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Research

Integrating Low-Carbon and Factor Strategies in Asia

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EXECUTIVE SUMMARY

Low-carbon and factor-based investing are two key trends in the global investment management industry. This paper investigates the impact of low-carbon screening on traditional market-cap-weighted portfolios and factor portfolios (quality, value, momentum, and low volatility) across seven Asian markets: Australia, China, Hong Kong, India, Japan, South Korea, and Taiwan.

HIGHLIGHTS

- The weighted average carbon-intensity scores of unconstrained carbon-efficient portfolios were at least 85% lower than their respective carbon-inefficient portfolios.[1] Due to variation in carbon efficiency across sectors, unconstrained carbon-efficient portfolios resulted in significant sector biases.
- Our analysis suggested that the implementation of simple carbon-efficient screening, either sector-neutral or unconstrained, resulted in significantly lower portfolio carbon intensity scores over the entire studied period, without sacrificing returns or penalizing targeted factor exposure across Asian markets across longer time horizons.
- Carbon-efficient screening resulted in the highest weighted average carbon intensity reduction to low volatility and value portfolios across Asian markets. Carbon-efficient screening also improved risk-adjusted returns for the quality, value, and momentum portfolios, but lowered returns for the low volatility portfolio.
- Sensitivity analysis of carbon screening of factor portfolios showed that even a subtle carbon-efficient screen (decile exclusion of companies with the highest carbon intensity scores) can lead to a significant reduction in portfolio carbon intensity scores while posing minimal impact on their returns.

[1] The tertile of stocks with the lowest and highest carbon intensity scores from the examined universe formed the sector-unconstrained carbon-efficient and carbon-inefficient portfolios, respectively.

INTRODUCTION

Governments are becoming aware of the perils of GHGs and aiming to penalize the source of pollution.

In December 2015, under the Paris Agreement, nearly 200 governments adopted a consensus to limit the increase in global average temperature to "well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels."[2]

Governments are now increasingly becoming aware of the perils of greenhouse gases (GHGs) and aiming to penalize the source of pollution while looking to incentivize low-carbon technologies. Pricing carbon emissions is one potential approach to reducing GHG emissions. As of 2017, carbon prices averaged around USD 40 per metric ton of carbon dioxide and are expected to increase in the near future, which could affect companies directly with regulatory costs imposed on their operations through energy and fuel price increases, or indirectly through costs passed on by suppliers. These costs may be borne by companies or passed on to consumers in the form of higher prices.[3] Therefore, understanding carbon exposure is essential for businesses to manage risk.

Eventually, one could expect capital flight toward investment themes that are aligned with global climate commitments.

It is equally important for asset owners, lenders, insurance underwriters, and portfolio managers to factor in the impact of climate risks in order to make informed decisions. They may want to consider an organization's future financial position to discount potential write-downs of assets as well as the effect on revenues, costs, cash flows, and capital expenditure associated with adhering to policy changes to factor in climate risks. Eventually, one could expect capital flight toward investment themes that are aligned with global climate commitments.

The global market for ESG ETFs is expected to expand from USD 25 billion to over USD 400 billion within a decade.

The Japan's Government Pension Investment Fund (GPIF), for example, decided to invest in carbon efficient passive portfolios that seek to track global and domestic carbon-efficient indices[4] in September 2018, with the intention of promoting carbon efficiency and disclosure by companies. The global market for environmental, social, and governance (ESG) exchange-traded funds (ETFs) alone is expected to expand from USD 25 billion to more than USD 400 billion within a decade.[5] In Japan, sustainable investments have grown fourfold between 2016 and 2018.[6]

[2] Task Force on Climate-related Financial Disclosures (TCFD), "Recommendations of the Task Force on Climate-related Financial Disclosures," June 2017.

[3] Bernick, Libby, Steven Bullock, and Rick Lord, "Carbon Pricing: Discover Your Blind Spots on Risk and Opportunity Blind Spots on Risk and Opportunity," January 2018.

[4] The S&P/JPX Carbon Efficient Indices and S&P Global Ex-Japan LargeMidCap Carbon Efficient Indices.

[5] Thuard, Johan, Harvey Koh, Anand Agarwal, and Riya Garg, "Financing the Future of Asia: Innovations in Sustainable Finance," April 2019.

[6] Kodaira, Ryushiro and Matsumoto, Hiroko, "After fending off eco-warriors, Asia Inc find 'ESG' investors hard to ignore," *Nikkei Asian Review*, June 12, 2019.

DATA AND METHODOLOGY

Carbon intensity helps identify sources of high carbon risk in portfolios across markets by normalizing for a company's size.

The methodology employed to construct carbon-efficient portfolios in our study broadly follows the approach adopted in an earlier research paper, "Carbon Risk Integration in Factor Portfolios," which examined carbon-efficient factor portfolios in the U.S.[7] We measured a company's carbon efficiency based on its carbon intensity score provided by Trucost, which is defined as the GHG emissions from a company's direct operations and first-tier suppliers, measured in metric tons of carbon dioxide equivalent (CO_2e) per USD 1 million of revenue (CO_2e/USD 1 million).[8] Companies were screened by their carbon intensity scores to form the carbon-efficient portfolios, where carbon efficiency for portfolios was measured by their weighted average carbon intensity scores (see Appendix A).

The base universe for each market includes companies from its broad market-cap-weighted benchmark index with carbon intensity scores.

Our study covers seven Asian markets—Australia, China, Hong Kong, India, Japan, South Korea, and Taiwan—and the base universe for each market includes companies from its respective broad market-cap-weighted benchmark index with carbon intensity scores available. The back-test covers the period from September 2007 to June 2018[9] and the carbon intensity score coverage has gradually increased to above 90% of the float market capitalization of the benchmark for most markets, except for China (approximately 49%; see Appendix B). There were differences in sector representation between the base universe and the benchmark (see Appendix C), and we observed slightly better performance for the base universe versus the benchmark in Australia, China, Hong Kong, India, and Taiwan[10] (see Appendix D).

The performance of all portfolios and base universes was measured in the local trading currency of the respective markets. All portfolios and base universes were equally weighted with semiannual rebalancing after the close of the third Friday of March and September. Reference data (e.g., carbon intensity score, market cap, etc.) for portfolio construction were sourced as of the close of the last trading day of February and August. Fundamental data used to form factor portfolios were sourced from Worldscope and FactSet, and the data were appropriately lagged by three months as of the reference date for each rebalance period to avoid look-ahead bias.

[7] Bill Hao, Aye Soe, and Kelly Tang, "Carbon Risk Integration in Factor Portfolios," S&P Dow Jones Indices, February 2018.

[8] For example, direct GHG emissions of an automobile manufacturer includes the emissions due to its own operation or production (e.g., welding, assembly of parts, painting, etc.), while the first-tier indirect emissions include emissions from its supply chains and procurement, such as utilities, steel manufacturing, tires, spare parts, and business travel.

