans, subsidies and carbon pricing is significantly and positively correlated to their understanding of such policies. The sectoral target negatively influences a company's MBI acceptance, especially carbon pricing, in that companies that feel highly pressured due to GHG mitigation targets show less acceptance towards MBIs all and carbon pricing. Accordingly, acceptability of MBIs varies across sectors. The petrochemical industry is more likely to embrace carbon policies compared to other industries, which may be because this industry has the largest energy saving potential in Korea (KEMCO, 2010). This result is consistent with the answer for another question in the survey, in which respondents were requested to evaluate the sectoral GHG mitigation target related to their industry. For petrochemical companies, 20% view the mitigation target of their

sector as appropriate, which shows they are relatively more credible as a target for GHG reductions than other sectors.TMS participating companies resisted carbon pricing. As described earlier, TMS targets the large energy-consuming entities in Korea that are to be covered by ETS and that are therefore opposed to ETS introduction. The sticking point is the presence of what they call a 'double burden', or the burden of the present system coupled with that of carbon pricing. There was no significant relationship between size, ownership and other external pressures with policy acceptability.

3. Companies' CEPs and relationship thereof with policy understanding and acceptability

1) Status of companies' carbon and energy practices

Ten CEPs are given in Table 11, and companies were requested to indicate to what extent they practiced them. Companies' practices to cope with Korean carbon pricing policy deviate little from conventional energy saving and environmental management. Overall, the most practiced activity is CEP07 (Participate in GHG-related and energy management training organised by the government), with a percentage of 85.2%. As for carbon management, 72.1% of companies had made efforts to improve production processes by installing energy-saving facilities and equipment (CEP08), and 65.6% had obtained ISO 14001 Certification as part of their carbon and energy management (CEP05). CEP09 (Participate in the Voluntary Agreement) follows at 57.4%. The proportion of VA is relatively low, considering the fact that energy saving activities were mainly carried out through voluntary agreements, probably due to the change in designation of large, energy-consuming companies as target companies under the TMS – meaning their energy saving activities were not counted as VA.

However, in general, there is little evidence demonstrating that carbon management takes place within Korean industry at large. One sure way to tell if companies are responding to climate change is whether they have set up specific goals or strategies for

GHG mitigation or energy saving strategies. Overall, half of the companies answered that they have implemented GHG mitigation and energy-saving strategies (CEP01). In order to tell whether a company has established environmental management, this is manifested by the presence of environment departments or appointment of managers in charge of environmental issues (Del Brio et al. 2001). Of the Korean companies, only a third had established specific divisions for carbon and energy management (CEP10). They also exhibited low interest in Green company certification (CEP06), as only 20% were certified as such. As the demand for high quality environmental reports is mounting, an increasing number of firms publish information on the environmental impact of their activities, and such function is handled by environmental management systems in most companies (OECD Secretariat and EIRIS). However, with the exception of several large, well-known companies, few regularly report on environmental and carbon performance – only a small percentage of the surveyed companies had published environmental reports (CEP03, 16.4%). With the object of measuring the cost and impact of implementing environment-related activities from the perspective of companies, in 2006 the Ministry of Environment published green accounting guidelines and encouraged companies to adopt them. The uptake was very low, however, as the related score for recognition and execution of Green accounting (CEP04) is at the insignificant level (4.9%).

〈Table 11〉 Status of company's carbon and energy practices (N=62)

No.	Carbon and energy practices	%
CEP01	Set up GHG mitigation and energy saving strategies	50.8
CEP02	Strengthen the network between companies in the same sector to exchange information of GHG mitigation and energy-efficient technologies, etc.	24.6
CEP03	Publish periodical environmental reports containing information of GHG emissions and energy consumption, e.g., Sustainable development report, carbon report, etc.	16.4
CEP04	Introduced Green accounting system	4.9
CEP05	Obtained ISO 14001 Certification in Environmental Management	65.6

〈Table 11〉 Status of company's carbon and energy practices (N=62) (Continued)

CEP06	Achieved Green company certification	21.3
CEP07	Participate in carbon and energy management training organised by the government	85.2
CEP08	Improve the production process by installing GHG mitigation and energy saving facilities and equipment	72.1
CEP09	Participate in the Voluntary Agreement (VA)	57.4
CEP10	Establish a specific division for carbon and energy management	32.8

2) Factor analysis of carbon and energy practices

CEPs were grouped into different dimensions via exploratory factor analysis. Four principal component factors were extracted: factor 1 was highly associated with all of CEP01-03, CEP07, and CEP08; factors 2, 3, and 4 are highly associated with CEP04, CEP05 and CEP06, respectively. Thus CEPs was classified into four categories, as defi ned in Table 12. The overall KMO value is 0.64, which indicates moderate suitability of the data for factor analysis to proceed.

