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The performance of Green Technology Investment in Korea

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Abstract

This study examines how green technology investments affect firm performance in the context of stock price growth, revenue growth, and profit growth. This study collected a total of 31 green firm performances from the Korean stock market. Using a regression framework, this paper seeks to answer the research questions; a) is green technology investment successful so far? b) how green technology investment affects firm performance? The empirical findings show that green technology investments, in general, do not have positive impact on firm performance so far, but green technology investments do have an impact on firm performances depending on the type of green technology that firms invested. The contribution of this study is to address the lack of empirical research in understanding whether green technology investments affect firm performance. In addition, this study discusses the research limitations such as the lack of consideration of market demand and characteristic of green technology.

Keywords: Green technology, Environment sustainability, Firm performance

1. INTRODUCTION

Nowadays, there is a growing concern worldwide about 'environment sustainability'. Many leaders understand that sustainability is now a critical part of the core value of the company because returns from launching green projects like positive cash flow, reduced energy and materials, and operating costs can up-build or break a company today (OECD, 2009). Thus, many countries are investing in green technologies to cope with environment problems such as greenhouse gas emission and also, many firms are exploring future business opportunity in green technology area as a new revenue stream. For example, the Korean governmentexpanded its R&D investment in green technologies from 2.5 trillion Korean won in 2009 to 3.5 trillion Korean won in 2013 ("Green Growth Korea," 2012).

Although many companies have addressed the importance of green technologies explicitly and have invested huge amount of money, but it is far from certain whether these investments can truly achieve the firm's success. Furthermore, there is little empirical support that clearly demonstrates the comparison between the performance of green technology focused firms and the performance of other companies. Therefore, this research aims to address this gap i.e. lack of empirical research in understanding whether green technology investments affect firm performance. More specifically, the study addresses two important research questions: a) is green

technology investment successful so far? and b) how can green technology investments affect firm performance? The answer of these research questions have considerably contributed to the field of environment sustainability. To do this end, firm performances are evaluated using the Korean stock market data.

The paper begins with a discussion on the circumstance of Korean green technology investments. Next, the data used in this study and research method are explained. And then, the results are discussed. Finally, the paper closes with implications for future research and practice.

2. KOREAN CREEN INDUSTRY–BACKGROUND

As is known, the first country that has pursued Green Growth by investing huge amounts of money in green technology area is the Republic of Korea. In 2008, Korean government declared "Low Carbon Green Growth" as a new vision to lead the country's development over the next 60 years ("Green Growth Korea," 2012). To achieve this goal, Korean government in January 2009 issued a Framework Act on Green Growth. Based on that, the Korean government announced 27 core green technologies and planned to focus on them as R&D investment areas in order to create new drivers for Green Growth.

Table 1. Selected greentechnologies companies from KOSPI

Sector	Selected green technologies	Sample companies from KOSPI	Competitiveness	Invest Timing
Energy source Technology (input)	silicon based solar cells, Non-silicon based solar cells	Hanmi Semiconductor/ OCI/OCI Materials/ WoongJinEnergy/ Unison/ Taewoong/Hanwa Chemical/ShingsungSolar Energy/ JUSUNG Engineering/ Osung LST/ S-energy	High	Longterm
Efficiency improvement Technology (Green IT)	LED, Smart grid	DongbuLightec/LG Innotek /Kumho Electronic/ Seoul Semiconductor	Low	Short
		Hyosung/Kepco E&C/, Kepco KPS/Kwangmyung Electronics/ Hyunjin Materials	Medium	Long
Efficiency improvement Technology(Logistics)	Green process technology, Green Cars (Electronic) Green Buildings	Hubis/ Samsung Electronics/ Samsung Electro-Mechanics/ Inktec/ LG Electronics	High	Medium
		LG Chem. / LS Industrial Systems/Samsung SDI	High	Medium
		Kolon Global/ Hyundai E&C/ GS E&C	High	Long
End-of-pipe technology	Water quality/ management	-	Low	Medium
Final sample size		31		

The Korean government, thus, prioritised the following green-energy technologies in order to support and invest in their Research and Development (R&D). These technologies are: high-efficiency photovoltaic (PV) cells, fuel cells, advanced nuclear power, green cars, smart grid, advanced carbon capture and storage (CCS), water treatment, rechargeable batteries, Light Emitting Diodes (LED), Green IT. To facilitate the development of green technologies, for example, the Korea government in the year of 2011 invested approximately 2% of its GDP (around 23 billion USD).

Investment in R&D gradually triggered the investment of private sector. As is known, private sector investment is vitally important for the success of Korean government's Green Growth strategy. During the implementation of this strategy, around 30 South Korean business groups had already invested more than 15.1 trillion won (around $ 13.6 billion) in the green technologies, starting with 2.4 trillion ($ 2.2 billion) in 2008, 5.4 trillion ($ 4.9 billion) in 2009 and 7.3 trillion ($ 6.6 billion) in 2010. These figures represent an increased annual investment of 74.5% between 2008 and 2010. These companies are projected to invest another 22.4 trillion won ($ 20.1 billion) between 2011 and 2013, which is an increase of 48.2% compared to the previous three years (Ekaterina, 2012).