[9] For China, the back-test covers the period from March 2011 to June 2018 due to relatively lower carbon intensity score coverage before 2010.

[10] We compared the absolute return, volatility, risk-adjusted return, and beta for the equal-weighted benchmark universe and the equal-weighted base universe.

CARBON EFFICIENCY OF SECTORS ACROSS MARKETS

Carbon efficiency of sectors displayed a wide spectrum due to varied business operations or production processes.

Carbon efficiency of sectors displayed a wide spectrum due to varied business operations or production processes. Based on the weighted average carbon intensity score of constituents within each sector (see Exhibit 1), it is evident that companies in Financials, Health Care, and Telecommunication Services[11] sectors tended to be the most carbon efficient. In contrast, companies from the Utilities, Materials, and Energy sectors were the least carbon efficient. Due to variation in carbon efficiency across sectors, unconstrained carbon-efficient portfolios would result in significant sector biases.

In addition, we observe significant differentials on carbon efficiency across markets, especially in the least-carbon-efficient sectors. For example, the Materials sector in India had a weighted average carbon intensity score of 4,069, whereas the Materials sector in Australia had a score of only 740. The Energy sector in China had a weighted average carbon intensity score of 3,207, while the Energy sector in Japan had a low ratio of 483. Differentials in carbon efficiency across markets and stocks indicate the carbon reduction potential by carbon-efficient screening across different sectors.

Companies in the Financials, Health Care and Telecommunication Services sectors tended to be the most carbon efficient…

…in contrast, companies from the Utilities, Materials, and Energy sectors were the least carbon efficient.

Exhibit 1: Weighted Average Carbon Intensity Scores for Each Sector across Markets

GICS SECTOR	AUSTRALIA	CHINA	HONG KONG	INDIA	JAPAN	SOUTH KOREA	TAIWAN
Consumer Discretionary	71	110	118	174	102	99	177
Consumer Staples	378	495	559	285	294	138	185
Energy	1,059	3,207	1,893	964	483	737	1,462
Financials	12	11	88	17	11	14	9
Health Care	66	62	61	352	63	56	79
Industrials	151	294	367	538	216	223	653
Information Technology	127	96	154	37	99	148	160
Materials	740	1,189	2,418	4,069	908	897	1,899
Real Estate	122	82	120	76	114	N/A	89
Telecommunication Services	31	26	41	40	46	81	85
Utilities	2,551	6,586	6,760	8,471	2,939	2,522	N/A

Source: S&P Dow Jones Indices LLC and Trucost ESG Analysis. Data as of March 16, 2018. Measured in CO2e/USD 1 million. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance. Please refer to Appendix B for benchmark indices used for each market.

[11] As of Sept. 21, 2018, the Global Industry Classification Standard® (GICS®) was updated with a new Communication Services sector that combined the Telecommunication Services sector with parts of the Information Technology and Consumer Discretionary sectors.

UNCONSTRAINED AND SECTOR-NEUTRAL CARBON-EFFICIENT PORTFOLIOS

We examined carbon-efficient portfolios with unconstrained and sector-neutral approaches.

We examined carbon-efficient portfolios with unconstrained[12] and sector-neutral approaches. With the unconstrained approach, we ranked all companies in the base universe by their carbon intensity scores. The tertile (one-third) of the base universe with the lowest and highest carbon intensity scores formed the unconstrained carbon-efficient and carbon-inefficient portfolios, respectively. With the sector-neutral approach, we ranked companies in the base universe within each sector by their carbon intensity scores. The tertile of stocks with the lowest and highest carbon intensity scores from each sector constituted the sector-neutral carbon-efficient and carbon-inefficient portfolios, respectively.[13] Companies in all portfolios and base universes were equally weighted.

Implementation of a simple carbon screen resulted in significantly lower portfolio carbon intensity scores without sacrificing returns.

Variation in carbon efficiency across sectors was substantial, which resulted in sector biases in the unconstrained carbon-efficient and carbon-inefficient portfolios (see Exhibit 2). The most significant sector biases were observed in the Financials and Materials sectors for most markets. However, our observations suggest that the implementation of a simple carbon-efficient screen, either with or without sector constraints, resulted in significantly lower portfolio carbon intensity scores without sacrificing returns across Asian markets over the longer horizons studied (see Exhibit 3).

Carbon-efficient portfolios tend to deliver positive information ratios in most markets.

Despite significant reduction in weighted average carbon intensity scores, the carbon-efficient portfolios also had lower return volatility than their respective carbon-inefficient portfolios in most markets with the unconstrained (except in Taiwan) and sector-neutral approaches. We also observed that the carbon-efficient portfolios outperformed their respective carbon-inefficient portfolio across the seven markets on absolute and risk-adjusted bases over the entire studied period. Compared with the base universe, the carbon-efficient portfolios tended to deliver positive information ratios, while the carbon-inefficient portfolios offered negative information ratios in most markets with the unconstrained and sector-neutral approaches.

As expected, the return spread, carbon intensity, and volatility reduction between the carbon-efficient and carbon-inefficient portfolios were much more pronounced with the unconstrained approach. The tracking error of unconstrained carbon-efficient portfolios was relatively higher (4.6%-8.0%). However, with the sector-neutral approach, tracking errors of the carbon-efficient portfolios tended to be much lower (3.0%-5.9%).

[12] The unconstrained approach allows for higher sector deviations, whereas the sector-neutral approach would have relatively lower active sector deviations.

[13] If there were only two stocks in a sector, the two stocks were segregated into the top and bottom bucket.

Exhibit 2: Average Active Sector Weights of Sector-Unconstrained Carbon-Efficient and Carbon-Inefficient Portfolios over the Base Universe (%)

