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FINANCIAL ANOMALIES OF CLIMATE CHANGE RESPONSIBILITY

This paper investigates the financial anomalies caused by climate change related responsibility. The main purpose is to test whether anomalies occur with climate change portfolio. We investigate whether HSBC Global Climate Change Index outperform the MSCI World Index from May 2006 to May 2011. The empirical results partially support that the firms with climate change strategy are a priority when investors make investment decisions. Although the results show that the mean returns and buy-and-hold returns of HSBC Global Climate Change Index are not quite significantly higher than MSCI World Index in the whole period, HSBC Global Climate Change Index has better performance than MSCI World Index before September 2008. Other sub-indexes of HSBC Global Climate Change Index, excluding LCEP, also outperform MSCI World Index, especially before September 2008.

Keywords: *climate change index; index performance; buy-and-hold returns.*

JEL classification: *G01, G21, G2.*

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ФІНАНСОВІ АНОМАЛІЇ В УМОВАХ ВІДПОВІДАЛЬНОСТІ ЗА ЗМІНИ КЛІМАТУ

У статті розглянуто фінансові аномалії, причина яких - відповідальність за зміни клімату. Перевірено залежність цих аномалій від змін клімату. Використано дані Індексу зміни клімату HSBC і фондового індексу MSCI World з травня 2006 по травень 2011 року. Емпіричні результати частково підтверджують гіпотезу про те, що фірми із розробленою стратегією захисту клімату отримують переваги при інвестуванні. Результати показують, що середня і довгострокова прибутковість за Індексом змін клімату HSBC ненабагато вищі, ніж ті ж показники індексу MSCI World. Індекс HSBC перевершував MSCI за всіма показниками, особливо до вересня 2008 року.

Ключові слова: *індекс зміни клімату; продуктивність індексу; довгострокова прибутковість.*

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ФИНАНСОВЫЕ АНОМАЛИИ В УСЛОВИЯХ ОТВЕТСТВЕННОСТИ ЗА ИЗМЕНЕНИЯ КЛИМАТА

В статье рассмотрены финансовые аномалии, причина которых - ответственность за изменения климата. Проверена зависимость аномалий от изменений климата. Использованы данные Индекса изменения климата HSBC и фондового индекса MSCI World с мая 2006 по май 2011 года. Эмпирические результаты частично подтверждают гипотезу о том, что фирмы с проработанной стратегией по защите климата получают преимущества при инвестировании. Результаты показывают, что средняя и долгосрочная доходность по Индексу изменений климата HSBC ненамного выше, чем те же показатели индекса MSCI World. Индекс HSBC превосходил MSCI по всем показателям, особенно до сентября 2008 года.

Ключевые слова: *индекс изменения климата; продуктивность индекса; долгосрочная доходность.*

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1. Introduction. With the threat of global warming, the government policy on climate change remains active worldwide from the last century. Business will face more restrictions on energy uses and business process in the carbon-constrained society. Governments' environmental and energy policies are stimulating new industries, such as energy efficiency industry, new and renewable energy industry, and new services. Policy trends combating CO2 emissions have not only created new industry, but also brought a growing investment opportunity. This study therefore aims to investigate what's been happening in climate change public equity markets.

Traditional financial theory is based on rational investors, efficient market, and profit maximization; however, those theories fail to explain some market anomalies after mid-1980s. Previous empirical literature defines so-called market anomalies as the gap which cannot be priced by rational asset pricing model, such as "size effect", "weekend effect", "dividend effect", "January effect", "P/E effect", and "price/book ratio effect" etc. However, very few studies investigate the market anomalies in environment and energy related fields. We collected the rare literature as follows. Derwall, Guenster, Bauer, and Koedijk (2005) used corporate eco-efficiency scores obtained from Innovest Strategic Value Advisors to form the portfolios. Using CAPM (Sharp, 1964; Lintner, 1965) and Fama-French Three Factor Model (Fama and French, 1993), they found that high ranked portfolios have around 6% of "eco-efficiency premium" compared with low ranked portfolios. Blank and Daniel (2002) also used corporate eco-efficiency scores to form portfolios and use long-run buy-and-hold strategy. Innovest enhanced that S&P 500 portfolios have higher returns and lower volatility related with S&P 500 from 1997 to 2001. This phenomenon is called the "eco-efficiency anomaly". Connected to asset pricing theory, the literature relating to climate-related investments is still emerging in the recent years. However, those subjects have become a main theme to investors, when some research institutions also announced to launch climate-change-related indices. These indices are categorized into two groups: (1) indices that comprise firms with relatively low carbon emission, such as S&P US Carbon Efficient Index, HSBC Global Climate Change Index, and UBS Europe Carbon Optimized Index etc.; (2) indices that measure the performance of the liquid carbon-related credit plans, such as Barclays Capital Global Carbon Index, MLCX Global CO2 Emissions Index, and SGI-Orbeo Carbon Credit Index etc. Performance of climate-related indices shown in previous reports can be deemed as probably climate change premium. For instance, HSBC announces the June quarterly review of HSBC Global Climate Change Index and this index has outperformed with global equities (DB Advisors, 2008).