〈Table 12〉 Rotated component matrix of factor analysis and KMO values (n=62)

CEPs	Factor				KMO value
	1	2	3	4	
CEP01	0.490	-0.065	0.065	0.008	0.689
CEP02	0.531	-0.048	0.001	-0.275	0.593
CEP03	0.700	0.032	-0.098	0.115	0.698
CEP04	0.293	0.325	0.025	0.209	0.638
CEP05	0.470	0.324	0.052	-0.178	0.784
CEP06	0.170	0.475	0.058	0.059	0.674
CEP07	0.145	0.020	0.050	0.398	0.357
CEP08	0.060	0.432	-0.177	-0.029	0.472
CEP09	0.152	-0.056	0.493	0.015	0.411
CEP10	0.680	0.228	0.311	0.045	0.678

The CEP items highly associated with factor 1 are managerial practice for environmental management of the companies. CEP04 (Green account system) and CEP06 (Green company certification) (factor 2), are relatively new and proactive managerial practices for carbon management. Others were individually defined into two: educational practice and Voluntary Agreement, CEP07 and 09. Further, the overall level of CEP_ALL, i.e., the variables representing the involvement of the above CEP sub-categories, are also used as dependent variables for the multivariate regressions to observe how they are respectively related to the predictive factors.

〈Table 13〉 Definition and valuation of the CEP sub-categories

Abbreviation	Description of the sub-category	Valuation
CEP_MP	Managerial practice	Sum of scores of CEP01 to CEP03, CEP05, CEP08, and CEP10
CEP_NMP	New managerial practice	Score of CEP04 and CEP06
CEP_ EDU	Educational practice	Score of CEP07
CEP_VA	Voluntary Agreement	Score of CEP09

3) Multivariate regression results of CEPs as dependent variables

CEP_ALL and 4 sub-categories, CEP_MP, CEP_NMP, CEP_EDU and CEP_VA defined are used as dependent variables for the multivariate regression to observe their respective relationships with the predetermined factors. As the independent variables, internal factors of company policy understanding and acceptability for MBIs are included, which are separated into incentive-based MBIs and carbon pricing to identify whether a company's CEPs are associated with understanding and acceptability for different MBIs.

As similar with above section, with the regards to endogeneity of internal factors, 'UNDERSTAND' and 'ACCPTABILITY', DWH test was conducted. The P values is 0.12, indicating there is no bias with endogeneity in this analysis. For the regression analysis, three models were adopted. Model 1 is the case of including only the internal

factors. Model 2 is the case of excluding the internal factors but including external pressures and control variables. Model 3 is the case of including all the variables. The results in Table 14 indicate that the identified determinant factors influence a company's. Since there is no significant in the result of CEP_EDU, the remaining are therefore discussed as follows.

〈Table 14〉 Multivariate regression results with CEPs as dependent variables

Independent variables and controls			CEP_ALL			CEP_MP			CEP_VA		
			Model_1	Model_2	Model_3	Model_1	Model_2	Model_3	Model_1	Model_2	Model_3
Internal factor	UNDERSTAND_IN		0.072[c]		0.109b	0.036		0.054	-0.022		-0.042
	UNDERSTAND_CP		0.191[c]		0.326[a]	0.254[b]		0.359[a]	0.266[c]		0.335[c]
	ACCEPTABILITY_IN		0.004		0.022	0.019		0.056[c]	0.044		0.022
	ACCEPTABILITY_CP		0.060		0.045	0.039		0.010	-0.108		-0.088
External	SECTORTARGET			-0.034	-0.224		-0.034	0.015		0.105	-0.062
	COMPETITION			0.592	0.745b		0.592	0.650b		0.249	0.174
	EN_PRICE			-0.067	0.126		-0.067	-0.114		0.234	0.344
	EXPORT			-0.040	0.436		-0.040	0.213		0.492	0.610
Cmpanoy's characteristics as	Sector	STEEL		0.328	0.396		0.328	0.590		-0.782	-0.799
		CHEMICAL		1.161	1.111b		1.161	0.986c		0.005	-0.044
	Size	SMALL			-10.126			-9.839			-8.912
		MEDIUM		7.333	-1.302		7.333	-1.347[a]		7.058	0.329
		LMEDIUM		6.822	-1.776		6.822	-1.567[a]		6.230	-0.680
		LARGE		7.943			7.943			6.714	
	Ownership	Domestic		-0.476	-0.440		-0.476	-0.835[b]		1.109	1.055[c]
	TMS			-0.278	0.879		-0.278	0.343[a]		-0.062	-0.133
Number of obs.			62	62	62	62	62	62	62	62	62
LR chi2(15)			15.73[a]	34.55	66.10[a]	13.43[b]	34.55	55.95[a]	4.78	14.15	18.42
Pseudo R2			0.062	0.166	.261	0.065	0.166	0.269	0.056	0.167	0.217