MARKET	PORTFOLIO	CONSUMER DISCRETIONARY	CONSUMER STAPLES	ENERGY	FINANCIALS	HEALTH CARE	INDUSTRIALS	INFORMATION TECHNOLOGY	MATERIALS	REAL ESTATE	TELECOMMUNICATION SERVICES	UTILITIES
Australia	Carbon Efficient	8.0	-3.0	-6.6	13.8	1.8	1.3	5.2	-18.8	-2.0	3.7	-3.4
	Carbon Inefficient	-13.8	1.0	11.8	-16.6	-5.6	-7.0	-2.8	32.4	-0.9	-2.2	3.7
China	Carbon Efficient	5.7	-4.5	-3.9	18.5	8.4	-12.9	4.5	-13.7	-1.7	1.5	-1.8
	Carbon Inefficient	-7.5	7.3	7.5	-21.3	-5.0	-4.3	-4.8	26.4	-2.0	-0.7	4.4
Hong Kong	Carbon Efficient	6.3	-3.3	-3.5	14.9	4.5	-10.7	3.8	-9.2	-2.4	4.3	-4.8
	Carbon Inefficient	-11.1	6.4	5.6	-20.5	-2.2	1.8	-2.8	17.4	-2.4	-2.7	10.2
India	Carbon Efficient	-2.9	-7.6	-7.5	29.5	-0.8	-5.6	8.3	-14.7	-0.2	6.7	-5.1
	Carbon Inefficient	-5.8	-0.8	11.6	-19.9	-4.4	-2.7	-5.5	22.3	-0.2	-3.7	9.1
Japan	Carbon Efficient	3.6	-4.5	-1.4	20.4	7.1	-15.2	3.0	-11.7	-0.1	1.9	-2.9
	Carbon Inefficient	-11.3	6.0	2.4	-12.3	-5.6	4.2	-7.2	20.0	-0.4	-1.0	5.1
South Korea	Carbon Efficient	-3.0	-3.0	-3.2	33.7	0.6	-17.3	0.1	-9.2	0.0	3.6	-2.2
	Carbon Inefficient	-4.9	2.3	6.4	-16.9	-2.3	-4.9	2.8	17.5	0.0	-3.3	3.3
Taiwan	Carbon Efficient	-3.1	0.1	-0.7	26.0	0.4	-7.8	-4.3	-11.1	-0.5	0.9	0.0
	Carbon Inefficient	1.2	0.2	1.3	-16.9	-0.7	13.7	-18.4	22.0	-0.5	-2.0	0.0

All portfolios shown are hypothetical.
Source: S&P Dow Jones Indices LLC, Trucost ESG Analysis, and FactSet. Data from Sept. 21, 2007, to June 29, 2018. Data for China from March 18, 2011, to June 29, 2018. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance. Please refer to Appendix B for indices used for each region. The most and least represented sector by active weight in each market is highlighted in green and yellow, respectively.

With the unconstrained approach, the carbon-efficient portfolios had much lower weighted average carbon intensity scores than their respective carbon-inefficient portfolios, with carbon intensity reductions between 95.6% and 99.5% across all markets. The highest return spreads and volatility reductions were seen in China, Australia, and Hong Kong. With sector constraints in place, the weighted average carbon intensity score reductions between the carbon-efficient and carbon-inefficient portfolios ranged from 84.3% to 95.8% across markets. China, Japan, and Hong Kong recorded the highest excess return spreads and reductions in volatility.

We carried out a similar analysis for the carbon-efficient and carbon-inefficient portfolios, with companies weighted by market cap (see Appendix E). Despite dominance by large-cap companies in the portfolio attributes, reduction in the weighted average carbon intensity score for the carbon-efficient portfolios versus their respective carbon-inefficient portfolios remained significant across all markets. However, observations on returns and volatilities were much less consistent. With the sector-neutral and unconstrained approaches, the carbon-efficient portfolios outperformed their respective carbon-inefficient portfolios and base universes in China, Hong Kong, Taiwan, and Japan on absolute and risk-adjusted bases, but the performance trend was not consistent in the other three markets.

Exhibit 3: Risk/Return Characteristics of Sector-Unconstrained and Sector-Neutral Carbon-Efficient and Carbon-Inefficient Portfolios (Equal-Weighted)

PORTFOLIO		ANNUALIZED RETURN (%)	ANNUALIZED VOLATILITY (%)	RISK-ADJUSTED RETURN	ANNUALIZED EXCESS RETURN (%)	TRACKING ERROR (%)	INFORMATION RATIO	WEIGHTED AVERAGE CARBON INTENSITY
AUSTRALIA								
Unconstrained	Carbon Efficient	5.1	16.8	0.30	2.2	6.2	0.36	28
	Carbon Inefficient	0.4	22.7	0.02	-2.4	9.4	-0.26	980
Sector-Neutral	Carbon Efficient	2.7	18.1	0.15	-0.1	4.2	-0.02	111
	Carbon Inefficient	1.3	18.3	0.07	-1.5	4.5	-0.33	784
CHINA								
Unconstrained	Carbon Efficient	8.3	24.5	0.34	3.1	6.1	0.51	30
	Carbon Inefficient	-0.3	26.4	-0.01	-5.5	6.0	-0.91	2,212
Sector-Neutral	Carbon Efficient	6.3	23.7	0.26	1.1	4.2	0.27	100
	Carbon Inefficient	3.7	26.3	0.14	-1.4	3.9	-0.36	1,668
HONG KONG								
Unconstrained	Carbon Efficient	8.4	23.5	0.36	1.9	5.0	0.39	37
	Carbon Inefficient	3.6	26.9	0.13	-2.8	5.5	-0.52	2,737
Sector-Neutral	Carbon Efficient	6.8	24.3	0.28	0.3	4.2	0.08	98
	Carbon Inefficient	4.8	26.6	0.18	-1.7	4.6	-0.36	2,270
INDIA								
Unconstrained	Carbon Efficient	10.7	24.8	0.43	-0.5	6.6	-0.07	24
	Carbon Inefficient	9.2	25.3	0.36	-2.0	6.5	-0.30	4,687
Sector-Neutral	Carbon Efficient	11.5	21.4	0.54	0.4	5.3	0.07	155
	Carbon Inefficient	9.6	23.6	0.41	-1.5	4.9	-0.31	3,683
JAPAN								
Unconstrained	Carbon Efficient	6.7	23.1	0.29	0.5	4.6	0.11	34
	Carbon Inefficient	4.6	23.9	0.19	-1.6	4.1	-0.40	771
Sector-Neutral	Carbon Efficient	7.3	22.4	0.33	1.1	3.0	0.37	93
	Carbon Inefficient	5.2	24.8	0.21	-1.0	3.4	-0.30	594
SOUTH KOREA								
Unconstrained	Carbon Efficient	3.9	21.1	0.18	1.2	8.0	0.15	25
	Carbon Inefficient	3.1	22.4	0.14	0.4	7.1	0.06	728
Sector-Neutral	Carbon Efficient	3.7	20.4	0.18	1.1	5.9	0.18	84
	Carbon Inefficient	2.0	21.7	0.09	-0.7	5.3	-0.13	606
TAIWAN								
Unconstrained	Carbon Efficient	5.5	20.5	0.27	2.1	4.8	0.44	30
	Carbon Inefficient	2.9	19.9	0.15	-0.5	5.0	-0.10	933
Sector-Neutral	Carbon Efficient	4.8	19.5	0.25	1.4	3.5	0.40	100
	Carbon Inefficient	3.4	20.8	0.16	0.0	3.7	0.01	765

All portfolios shown are hypothetical.
Source: S&P Dow Jones Indices LLC, Trucost ESG Analysis, and FactSet. Data from Sept. 21, 2007, to June 29, 2018. Data for China from March 18, 2011, to June 29, 2018. Weighted average carbon intensity score measured in CO2e/USD 1 million. Performance based on total return in local currency. Excess return, tracking error, and information ratio are calculated with respect to base universe. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance. Please refer to Appendix B for benchmark indices used for each region.