While the previous literature focuses on abnormal returns between portfolios with eco-efficiency and portfolios without eco-efficiency, this study takes a broader view taking the climate change related indices and global stock indices, and investigating which type of index has better performance and higher returns. Both "mean returns" of indices and "buy-and-hold returns" of indices are computed in this paper. Investors usually use "buy-and-hold" strategy rather than measure mean returns since they buy a financial asset and hold it for a long horizon despite periods of volatility or decline. This paper aims to investigate whether there is the climate change premium of climate-related indices compared with global equities indices. We calculate both 5-year mean returns and buy-and-hold returns to measure whether climate-related

index is outperformed to global equities index from May 16, 2006 to May 16, 2011. The empirical results show that the mean returns of the climate-related indices and its sub-indices are positive but not significantly higher than those of global equities indices. However, while separating the investigating period into two based on August 2008 (Lehman Brother collapse), all climate-related indices outperform MSCI global equities indices before August 2008 while most of them do not outperform after August 2008. We therefore conclude that the climate change anomaly really exists during the period while the macroeconomics is in a relatively stable period.

This paper proceeds as follows. Section 1 introduces the origin of the paper. Section 2 presents the financial literature about the environmental anomalies. Section 3 describes the data sources and the methodologies used in the paper. In Section 4 we describe the empirical results. Finally, Section 5 concludes.

2. Literature. Firms maximize their profits and they may also have negative impacts on environment. On the other hand, firms have to pay costs to minimize the impacts on environment. Thus, there seems to be a tradeoff relationship between business process and environment innovation. Eco-efficiency refers to a process when firms try to maximize efficiently the business process while they also minimize the impacts on the environment. Actually, eco-efficiency is becoming a new and important requirement for firms. "Eco-efficiency" defined by the World Business Council for Sustainable Development (WBCSD) is a management strategy of doing more with less. In practice, the core objectives of eco-efficiency contain increasing product or service value, optimizing the use of resources, and the most important, reducing environmental impacts.

Sinkina, Wrightb and Burnett (2008) found that market has positive relation to the firms which achieve to maximize profits and minimize the impacts on the environment compared with firms which do not adopt eco-efficient business strategies. Based on Innovest Strategic Value Advisors' corporate eco-efficiency scores, Derwall, Gunster, Bauer and Koedijk (2005) provided evidence that high-ranked portfolio have higher average returns related with low-ranked matching portfolio from 1995 to 2003. Guenster, Bauer, Derwall and Koedijk (2011) used a new database of eco-efficiency scores and investigated the relationship between eco-efficiency and firm performance from 1997 to 2004. They found that eco-efficiency is positive with operating performance and market value. Their results also implied that managers do not have to overcome a tradeoff between eco-efficiency and operation performance. Moreover, investors consider the environmental information when they make investment decisions and positively reflect to the stock prices with high eco-efficiency. However, Bauer, Koedijk and Otten (2005) investigated 103 German, UK and US SRI (Socially Responsible Investing) mutual funds and there is no evidence of significant differences in risk-adjusted returns between ethical mutual funds and conventional funds from 1990 to 2001. Arguments on whether environmental (or eco) anomaly exists still need more empirical evidence to validate.

3. Data and Methodology. The daily index prices are obtained from HSBC and MSCI websites from May 16, 2006 to May 16, 2011. Since the climate change related indices were constructed only in these 5 or 6 years, the investigating period is shorter than regular index. In order to have as many observations as possible, we choose the HSBC climate change index to be the sample index in this paper after

considering a number of related target indices because the indices have longer period with broader range of industry groups.