3. THE METHODOLOGY AND RESEARCH PROPOSITIONS

3.1. DATA COLLECTION

To evaluate the performance of the firm that have been invested in green technologies, this study selected the firms that included in Korea Exchange (KRX) Green Index. KRX Green is a stock price index calculated for companies engaged in green industry businesses including those that have obtained the Green Certification from the Korean government, and was introduced since December 20, 2010. The index first was calculated based on 20 company's stock prices and intends to promote green industry investments.

As a result, we assumed that the firm included in KRX Green could be determined as a green technology company. KRX realigns the firms included in KRX Green Index twice a year (regular and mid-term Realignment). Thus, we find that total 31 companies are included in KRX Green until December 2013. The list of 31 KRX Green companies are as follows; Hyosung, Shingsung Solar Energy, JUSUNG Engineering, Kepco E&C, Kepco KPS, Taewoong, Hyunjin Materials, LG Electronics, LG Chemicals, LG Innotek, LS Industrial Systems, OCI, OCI Materials, Samsung Electronics, Samsung Electro-Mechanics, Samsung SDI, Woongjin Energy, Unison, Osung LST, S-energy, Inktec, Seoul Semiconductor, Kumho Electronic, Kwangmyung Electronic, Kolon Global, Hanmi Semiconductor, Hyundai E&C, GS E&C, Hubis, Hanwa Chemical, and DongbuLightec,

In addition, this study collected data on stock prices, revenues and operating profits from KRX homepage (http://www.krx.co.kr) and the largest portal site in Korea (http://finance.naver.com).

3.2. RESEARCH PROPOSITIONS

The debate is still on-going whether the environment practice in a company is really improved the economic performance. Several studies show that environmental management activities can contribute directly to improving firm performance (DiMaggio & Powell, 1993; Porter & Van der Linde, 1995). According to Porter and Van der Linde (1995), strict environment regulations do not hinder competitive advantage of the firm, but on the contrary they enhance firm performance by triggering green innovations in order to cope with these regulations (Popp, 2006).

However, others argue that a strict environmental regulation endangers the competitiveness of regulated firm performance since they raise their production cost. Wagner (2005) found that focusing on improvements of environmental performance in terms of reducing (undesired) outputs (i.e. emissions) from production is unlikely to bring about a positive influence on economic performance beyond relatively low levels of environmental performance.

Based on above discussions, this study suggests that green technology investments have a positive impact on firm performance. Hence,

H1: Green technology investment is positively associatedwith firm performance

H2: Types of green technology investment are positively associated with firm performances

4. THE FINDINGS

4.1. DESCRIPTIVE STATISTICS

Tables 2-4 provide a brief summary of data. Most of the statistics in the tables are classified by the following six elected green technologies areas; solar cells, LED, Smart grid, Green cars, Green building, and Green process technology. Tables 2-4 show the firm performances for each category of green technologies from January 4, 2010 to December 30, 2013.

The average of stock price growth rate is ranged between 54% and 131% in table 2. Since the stock price growthof 31 firms, on 4-year average, is 79% (namely, 21% decrease), we can say that stock price growth of some type of green technologies (green cars, smart grid and green process) is higher than average stock price growth of 31 firms. It points out that the firm performances are varied with the type of green technologies that the firm have engaged.

The means show in table 3 are in the range of 3.3% - 111%. Since the revenue growth of 31 firms, on 4-year average, is 28.6%, we can say that revenue growth of some type of green technologies (green building, green cars, smart grid and green process) is higher than average revenue growth of 31 firms. It also points out that the firm performances are varied with the type of green technologies the firm have engaged.

Table 2. Firm performance - stock price growth (Jan 4, 2010 ~ Dec 30, 2013)

	N	Min	Max	Mean	Std. Dev.
solar cells	11	14%	157%	60%	53%
LED	4	12%	84%	57%	34%
Smart Grid	5	21%	132%	90%	43%
Green Process	5	54%	275%	131%	92%
Green cars	3	69%	134%	104%	33%
Green building	3	29%	85%	54%	29%

Table 3. Firm performance - revenue growth (Jan 4, 2010 ~ Dec 30, 2013)

	N	Min	Max	Mean	Std. Dev.
solar cells	11	-81.1%	91.9%	3.3%	43.3%
LED	4	2.0%	39.2%	18.3%	19.0%
Smart Grid	5	19.5%	71.8%	40.3%	22.4%
Green Process	5	-8.6%	52.2%	30.5%	23.2%
Green cars	3	12.6%	58.3%	30.1%	24.7%
Green building	3	17.1%	282%	111%	147%

Table 4. Firm performance – operating profit growth (Jan 4, 2010 ~ Dec 30, 2013)