INTEGRATING CARBON-EFFICIENT SCREENS INTO COMMON RISK FACTORS

With increasing awareness of climate change and risks, investors may look to integrate carbon screening into their factor portfolios.

Factor investing in the Asia Pacific region has grown at a rapid pace, with smart beta passive AUM growing at a 42% compound annual growth rate over the past five years, though starting at a lower base.[14] With increasing awareness of climate change and related risks, investors may look to integrate carbon screening into their factor portfolios. In previous sections, we concluded that the implementation of simple carbon screening, with or without sector constraints, resulted in significant reduction in portfolios' weighted average carbon-intensity scores without sacrificing returns across Asian markets over the longer horizon studied. In this section, we examine the impact of carbon screening on various common risk factors, including momentum, value, quality, and low volatility.

Carbon screening resulted in higher carbon intensity reduction to the low volatility and value factors…

For our analysis, we constructed pure factor portfolios and carbon-efficient factor portfolios for each market and each factor. Pure factor portfolios were constructed by selecting the top quintile of stocks by factor scores from each market from their respective base universe. The carbon-efficient factor portfolios included the same number of stocks as in their respective pure factor portfolios, but were selected from the carbon-screened universe, from which the 33% of stocks with the highest carbon intensity scores were removed. The pure factor and carbon-efficient portfolios were unconstrained by sectors and were equally weighted.

…than to the quality and momentum factors across Asian markets

The carbon-efficient screening affected the performance and carbon intensity of each factor portfolio differently (see Exhibit 4). Overall, the carbon screening broadly resulted in higher carbon intensity reductions to the low volatility and value factors than to the quality and momentum factors across Asian markets. Carbon-efficient screening also improved risk-adjusted returns for the quality, value, and momentum portfolios. In contrast, low volatility factor performance was adversely affected by the carbon-efficient screening.

Quality: The carbon-efficient quality portfolios had higher risk-adjusted returns than their respective pure factor portfolios in most markets (except South Korea) and weighted average carbon intensity score reductions of at least 50% across all markets. The pure quality factor portfolios overweighted Consumer Discretionary and Information Technology and underweighted Financials across all markets. Compared with the pure factor portfolios, the carbon-efficient quality portfolios tended to overweight Financials and Information Technology and underweight Materials and Consumer Staples (except Australia).

[14] Banerjee, Alka, "ETFs and the Factor-Based Investing Landscape," *Forum Views: One World One BBF*, Vol. 8, Issue 1, pp. 154-156, April 2019.

Carbon-efficient screening improved risk-adjusted returns for the quality, value, and momentum portfolios…

Value: The carbon-efficient value portfolios had better risk-adjusted returns and lower volatility than their respective pure factor portfolios in all markets, except India and Taiwan. The carbon screening resulted in more than 70% carbon intensity score reduction across all markets. The pure value portfolio most underweighted Consumer Staples in most markets (except Australia) and most overweighted Financials (except Australia and Taiwan). Compared with the pure factor portfolios, the carbon-efficient value portfolios tended to overweight Financials and Consumer Discretionary and underweight Materials and Energy.

Momentum: The carbon-efficient momentum portfolios had higher risk-adjusted returns than their respective pure factor portfolios in most markets (except Australia and Taiwan) and weighted average carbon intensity score reductions of at least 70% across all markets. The pure momentum factor portfolios overweighted Consumer Staples and Health Care and underweighted Financials across all markets. Compared with the pure factor portfolios, the carbon-efficient momentum portfolios tended to overweight Financials and Consumer Discretionary (except Taiwan) and underweight Materials and Energy.

…in contrast, low volatility factor performance was adversely affected by carbon-efficient screening.

Low Volatility: The carbon-efficient low volatility portfolios had lower risk-adjusted returns than their respective pure factor portfolios in most markets (except China) and weighted average carbon intensity score reductions of at least 75% across all markets. The pure low volatility factor portfolios overweighted Consumer Staples and underweighted Information Technology across most markets (except India). Compared with the pure factor portfolios, the carbon-efficient low volatility portfolios tended to overweight Financials and Consumer Discretionary and underweight Materials and Utilities.

Exhibit 4: Performance Comparison between Pure Factor and Carbon-Efficient Factor Portfolios

PORTFOLIO		ANNUALIZED RETURN (%)	ANNUALIZED VOLATILITY (%)	RISK-ADJUSTED RETURNS	INFORMATION RATIO	WEIGHTED AVERAGE CARBON INTENSITY
AUSTRALIA						
Quality	Pure Factor	0.4	19.1	0.02	-0.39	290
	Carbon-Efficient Factor	1.9	17.0	0.11	-0.14	69
Value	Pure Factor	-2.4	21.8	-0.11	-0.54	325
	Carbon-Efficient Factor	1.1	20.0	0.06	-0.20	86
Momentum	Pure Factor	6.7	19.4	0.34	0.44	406
	Carbon-Efficient Factor	4.6	16.1	0.29	0.23	75
Low Volatility	Pure Factor	6.8	13.4	0.51	0.43	305
	Carbon-Efficient Factor	5.8	13.6	0.43	0.32	74
CHINA						
Quality	Pure Factor	7.2	25.0	0.29	0.31	416
	Carbon-Efficient Factor	8.6	24.9	0.34	0.56	70
Value	Pure Factor	9.0	23.8	0.38	0.40	1371
	Carbon-Efficient Factor	11.1	23.7	0.47	0.68	61
Momentum	Pure Factor	6.3	27.2	0.23	0.15	631
	Carbon-Efficient Factor	6.5	26.5	0.24	0.19	69
Low Volatility	Pure Factor	11.7	21.9	0.54	0.71	1242
	Carbon-Efficient Factor	13.0	22.3	0.59	0.90	58
HONG KONG						
Quality	Pure Factor	7.2	22.1	0.33	0.11	589
	Carbon-Efficient Factor	7.9	21.7	0.36	0.21	78
Value	Pure Factor	12.5	27.3	0.46	0.77	1272
	Carbon-Efficient Factor	12.6	25.5	0.49	0.88	78
Momentum	Pure Factor	5.5	26.3	0.21	-0.10	1020
	Carbon-Efficient Factor	8.8	25.6	0.34	0.28	74
Low Volatility	Pure Factor	8.8	15.5	0.56	0.18	1008
	Carbon-Efficient Factor	9.4	17.2	0.55	0.28	69
INDIA						
Quality	Pure Factor	18.8	16.2	1.16	0.72	910
	Carbon-Efficient Factor	19.4	16.3	1.19	0.76	116
Value	Pure Factor	9.9	29.3	0.34	-0.10	1731
	Carbon-Efficient Factor	8.5	28.4	0.30	-0.24	64
Momentum	Pure Factor	14.5	22.4	0.64	0.29	1097
	Carbon-Efficient Factor	15.8	21.3	0.74	0.45	87
Low Volatility	Pure Factor	19.7	14.5	1.36	0.70	1296
	Carbon-Efficient Factor	18.0	14.7	1.22	0.56	109

All portfolios shown are hypothetical.
Source: S&P Dow Jones Indices LLC, Trucost ESG Analysis, and FactSet. Data from Sept. 21, 2007, to June 29, 2018. Data for China from March 18, 2011, to June 29, 2018. Performance based on total return in local currency. Information ratio is calculated with respect to base universe. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance. Please refer to Appendix B for indices used for each region.