According to the definition of HSBC, the climate change investment opportunity set is defined as 4 global sectors and 19 global industrial themes. HSBC Global Climate Change Index is constructed by 4 sub-indices, including HSBC Low Carbon Energy Production Index (shown as HSBC LCEP), HSBC Energy Efficiency & Energy Management Index (HSBC EEEM), HSBC Water, Waste & Pollution Control Index (HSBC WWPC), and HSBC Climate Finance Index (HSBC Finance). First, LCEP contains firms from agrochemical, biofuels, gas, geothermal/hydro, nuclear, solar integrated power, wind power, and diversified renewable industry. Second, EEEM contains firms from building insulation, energy efficient solutions, fuel cells, and power storage industry. Third, WWPC includes firms from water, waste, and pollution control industry. Finally, Finance index contains firms from investment companies and carbon trading industry (see Figure 1).

MSCI All Countries World Index (MSCI AC World index) and MSCI World Index are chosen as the benchmark index since the constituent stocks of climate change related indices are from global countries, such as HSBC Global Climate Change Index. We choose both MSCI AC World Index and MSCI World Index as benchmark since MSCI World Index only contains firms from developed countries. On the other hand, MSCI AC World Index contains firms from all countries, including developed ones, emerging markets, and Far East market.

First, monthly return is the arithmetic average of daily returns. Then, the benchmark-adjusted abnormal return is defined as:

$$WR = \frac{1 + HPR_i / 100}{1 + HPR_{comtrol} / 100}, \quad (1)$$

where $R_{i,t}$ is the raw return of climate change index i in event month t. $R_{control,t}$ is the raw return of benchmark index in event month t.

Then, the holding period returns of climate change index and benchmark index are computed as (Ritter, 1991):

$$HPR_{i,t} = \left[\prod_{t=1}^{N} (1 + R_{i,t}) - 1 \right] \times 100, \quad (2)$$

where $R_{i,t}$ is the raw return of stock index i in event month t. $R_{control,t}$ is used to measure total returns from a buy-and-hold strategy where a stock is purchased at month 1 and held until the month N. In this paper, the holding period returns are calculated as 3 different periods: (1) the whole period (N is 61 months); (2) the sub-period from May, 2006 to August, 2008 (N is 28 months); (3) the sub-period from September, 2008 to May, 2011 (N is 33 months), respectively and shown in percentages.

Following the methodology provided in Ritter (1991), the wealth relatives is a performance measure proxy, defined as

$$WR = \frac{1 + HPR_i / 100}{1 + HPR_{comtrol} / 100} \quad (3)$$

where $HPR_{control}$ is used to measure total returns of benchmark index in the sample period. A wealth relative of greater than 1 means climate change index outperforms benchmark index. On the other hand, a wealth relative of less than 1 means climate change index underperforms.

Giambona et al. (2005) used a similar indicator to measure return performance, defined as

$$PHPR_i = \frac{\prod_{t=1}^{N}(1+R_{i,t})}{\prod_{t=1}^{N}(1+R_{control,t})}, \quad (4)$$

where $R_{i,t}$ is the raw return of climate change index i in event month t. $R_{control,t}$ is the raw return of benchmark index in event month t. This ratio greater than 1 means climate change index has positive abnormal performance to the benchmark index. Giambona et al. (2005) indicate that this methodology can induce in part of serial correlation by the rebalancing bias.

4. Empirical Results

4.1 Summary Statistics

Figure 1 exhibits the daily prices of 3 stock indices based on May 16, 2006 as 100. The daily prices of HSBC Global Climate Change Index are higher before September 2008 compared with MSCI All Countries World Index and MSCI World Index. However, one can obviously observe that the returns of climate changes related index are higher than MSCI indices for investors. The daily prices of HSBC Global Climate Change Index are higher than the price of MSCI All Countries World Index after September 2008. It seems to mean that climate change stock index outperforms MSCI AC World index until financial crisis in 2008. We choose both MSCI AC World Index and MSCI World Index as benchmark since MSCI World Index only contains firms from developed countries. On the other hand, MSCI AC World Index contains firms from all countries, including developed countries, emerging market, and Far East market.