	N	Min	Max	Mean	Std. Dev.
solar cells	11	-445.8%	95.1%	-118.1%	166.2%
LED	4	62.1%	140.3%	34.8%	78.8%
Smart Grid	5	-177.2%	54.1%	-64.1%	95.5%
Green Process	5	24.6%	1189.0%	370.0%	502.0%
Green cars	3	-32.7%	5.7%	-15.8%	19.6%
Green building	3	-69.2%	32.3%	-2.3%	58.0%

The average of operating profit growth is ranged between -118.1% and 370% in table 4. Since the operating profit growth of 31 firms, on 4-year average, is 13.4%, we can say that operating profit growth of some type of green technologies (LED and green process) is higher than average operating profit growth of 31 firms. It points out that the firm performances are varied with the type of green technologies that firm engaged.

In order to see whether the green technology investment is successful or not, we compare the stock price of KOSPI with the KRX Green Index. Figure 1 graphically shows the stock price of

KOSPI and KRX Green Index and compares the changes of Green Index with that of KOSPI Index. We can see that the stock price growth rates of green companies is negative, but the stock price growth rate of all general companies is positive. This result can be interpreted that in Korea the green technology investment is not successful so far.

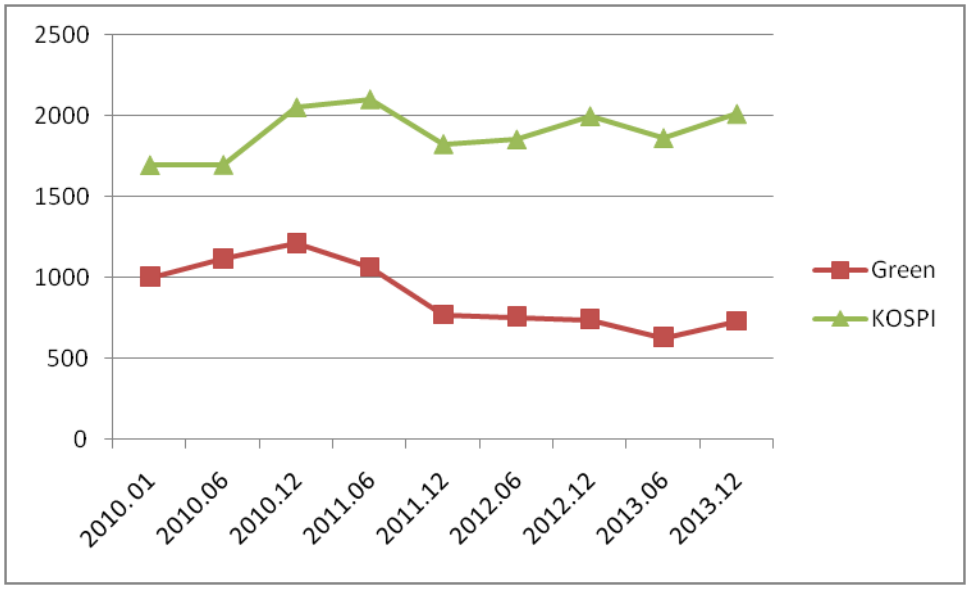

Figure 1: KOSPI and Green Index (Jan. 04 – Dec. 2013)

4.2. REGREESION ANALYSIS

In Addition, this study investigates how the types of green technology investments affect firm performance. For this, we assume a simple regression framework as follows:

$$Firm\ performance = \alpha + \beta_1 * Investment\ area + \varepsilon$$

α: constant β:standardized coefficient ε:residuals

Table 5 shows the results of the regression analysis. In model 1(stock price growth), model 2(revenue growth), and model 3(operating profit growth), the results indicate that types of green technology investment area as an independent variable are statistically significant at level $p<0.1$.

Table 5: Regression results of firm performance

Dependent variable	Model 1 Stock price growth	Model 2 Revenue growth	Model 3 Operating profit growth
Independent variable			
Type of green technology investment area	-0.212	-0.246	-.1.407
Correlation coefficient	0.313	0.368	0.445
R^2	0.10	0.135	0.198
Adj R^2	0,07	0.106	0.171
p-value	0.087*	0.042**	0.012**

* Regression analysis is significant at the 0.1 level.

** Regression analysis is significant at the 0.05 level.

5. SUMMARY AND CONCLUSIONS

This study seeks to provide insights into whether the firm investing green technology outperforms other companies. To do this, this study firstly compares the stock price growth of green firms with that of other general firms using the Korean Stock market, secondly examines how they are related to the types of green technology investment area. The empirical findings show that the performance of green firms is not so good so far compared to that of other firms. In addition, the results also indicated that the type of green investment area has positive correlation with firm performance. Thus, this study underscores the strategic importance of selecting green technology sector.

This paper could considerably contribute to the field of environment sustainability, by considering how green technology investment affects firm performance. A promising direction for future study is to investigate these arguments in greater details and find other factors such as market demand and world economic situation affect on firm performance.

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