Exhibit 4: Performance Comparison between Pure Factor and Carbon-Efficient Factor Portfolios (cont.)

PORTFOLIO		ANNUALIZED RETURN (%)	ANNUALIZED VOLATILITY (%)	RISK-ADJUSTED RETURNS	INFORMATION RATIO	WEIGHTED AVERAGE CARBON INTENSITY
JAPAN						
Quality	Pure Factor	5.7	23.4	0.24	-0.12	154
	Carbon-Efficient Factor	6.8	22.5	0.30	0.14	74
Value	Pure Factor	7.7	26.5	0.29	0.21	390
	Carbon-Efficient Factor	7.9	26.1	0.30	0.28	70
Momentum	Pure Factor	3.0	22.9	0.13	-0.39	276
	Carbon-Efficient Factor	3.7	22.5	0.16	-0.36	81
Low Volatility	Pure Factor	7.2	17.6	0.41	0.09	326
	Carbon-Efficient Factor	7.4	18.7	0.40	0.13	79
SOUTH KOREA						
Quality	Pure Factor	7.4	21.2	0.35	0.55	211
	Carbon-Efficient Factor	5.6	21.6	0.26	0.31	68
Value	Pure Factor	5.9	25.6	0.23	0.32	456
	Carbon-Efficient Factor	5.9	24.9	0.24	0.31	58
Momentum	Pure Factor	1.4	24.7	0.05	-0.10	287
	Carbon-Efficient Factor	1.7	22.4	0.08	-0.08	69
Low Volatility	Pure Factor	4.5	16.3	0.28	0.15	383
	Carbon-Efficient Factor	3.9	18.5	0.21	0.10	48
TAIWAN						
Quality	Pure Factor	2.5	19.9	0.12	-0.14	225
	Carbon-Efficient Factor	2.5	19.8	0.13	-0.13	86
Value	Pure Factor	3.3	21.2	0.16	-0.01	211
	Carbon-Efficient Factor	2.4	21.4	0.11	-0.16	64
Momentum	Pure Factor	4.4	21.3	0.21	-0.13	375
	Carbon-Efficient Factor	2.1	21.0	0.10	-0.19	79
Low Volatility	Pure Factor	7.5	15.8	0.48	0.50	461
	Carbon-Efficient Factor	4.8	17.5	0.27	0.20	53

All portfolios shown are hypothetical.
Source: S&P Dow Jones Indices LLC, Trucost ESG Analysis, and FactSet. Data from Sept. 21, 2007, to June 29, 2018. Data for China from March 18, 2011, to June 29, 2018. Performance based on total return in local currency. Information ratio is calculated with respect to base universe. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance. Please refer to Appendix B for indices used for each region.

Exhibit 5: Active Factor Exposures for Factor Portfolios in Japan (Averaged Quarterly)

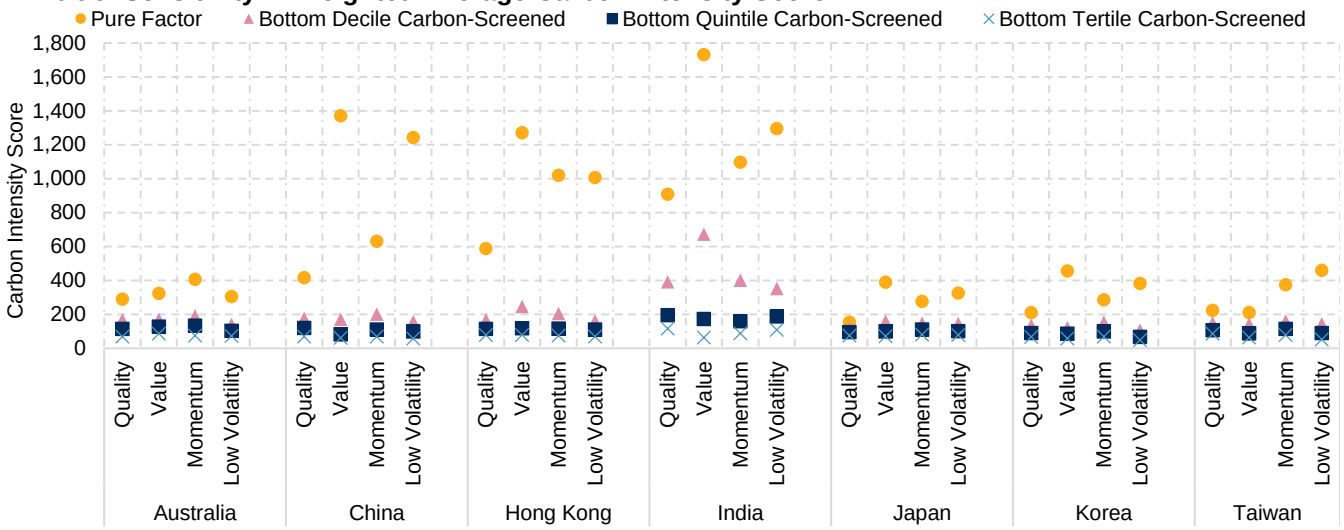
FACTOR	RISK MODEL FACTOR DEFINITION	QUALITY		VALUE		MOMENTUM		LOW VOLATILITY	
		PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT
Quality	ROE, ROA, Cash Flow to Assets, Cash Flow to Income, Gross Margin, and Sales to Assets	0.53	0.52	-0.25	-0.26	0.23	0.24	0.16	0.17
	Total Debt to Assets and Total Debt to Equity	-0.55	-0.56	0.33	0.11	-0.14	-0.21	-0.06	-0.17
Value	Book to Price	-0.38	-0.36	0.70	0.59	-0.36	-0.33	-0.10	-0.10
	Earnings to Price and Estimated Earnings to Price	0.03	-0.03	0.41	0.31	-0.05	-0.10	-0.08	-0.06
	Dividend Yield	-0.00	0.00	0.42	0.34	-0.36	-0.31	0.20	0.14
Momentum	Past One-Year Return (Excluding Most Recent Month)	0.09	0.09	-0.31	-0.24	0.73	0.59	0.01	-0.01
Volatility (High)	Six-Month Average of Absolute Returns over Cross-Sectional Standard Deviation	0.04	0.05	-0.03	-0.08	0.14	0.09	-0.31	-0.27
Size (Large)	Natural Logarithm of Market Capitalization	0.06	0.06	-0.12	-0.07	0.05	0.07	0.06	0.07
Growth	Sales Growth, Estimated Sales Growth, Earnings Growth, Estimated Earnings Growth	0.22	0.21	-0.07	-0.07	0.18	0.16	-0.06	-0.02
Liquidity	Natural Logarithm of (Three-Month Average Daily Volume) Divided by (One-Month Average Market Cap)	-0.01	-0.04	0.06	-0.03	0.04	-0.02	-0.33	-0.34
Exchange Rate Sensitivity	Two-Year Weekly Beta to Returns of USD	-0.00	0.00	0.02	-0.10	0.01	-0.03	0.07	0.03