Table 1 shows the summary statistics of MSCI indices and HSBC climate change related indices from May 16, 2006 to May 16, 2011. Panels A and B are the summary statistics of benchmark indices and climate change indices, respectively. The returns of HSBC Global climate change indices are lower than MSCI AC World index and MSCI World index on average. For example, the mean (median) of daily returns of MSCI AC World index is 0.012% (0.097%) in the past 5 years while the mean (median) of daily returns of HSBC Climate Change Index is only 0.008% (0.090%). HSBC Global Climate Change Index also has higher volatility at 1.454% than MSCI AC World index at 1.298% in the past 5 years.

According to the last indices report of HSBC, LCEP and WWPC have each received approximately 22% and 25% of indices, respectively. EEEM has received approximately 53% of indices while Finance has received around 0% of them. In panel B of Table 1, the mean (median) daily returns of LCEP, EEEM, and WWPC are 0.001% (0.000%), 0.027% (0.000%), and 0.013% (0.000%), respectively. The daily returns of EEEM and WWPC are higher than MSCI AC World index in the past 5 years.

4.2 Long-run Performance

Table 2 demonstrates whether HSBC Global Climate Change Index outperforms MSCI AC World Index or MSCI World Index in the past 5 years. Panel A shows the difference between HSBC Global Climate Change Index and MSCI AC World Index in the whole period. Panel B shows the difference between HSBC Global Climate Change Index and MSCI World Index in the whole period. Figure 1 reveals that the daily prices of HSBC Global Climate Change Index are higher before September 2008 compared with MSCI All Countries World Index and MSCI World Index. At the same time, Lehman Brother Holdings Inc. filed for the Chapter 11 bankruptcy protection on September 15, 2008. Lehman Brother collapse also induced global stocks, including US, European, and Asian stock markets, drop after announcement. We infer that the relationship between MSCI AC World Index and HSBC Global Climate Change Index has structurally changed after Lehman Brother collapse, thus two sub-periods are separated by the month of September 2008.

In panel A of Table 2, the difference between HSBC Global Climate Change Index and MSCI AC World Index is insignificantly negatively different from zero, regardless daily returns or monthly returns. Panel B also shows the same results if the benchmark index is altered as MSCI World Index. The results do not change if only the sub-period May 16, 2008 to August 31, 2008 is investigated.

Next, HSBC Global Climate Change Index is divided into 4 sub-indices to investigate whether one of sub-indices outperform MSCI AC World Index. Table 3 shows the mean returns of sub-indices of HSBC Global Climate Change Index and the mean returns of MSCI AC World Index. Unfortunately, the sub-indices of HSBC Global Climate Change Index insignificantly outperform MSCI AC World Index. For example, the difference between daily returns of LCPE and daily returns of MSCI AC World Index is only 0.2% but it is insignificant. The mean of daily returns of EEEM, WWPC, and Finance insignificantly underperform MSCI AC World Index.

In summary, the results in Tables 2 and 3 demonstrate that HSBC Global Climate Change Index seems to not outperform significantly MSCI AC World Index and MSCI World Index, regardless the sub-indices.

4.3 Long-run Abnormal Performance

Actually, the mean returns may be not important for investors since investors buy a financial asset and hold it for a long horizon despite periods of volatility or decline. This strategy in investment is called "buy-and-hold" strategy and the return is "buy and hold returns" (also called holding period returns). Investors using the buy-and-hold strategy select stocks on the basis of their long-run outlook. Such investors are not influenced by short- or intermediate-run movements in the stock prices. Buy-and-hold strategy is easy to practice and is a passive investment strategy. It is also widely used in the empirical literature, especially for event study researches. For example, Mackinlay (1997) showed that the bid-ask spread bias can be eliminated by considering cumulative abnormal returns using buy-and-hold strategy. Ritter (1991) used buy-and-hold strategy to calculate the wealth relatives in order to measure the relative long-run performance of IPO. In this section we compute the buy-and-hold returns of HSBC climate change related indices and benchmark indices in order to accord with the investment strategy of investors.