a significant at 1% level
b significant at 5% level
c significant at 10% level

The present study confirmed that companies' understanding of policy is essence of stimulating the implementation of carbon and energy practices, as had been presumed at the outset of this study although acceptability is not necessary related. Company understanding of the carbon policy significantly influenced the CEPs, especially managerial practice and voluntary activities, Government regulations are one of the key drivers for resource allocation in various environmental management domains (Buysse and Verbeke, 2003). However, this study showed that the companies' CEPs are not particularly associated with pressures derived from sectoral mitigation targets. Meanwhile, as has been confirmed by several studies, competition is an essential external pressure driving companies to conduct CEPs, which indicates that companies are sensitive to the climate change response performance of their business competitors, i.e., that they may face an overall loss of competitive advantage if proactive environmental management becomes common practice among its rivals (Garrod, 1997). The status of CEPs differs according to company characteristics, i.e., the belonging sector, size and ownership (Gonzalez-Benito & Gonzalez-Benito, 2006). The petrochemical industry, as confirmed in another part of this study, is positively involved in the CEPs. The level of CEPs in companies is determined by the size of the company, which agrees with the results found in world literature (University of Cambridge, 2015). Further, companies under the TMS were found to be more active in engaging in general managerial practice

V. Conclusions

The increasing reliance of energy and climate change policy on market mechanisms under the present climate change policy has required companies to shift their strategy focus from voluntary, or regulation-driven management approaches, to innovative carbon management. In terms of the GHG responsibilities of energy-intensive sectors in Korea, it is their carbon and energy practices that are important in addressing current climate change and environment problems.

This study aimed to contribute to this body of knowledge by measuring the extent of understanding of policy and acceptance of carbon pricing, on the part of businesses, in the early phase of introduction of carbon pricing and by linking such awareness or acceptance with company performances.

Being moderate understood, carbon pricing policies are still highly resisted by the sampled Korean companies, especially those within the sector with high GHG mitigation targets or those targeted by TMS. With regards to the carbon and energy practice, this study revealed companies' practices in accordance with carbon pricing policy deviate little from conventional energy saving and environmental management.

This study revealed that company understanding of carbon pricing is essential for their policy acceptance, as well as to proceed with aspects of actual management, even though policy acceptance itself does not necessarily lead to implementation. In other words, even if the policy is not favorable, understanding of the policy enhances the company's response. The companies are more open to incentive policies as they expressed higher understanding of them and agree with the utility of certain regulative requirements for industrial climate change performance. This study observed divergences in the way different sectors perceive and accept carbon pricing as well as in how they incorporate their understanding in their carbon management. It confirmed that their behaviors are likely more influenced by the internal aspects than external pressures, although they are concerned about rivals. The results of this study underlined the importance of increasing the level of policy understanding among companies, particularly with regards to characteristics of companies, and this has important implications in terms of policy not only for Korea's government but also that of other countries planning to introduce market mechanisms related to climate change.

Nevertheless, this study is subject to the following shortcomings, which could be addressed through further study. This study used self-reporting questionnaires to gather data, in which companies made subjective assessments of their policy understanding and acceptability, which introduces the potential for bias in interpreting the scale. In this

study, a company's carbon management and practices are not defined but mainly focused on energy and GHG reduction activities included in existing energy and environmental management. However, in order to carry out the carbon management necessary for participating in the carbon market in which carbon credits are traded under the ETS, companies may need to adopt more proactive strategies that are clearly discernable from those of existing environmental management, which are regarded as a form of social responsibility. In this respect, future research will need to clarify exactly at what stage Korean companies are presently at in terms of carbon management.

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