Source: S&P Dow Jones Indices LLC, FactSet, and Axioma. Data from Sept. 21, 2007, to June 28, 2018. The Axioma Japan Fundamental Equity Risk Model MH 4 is used for the comparison of the factor portfolios against the base universe for Japan. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Apart from the impact on portfolio return and volatility, we also evaluated the impact of the carbon-efficient screen on factor portfolios by evaluating the change in the active factor exposures. Exhibit 5 shows the active factor exposures (in terms of the number of standard deviations) of the carbon-efficient factor portfolios versus their respective pure factor portfolios in Japan. In most cases, the impact of carbon-efficient screening was modest on the targeted factor exposures. Similar observations are made in other Asian markets (see Appendices I1-I6). These results conclude that carbon-efficient screening did not result in the loss of targeted active factor exposure.

To examine how portfolio performance and carbon intensity reduction are sensitive to different levels of carbon screening, we replicated the analysis with relaxed carbon screening from tertile to quintile and decile exclusion (based on carbon intensity scores). While factor portfolios with relaxed carbon screenings tended to induce smaller performance difference from the pure factor portfolios, the reduction in the weighted average carbon intensity score remained significant, as shown in Exhibit 6. Factor portfolio with tertile carbon screening resulted in an average reduction in carbon intensity score of 82% versus the pure factor portfolios, while the quintile and decile carbon-screened portfolios recorded average carbon intensity score reductions of 74% and 60%, respectively.

Exhibit 6: Sensitivity in Weighted Average Carbon Intensity Score



All portfolios shown are hypothetical.
Source: S&P Dow Jones Indices LLC, Trucost ESG Analysis, and FactSet. Data from Sept. 21, 2007, to June 29, 2018. Data for China from March 18, 2011, to June 29, 2018. Performance based on total return in local currency. Chart is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance. Please refer to Appendix B for indices used for each region.

CONCLUSION

In this paper, we investigated portfolio construction to incorporate two trends that are gripping the global investment industry: low-carbon and factor strategies. We demonstrated the impact of low-carbon screening on traditional market-cap-weighted portfolios. We also studied the integration of carbon-efficient screens on common risk-factors (quality, value, momentum, and low volatility) across the seven Asian markets of Australia, China, Hong Kong, India, Japan, South Korea, and Taiwan.

Carbon-efficient screening and tilting portfolio weights toward carbon-efficient companies are common practices in constructing carbon-efficient portfolios. According to our back-test on carbon-efficient and carbon-inefficient portfolios in Pan Asian markets, the weighted average carbon intensity scores of carbon-efficient portfolios were at least 85% lower than their respective carbon-inefficient portfolios.

Due to variation in carbon efficiency across sectors, unconstrained carbon-efficient portfolios resulted in significant sector biases, but our observations suggested that the implementation of a simple carbon screen, either with or without sector constraints, resulted in significantly lower portfolio carbon intensity scores without sacrificing returns across Asian markets over the entire studied period.

Carbon-efficient screening had different impacts on the performance of each factor, and there were subtle variations across the seven markets studied. Carbon-efficient screening resulted in the highest weighted average carbon intensity reduction in the low volatility and value portfolios across Asian markets. Carbon-efficient screening also improved risk-adjusted returns for the quality, value, and momentum portfolios. In contrast, low volatility factor performance was adversely affected by carbon-efficient screening. Based on the factor risk decomposition analysis on the carbon-efficient and pure factor portfolios, carbon-efficient screening had a modest impact on the portfolios' targeted factor exposures.

Sensitivity analysis of carbon-efficient factor portfolios validate the point that a modest carbon-efficient screen (decile exclusion by carbon intensity scores) can lead to a significant reduction in portfolio carbon intensity scores while having a minimal impact on their returns.

APPENDIX A: TRUCOST ESG ANALYSIS METHODOLOGY

Trucost ESG Analysis (Trucost) has analyzed the environmental performance of over 4,200 companies worldwide. Trucost has the world's largest bank of standardized GHG emissions data, which provides a proxy for carbon performance. The carbon intensity score is calculated by Trucost and is defined as the company's annual GHG emissions, expressed as metric tons of carbon dioxide equivalent (CO_2e) divided by annual revenues. To calculate the carbon intensity of any company included in the indices, Trucost reviews company annual reports and accounts, environmental/sustainability reports, public disclosures, and corporate websites.

However, many companies do not disclose their environmental or carbon impacts. Where there is no public disclosure, Trucost employs its environmental profiling system. This proprietary input-output model maps the GHG impacts of business activities in 464 sectors. Trucost's broad coverage seeks to ensure that all non-disclosing companies are considered for index eligibility, not just those that disclose environmental information.

Six GHGs are included in the analysis; these are all the GHGs regulated under the Kyoto protocol. Each gas has a different capacity to cause global warming. Although carbon dioxide (CO_2) is the least potent of the GHGs, it is one of the most prevalent in terms of man-made emissions. The GHGs are calculated for each company and converted into metric tons of CO_2e based on the appropriate global warming potential (GWP) factors. The GWP index, published by the Intergovernmental Panel on Climate Change, assesses the effect of the emissions of different gases over a 100-year time period, relative to the emission of an equal mass of CO_2. GWP enables all the GHGs to be expressed in terms of CO_2e and is used as the basis for the analysis and for index calculation.

Quantities of GHG emissions are then normalized by sales to calculate the company's carbon footprint, or carbon intensity. The smaller the carbon footprint, the less the investments contribute to climate change and the lower an index's exposure is to the rising costs of emitting carbon dioxide.

Each company's carbon intensity score is updated annually, approximately eight months following the company's fiscal year-end. Any update to a company's score is applied to the screening process at the subsequent semiannual rebalancing.[15]

[15] Please see the S&P Global 1200 Fossil Fuel Free Carbon Efficient Index Series Methodology.