Table 4 shows the buy-and-hold returns, relative wealth (Ritter, 1991) and abnormal performance (Giambona, Giaccotto and Sirmans, 2005) of HSBC Global Climate Change Index and MSCI AC World Index. Panel A is the results of buy-and-hold returns. Panels B and C investigate whether HSBC Global Climate Change Index and its sub-indices outperform MSCI AC World Index measured by relative wealth and abnormal performance, respectively. Moreover, we also separate the period into two sub-periods from May 2006 to September 2008 and from September 2008 to the present.

In panel B of Table 4, HSBC Global Climate Change Index underperforms MSCI AC World Index and MSCI World Index in the whole sample period. However, HSBC Global Climate Change Index outperforms MSCI AC World Index and MSCI World Index from May 2006 to September 2008 while HSBC Global Climate Change Index has underperformance from September 2008 to the present. HSBC MMME, WWPC and Finance have outperformance compared with MSCI AC World Index in the whole period, excluding LCEP. All sub-indices have outperformance compared with MSCI AC World Index from May 2006 to September 2008. Most of sub-indices underperform MSCI AC World Index after September 2008, excluding EEEM. In general, HSBC Global Climate Change Index and most of its sub-indices have outperformance compared with MSCI AC World Index only before September 2008, while EEEM has outperformance in the whole period, before and after September 2008. Panel C of Table 4 shows the similar results. HSBC Global Climate Change Index underperforms MSCI AC World Index and MSCI World Index in the whole sample period. HSBC LCEP underperforms MSCI AC World Index while HSBC's other three sub-indices outperform in the whole period and sub-period before September 2008.

5. Conclusions. This paper investigates the financial anomalies caused by climate change related responsibility. The main purpose is to test whether anomalies occur with climate change portfolio. We take HSBC Global Climate Change Index as example and the MSCI World Index as benchmark from May 2006 to May 2011. The empirical results partially support that investors consider the firms with climate change strategy when they make the investing decisions. The results show that the mean returns and buy-and-hold returns of HSBC Global Climate Change Index are higher than MSCI (All Countries) World Index in the whole period, but not significantly. However, HSBC Global Climate Change Index has better performance than MSCI (All Countries) World Index before September 2008. Other sub-indices of HSBC Global Climate Change Index, excluding LCEP, also outperform MSCI (All Countries) World Index, especially before September 2008. We therefore conclude that the climate change anomaly really exists, especially in the period while the macroeconomics is relatively stable.

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Appendices:

Table 1. **Summary Statistics of Indices from 2006/5/16 to 2011/5/16**

Panel A: MSCI Indexes

Year	Number of observations	MSCI AC World Index			MSCI World Index		
		Mean	Median	Standard Deviation	Mean	Median	Standard Deviation
2006	163	0.056%	0.687%	0.061%	0.054%	0.674%	0.052%
2007	261	0.037%	0.819%	0.149%	0.028%	0.807%	0.138%
2008	262	-0.198%	2.017%	-0.120%	-0.188%	2.027%	-0.116%
2009	261	0.121%	1.439%	0.212%	0.107%	1.457%	0.190%
2010	261	0.049%	1.030%	0.097%	0.047%	1.051%	0.069%
2011	96	0.041%	0.747%	0.119%	0.049%	0.760%	0.153%
Total	1,304	0.012%	0.097%	1.298%	0.009%	0.088%	1.306%

Panel B: HSBC Climate Change Indices

Year	Number of observations	HSBC Climate Change Index			HSBC LCEP			HSBC EEEM			HSBC WWPC		
		Mean	Median	Standard Deviation	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation	Mean	Median	Standard Deviation
2006	163	0.071%	0.983%	0.117%	0.078%	0.994%	0.163%	0.057%	1.383%	0.127%	0.075%	0.846%	0.056%
2007	261	0.102%	1.048%	0.248%	0.140%	1.093%	0.228%	0.070%	1.348%	0.212%	0.067%	0.899%	0.075%
2008	262	-0.199%	2.272%	-0.150%	-0.201%	2.271%	0.000%	-0.239%	2.798%	0.000%	-0.175%	2.121%	0.000%
2009	261	0.079%	1.449%	0.109%	0.054%	1.287%	0.000%	0.181%	2.125%	0.000%	0.072%	1.419%	0.000%
2010	261	0.014%	1.130%	0.054%	-0.033%	1.044%	0.000%	0.074%	1.490%	0.000%	0.036%	1.060%	0.000%

The end of *Table 1*

2011	96	-0.005%	0.885%	-0.030%	-0.009%	0.921%	0.000%	0.043%	1.065%	0.000%	0.048%	0.758%	0.000%
Total	1,304	0.008%	0.090%	1.454%	0.001%	0.000%	1.420%	0.027%	0.000%	1.901%	0.013%	0.000%	1.352%

The daily index prices are obtained from HSBC and MSCI website from May 16, 2006 to May 16, 2011. Panels A and B are the summary statistics of benchmark indices and climate change indices, respectively. MSCI AC World Index is MSCI All Countries World Index, including all countries, developed and emerging ones. On the other hand, MSCI World Index only includes developed countries. 4 sub-indices of HSBC Climate Change Index is HSBC Global Climate Change Index are HSBC Low Carbon Energy Production Index (shown as HSBC LCEP), HSBC Energy Efficiency & Energy Management Index (shown as HSBC EEEM), HSBC Water, Waste & Pollution Control Index (shown as HSBC WWPC), and HSBC Climate Finance Index (shown as HSBC Finance).

Table 2. **The mean (median) returns of HSBC Global Climate Change Index and MSCI All Countries World Index**

Panel A: Whole period - HSBC Global Climate Change Index v.s. MSCI AC World Index						
	Daily returns			Monthly returns		
	N	Mean	Median	N	Mean	Median
HSBC Climate Change	1,304	0.008%	0.092%	61	-0.001%	0.044%
MSCI AC World Index	1,304	0.012%	0.097%	61	0.005%	0.046%
Difference		-0.004%			-0.006%	
		(-0.070)			(-0.110)	
Panel B: Whole period - HSBC Global Climate Change Index v.s. MSCI World Index						
	Daily returns			Monthly returns		
	N	Mean	Median	N	Mean	Median
HSBC Climate Change	1,304	0.008%	0.092%	61	-0.001%	0.044%
MSCI World Index	1,304	0.007%	0.089%	61	0.002%	0.047%
Difference		0.000%			-0.002%	
		(0.010)			(-0.040)	
Panel C: Subperiod 2003/05/16 to 2008/08/31 - HSBC Global Climate Change Index v.s. MSCI AC World Index						
	Daily returns			Monthly returns		
	N	Mean	Median	N	Mean	Median
HSBC Climate Change	599	0.036%	0.146%	55	-0.008%	0.114%
MSCI AC World Index	599	0.002%	0.069%	55	-0.005%	0.065%
Difference		0.034%			-0.003%	
		(0.600)			(-0.050)	
Panel D: Subperiod 2003/05/16 to 2008/08/31 - HSBC Global Climate Change Index v.s. MSCI World Index						
	Daily returns			Monthly returns		
	N	Mean	Median	N	Mean	Median
HSBC Climate Change	599	0.036%	0.146%	55	-0.008%	0.114%
MSCI World Index	599	0.000%	0.086%	55	-0.009%	0.090%
Difference		0.036%			0.001%	
		(0.640)			(0.010)	

This table shows the mean (median) daily returns of indices from May 16, 2006 to May 16, 2011. HSBC Climate Change Index. Its 4 sub-indices are HSBC Low Carbon Energy Production Index (shown as HSBC LCEP), HSBC Energy Efficiency & Energy Management Index (shown as HSBC EEEM), HSBC Water, Waste & Pollution Control Index (shown as HSBC WWPC), and HSBC Climate Finance Index (shown as HSBC Finance). The null hypothesis is that the difference of mean returns is zero. The *t*-statistics are shown in parentheses. "***", "**", and "*" represent the 1%, 5%, and 10% significance levels, respectively.

Table 3. **The mean (median) daily returns of the sub-indices of HSBC Global Climate Change Index and MSCI All Countries World Index in the whole period**