Appendix B: Benchmark and Base Universes for Each Market[16]

MARKET	BENCHMARK	STOCK COUNT IN BENCHMARK		BENCHMARK REPRESENTATION IN BASE UNIVERSE	
		START DATE	END DATE	STOCK COUNT (%)	FLOAT MARKET CAP (%)
Australia	S&P/ASX 300	300	300	77.6	96.1
China	S&P China A BMI	1,678	2,688	13.4	49.4
Hong Kong	S&P HK BMI + Hong Kong-Listed Stocks from S&P China BMI	331	739	45.6	92.2
India	S&P BSE LargeMidCap	146	186	78.2	94.6
Japan	S&P Japan 500	500	500	83.9	97.7
South Korea	S&P Korea LargeMidCap	61	160	88.1	95.2
Taiwan	S&P Taiwan LargeMidCap	103	178	90.4	97.7

Source: S&P Dow Jones Indices LLC. Data as of Sept. 21, 2007, to June 29, 2018. Data for China from March 18, 2011, to June 29, 2018. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

[16] To appropriately represent the entire investible universe for investors based in Hong Kong, the benchmark universe for Hong Kong consisted of all companies in the S&P Hong Kong BMI Index and Hong Kong-listed companies from the S&P China BMI with built-in coverage caps. In Hong Kong and Chinese markets, the weighted average carbon intensity data coverage expands considerably after 2017. Therefore, coverage caps were built into the selection criteria to avoid an abrupt increase in the number of stocks in the base universe and also bearing in mind the investability of the portfolio for Hong Kong and China markets.

Appendix C: Average Sector Coverage Relative to the Benchmark Universe (%)

SECTOR	AUSTRALIA	CHINA	HONG KONG	INDIA	JAPAN	SOUTH KOREA	TAIWAN
CONSUMER DISCRETIONARY							
by Stock Count	85.9	8.3	37.7	80.5	84.6	80.8	84.1
by Float Market Cap	88.2	34.0	81.9	93.0	98.4	93.9	91.5
CONSUMER STAPLES							
by Stock Count	82.9	11.3	44.6	82.2	82.7	82.4	91.2
by Float Market Cap	98.3	43.1	87.3	97.6	97.5	96.3	98.9
ENERGY							
by Stock Count	65.4	22.6	44.4	79.5	88.3	84.4	100.0
by Float Market Cap	95.4	56.4	96.9	96.6	98.1	94.7	100.0
FINANCIALS							
by Stock Count	84.4	39.4	49.5	72.0	85.4	89.9	86.4
by Float Market Cap	97.6	88.9	95.6	96.1	97.7	98.5	96.4
HEALTH CARE							
by Stock Count	79.7	12.7	30.3	82.5	88.5	81.8	42.9
by Float Market Cap	97.5	36.5	72.5	96.0	98.4	89.8	45.0
INDUSTRIALS							
by Stock Count	80.2	13.5	53.3	74.8	77.7	95.8	90.7
by Float Market Cap	93.7	43.3	91.5	93.2	96.7	98.8	94.4
INFORMATION TECHNOLOGY							
by Stock Count	69.4	9.2	26.5	72.4	82.3	87.0	92.6
by Float Market Cap	90.7	33.6	89.5	98.1	98.0	92.0	98.5
MATERIALS							
by Stock Count	67.1	9.8	47.6	82.4	90.0	85.9	94.0
by Float Market Cap	96.1	33.1	82.2	95.2	97.6	95.4	99.2
REAL ESTATE							
by Stock Count	94.5	19.6	53.1	100.0	96.2	-	100.0
by Float Market Cap	99.0	57.8	92.2	100.0	99.5	-	100.0
TELECOMMUNICATION SERVICES							
by Stock Count	79.2	44.1	67.2	81.7	100.0	100.0	100.0
by Float Market Cap	97.3	87.7	97.6	97.3	100.0	100.0	100.0
UTILITIES							
by Stock Count	86.4	15.7	63.4	84.5	100.0	100.0	-
by Float Market Cap	97.1	47.4	95.6	94.4	100.0	100.0	-

Source: S&P Dow Jones Indices LLC. Data as of Sept. 21, 2007, to June 29, 2018. Data for China from March 18, 2011, to June 29, 2018. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

Appendix D: Performance Comparison of Base Universe and Benchmark Universe

REGION	UNIVERSE	ANNUALIZED RETURN (%)	ANNUALIZED VOLATILITY (%)	RISK-ADJUSTED RETURNS	BETA (AGAINST BENCHMARK UNIVERSE)
Australia	S&P/ASX 300	1.0	17.4	0.06	-
	Base Universe	2.8	17.5	0.16	0.99
China	S&P China A BMI	3.7	26.6	0.14	-
	Base Universe	5.1	25.3	0.20	0.89
Hong Kong	S&P HK BMI + Hong Kong-Listed Stocks from S&P China BMI	1.2	22.6	0.05	-
	Base Universe	6.5	24.7	0.26	1.07
India	S&P BSE LargeMidCap	10.3	22.5	0.46	-
	Base Universe	11.2	22.5	0.50	0.99
Japan	S&P Japan 500	6.7	22.9	0.29	-
	Base Universe	6.2	23.3	0.27	1.01
South Korea	S&P Korea LargeMidCap	2.7	20.6	0.13	-
	Base Universe	2.6	21.3	0.12	1.03
Taiwan	S&P Taiwan LargeMidCap	2.6	19.9	0.13	-
	Base Universe	3.4	20.0	0.17	1.00

All portfolios shown are hypothetical.
Source: S&P Dow Jones Indices LLC, Trucost ESG Analysis, and FactSet. Data from Sept. 21, 2007, to June 29, 2018. Data for China from March 18, 2011, to June 29, 2018. Performance based on total return in local currency. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance. Please refer to Appendix B for indices used for each region.

Appendix E: Risk/Return Characteristics of Carbon-Efficient and Carbon-Inefficient Portfolios (Float-Market-Cap Weighted)