Panel A: Whole period - HSBC LCEP Index v.s. MSCI AC World index			
	Daily returns		
	N	Mean	Median
HSBC LCEP	1,304	0.001%	0.000%
MSCI AC World Index	1,304	0.012%	0.097%
Difference		0.011%	
		(0.200)	
Panel B: Whole period - HSBC EEEM Index v.s. MSCI AC World index			
	Daily returns		
	N	Mean	Median
HSBC EEEM Index	1,304	0.028%	0.000%
MSCI AC World Index	1,304	0.012%	0.097%
Difference		-0.016%	
		(-0.250)	
Panel C: Whole period - HSBC WWPC Index v.s. MSCI AC World index			
	Daily returns		
	N	Mean	Median
HSBC WWPC Index	1,304	0.012%	0.000%
MSCI AC World Index	1,304	0.012%	0.097%
Difference		-0.001%	
		(-0.020)	
Panel D: Whole period - HSBC Finance Index v.s. MSCI AC World index			
	Daily returns		
	N	Mean	Median
HSBC Finance Index	1,085	0.013%	0.021%
MSCI AC World Index	1,304	0.012%	0.097%
Difference		-0.001%	
		(-0.010)	

This table shows the mean (median) daily returns of indexes from May 16, 2006 to May 16, 2011. HSBC Climate Change Index is HSBC Global Climate Change Index. Its 4 sub-indexes are HSBC Low Carbon Energy Production Index (shown as HSBC LCEP), HSBC Energy Efficiency & Energy Management Index (shown as HSBC EEEM), HSBC Water, Waste & Pollution Control Index (shown as HSBC WWPC), and HSBC Climate Finance Index (shown as HSBC Finance). The null hypothesis is that the difference of mean returns is zero. The *t*-statistics are shown in parentheses. "***", "**", and "*" represent 1%, 5%, and 10% significance levels, respectively.

Table 4. **Holding period returns and wealth relative, from May 2006 to May 2011**

The holding period returns of HSBC Global Climate Change Indices and MSCI indices, and wealth relatives are computed by monthly returns. In Panel A, holding period returns are calculated as

$$HPR_{i,t} = \left[\prod_{t=1}^{n}(1+R_{i,t})-1\right]\times 100, \quad (2)$$

where R_{it} is the monthly raw return on index i at month t. The holding period returns are calculated as 3 different periods: (1) the whole period (61 months); (2) the period from May, 2006 to August, 2008 (28 months); (3) the period from September, 2008 to May, 2011 (33 months), respectively and is shown in %. In Panel B, the wealth relative (Ritter, 1991) is the ratio of one plus the HSBC climate change related index holding period return (not in %) divided by one plus the benchmark index holding period return (not in %).

$$WR = \frac{1+HPR_i/100}{1+HPR_{comtrol}/100}. \quad (3)$$

A wealth relative of greater than 1 means climate change index outperforms benchmark index. In Panel C, the abnormal performance (Giambona, Giaccotto, and Sirmans, 2005) is defined as

$$PHPR_i = \frac{\prod_{t=1}^{N}(1+R_{i,t})}{\prod_{t=1}^{N}(1+R_{control,t})}. \quad (4)$$

This ratio greater than 1 means climate change index has positive abnormal performance to the benchmark index.

Panel A: Holding period returns				
		Whole period	2006/05 - 2008/08	2008/09 — 2011/05
	Index	HPR	HPR	HPR
(1)	MSCI AC Index	0.2985	-0.0312	0.3297
(2)	MSCI World Index	0.1717	-0.0825	0.2544
(3)	HSBC Global Climate Change Index	-0.0766	0.8932	-0.9612
(4)	HSBC LCEP Index	-0.2987	1.2635	-1.5427
(5)	HSBC EEEM Index	1.2578	0.3242	0.9306
(6)	HSBC WWPC Index	0.5091	0.6969	-0.1865
(7)	HSBC Finance Index	2.1346	4.1157	-1.9028
Panle B: Wealth relatives defined by Ritter (1991)				
		Whole period	2006/05 - 2008/08	2008/09 — 2011/05
	Index	WR	WR	WR
(3) / (1)	HSBC Climate Change Index vs MSCI AC World Index	0.9963	1.0092	0.9871
(3) / (2)	HSBC Climate Change Index vs MSCI World Index	0.9975	1.0098	0.9879
(4) / (1)	HSBC LCEP vs MSCI AC World Index	0.9940	1.0130	0.9813
(5) / (1)	HSBC EEEM vs MSCI AC World Index	1.0096	1.0036	1.0060
(6) / (1)	HSBC WWPC vs MSCI AC World Index	1.0021	1.0073	0.9949
(7) / (1)	HSBC Finance vs MSCI AC World Index	1.0183	1.0415	0.9777
Panle C: Abnormal performance as defined by Giambona, Giaccotto, and Sirmans (2005)				
		Whole period	2006/05 - 2008/08	2008/09 — 2011/05
	Index	PHPR	PHPR	PHPR
(3) / (1)	HSBC Climate Change Index vs MSCI AC World Index	0.9963	1.0092	0.9871
(3) / (2)	HSBC Climate Change Index vs MSCI World Index	0.9975	1.0098	0.9879
(4) / (1)	HSBC LCEP vs MSCI AC World Index	0.9940	1.0130	0.9813
(5) / (1)	HSBC EEEM vs MSCI AC World Index	1.0096	1.0036	1.0060
(6) / (1)	HSBC WWPC vs MSCI AC World Index	1.0021	1.0073	0.9949
(7) / (1)	HSBC Finance vs MSCI AC World Index	1.0183	1.0415	0.9777

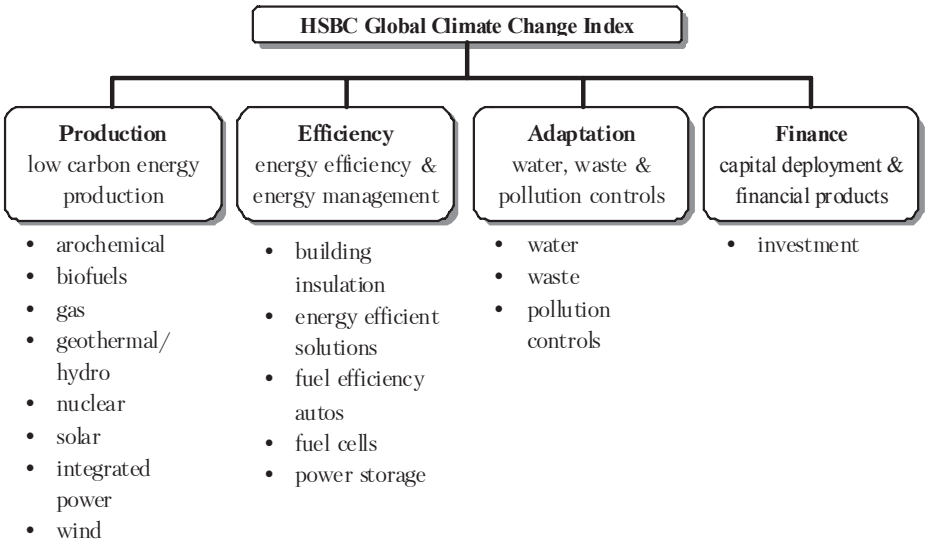

Figure 1. **HSBC Global Climate Change Framework — Sectors and Themes**

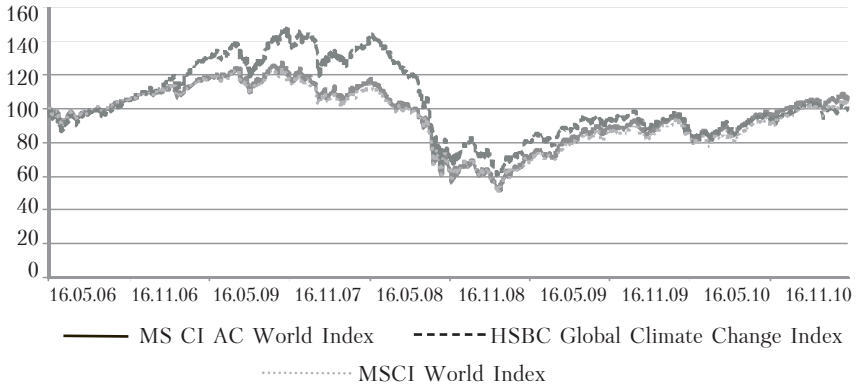

Figure 2. **Daily prices of HSBC Global Climate Change Index, MSCI All Countries World Index, and MSCI World Index from May 16, 2006 to May 16, 2011**

The daily index prices are obtained from HSBC and MSCI website. The dashed line is the daily prices of HSBC Global Climate Change Index based on May 16, 2006 as 100. The solid line is the daily price of MSCI All Countries World Index based on May 16, 2006 as 100. Finally, the dotted line is the daily prices of MSCI World Index based on May 16, 2006 as 100.

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