PORTFOLIO		ANNUALIZED RETURN (%)	ANNUALIZED VOLATILITY (%)	RISK-ADJUSTED RETURNS	TRACKING ERROR (%)	INFORMATION RATIO	WEIGHTED AVERAGE CARBON INTENSITY
AUSTRALIA							
Unconstrained	Carbon Efficient	5.41	18.5	0.29	6.5	0.06	24
	Carbon Inefficient	2.90	21.2	0.14	9.8	-0.22	1,724
Sector-Neutral	Carbon Efficient	3.21	17.3	0.19	5.5	-0.32	88
	Carbon Inefficient	4.06	17.5	0.23	5.9	-0.16	1,346
CHINA							
Unconstrained	Carbon Efficient	7.86	23.6	0.33	6.4	0.36	18
	Carbon Inefficient	0.97	24.8	0.04	9.2	-0.50	2,199
Sector-Neutral	Carbon Efficient	6.84	22.5	0.30	6.2	0.20	61
	Carbon Inefficient	3.44	25.4	0.14	7.9	-0.27	1,797
HONG KONG							
Unconstrained	Carbon Efficient	6.87	26.3	0.26	4.3	0.34	23
	Carbon Inefficient	2.37	25.1	0.09	6.4	-0.47	3,240
Sector-Neutral	Carbon Efficient	6.94	26.6	0.26	4.2	0.37	60
	Carbon Inefficient	2.85	25.9	0.11	6.0	-0.42	2,372
INDIA							
Unconstrained	Carbon Efficient	10.04	24.9	0.40	6.3	-0.06	26
	Carbon Inefficient	7.59	24.2	0.31	8.0	-0.35	3,935
Sector-Neutral	Carbon Efficient	8.51	23.7	0.36	6.5	-0.29	188
	Carbon Inefficient	10.30	21.6	0.48	5.2	-0.02	2,555
JAPAN							
Unconstrained	Carbon Efficient	3.20	24.6	0.13	4.4	0.00	35
	Carbon Inefficient	1.52	23.6	0.06	5.5	-0.30	786
Sector-Neutral	Carbon Efficient	4.07	23.5	0.17	3.1	0.29	87
	Carbon Inefficient	2.61	25.0	0.10	3.9	-0.15	499
SOUTH KOREA							
Unconstrained	Carbon Efficient	3.14	21.0	0.15	8.9	-0.10	26
	Carbon Inefficient	3.80	22.4	0.17	8.6	-0.03	1,012
Sector-Neutral	Carbon Efficient	3.81	21.2	0.18	7.6	-0.03	84
	Carbon Inefficient	4.88	21.1	0.23	6.9	0.12	901
TAIWAN							
Unconstrained	Carbon Efficient	5.69	21.4	0.27	6.7	0.13	24
	Carbon Inefficient	3.56	19.3	0.18	5.7	-0.22	1,044
Sector-Neutral	Carbon Efficient	5.60	19.5	0.29	5.3	0.15	125
	Carbon Inefficient	3.74	19.3	0.19	4.0	-0.26	908

All portfolios shown are hypothetical.
Source: S&P Dow Jones Indices LLC, Trucost ESG Analysis, and FactSet. Data from Sept. 21, 2007, to June 29, 2018. Data for China from March 18, 2011, to June 29, 2018. Stock weight capped at 10%. Performance based on total return in local currency. Tracking error and information ratio are calculated with respect to base universe. Past performance is no guarantee of future results. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance. Please refer to Appendix B for benchmark indices used for each region.

Appendix F: S&P Dow Jones Indices Standard Style and Factor Definitions

STYLE	STYLE FACTORS
Quality	○ Return on equity ○ Accruals ratio ○ Financial leverage
Value	○ Book-value-to-price ratio ○ Earnings-to-price ratio ○ Sales-to-price ratio
Momentum	○ 12-month risk-adjusted momentum lagged by one month
Low Volatility	○ Inverse of volatility

Source: S&P Dow Jones Indices LLC. Table is provided for illustrative purposes. For further details on the factor definitions, please see Appendix A in Hao, Bill, Aye Soe, and Kelly Tang, "Carbon Risk Integration in Factor Portfolios," S&P Dow Jones Indices, February 2018.

Appendix G: Average Active Sector Weights of Pure Factor and Carbon-Efficient Factor Portfolios over Base Universe (%)

PORTFOLIO	CONSUMER DISCRETIONARY	CONSUMER STAPLES	ENERGY	FINANCIALS	HEALTH CARE	INDUSTRIALS	INFORMATION TECHNOLOGY	MATERIALS	REAL ESTATE	TELECOM-MUNICATION SERVICES	UTILITIES
AUSTRALIA											
Pure Quality	4.9	-0.1	-0.1	-3.5	2.2	-2.1	3.5	1.6	-1.5	-1.3	-3.6
Carbon-Efficient Quality	11.4	0.8	-5.4	2.9	4.6	1.8	4.9	-16.7	-0.3	-0.3	-3.6
Pure Value	2.5	2.9	-2.7	-2.4	-1.2	10.9	-2.2	-2.5	2.4	-2.1	-0.7
Carbon-Efficient Value	4.4	1.6	-5.9	6.7	-0.3	9.0	-1.9	-14.1	4.0	-1.9	-1.6
Pure Momentum	0.4	0.3	-0.2	-5.0	2.6	-0.5	0.5	2.6	-1.3	1.3	-0.8
Carbon-Efficient Momentum	7.1	-0.1	-5.5	3.5	5.8	3.6	1.6	-16.5	-0.2	2.8	-2.1
Pure Low Volatility	-5.0	3.6	-5.1	12.5	2.9	-7.0	-1.8	-12.9	5.6	2.2	4.9
Carbon-Efficient Low Volatility	-0.2	3.6	-7.7	18.7	5.2	-6.1	0.3	-19.5	4.4	2.6	-1.2
CHINA											
Pure Quality	8.1	5.2	-0.1	-6.7	4.7	-3.7	0.7	-3.7	-1.0	-0.5	-3.0
Carbon-Efficient Quality	10.4	-3.0	-3.0	-1.3	7.8	2.5	3.5	-13.6	-0.4	-0.2	-2.6
Pure Value	1.4	-5.0	-0.1	7.5	-5.2	5.6	-6.0	-1.2	0.5	0.5	2.1
Carbon-Efficient Value	6.1	-5.0	-2.5	18.8	-4.1	5.5	-5.3	-13.5	2.5	0.9	-3.4
Pure Momentum	1.8	2.1	-0.9	-2.7	3.3	-1.3	1.2	-1.7	-0.5	-0.4	-0.8
Carbon-Efficient Momentum	4.2	-3.3	-4.0	6.7	6.2	2.2	3.0	-13.3	0.7	-0.3	-2.0
Pure Low Volatility	-2.4	0.1	1.1	5.3	1.3	-1.9	-4.5	-5.3	-0.9	0.4	6.8
Carbon-Efficient Low Volatility	1.8	-3.8	-2.6	14.8	4.2	2.8	-3.6	-13.8	-0.8	0.5	0.4
HONG KONG											
Pure Quality	12.3	3.3	-0.1	-9.4	1.9	-5.3	4.1	-3.1	-1.9	1.3	-3.2
Carbon-Efficient Quality	15.2	-1.8	-3.6	-2.7	3.4	-3.2	4.2	-7.9	0.2	2.3	-6.0
Pure Value	-7.1	-2.2	0.0	1.7	-2.2	5.8	-0.4	4.9	2.4	-0.6	-2.3
Carbon-Efficient Value	-3.1	-4.6	-1.7	18.6	-1.6	3.2	-0.4	-8.8	4.0	0.4	-5.9
Pure Momentum	1.1	1.6	-1.2	-4.0	0.9	-3.6	1.6	-1.0	1.5	0.2	2.6
Carbon-Efficient Momentum	6.8	-2.5	-2.7	7.4	1.9	-4.8	3.2	-8.8	3.4	1.4	-5.4
Pure Low Volatility	-7.8	1.7	-1.1	14.2	-2.2	-0.4	-4.6	-9.0	0.8	3.3	5.2
Carbon-Efficient Low Volatility	-5.8	-1.6	-2.5	23.5	-1.4	-0.3	-3.7	-9.3	1.5	5.5	-5.8

All portfolios shown are hypothetical.
Source: S&P Dow Jones Indices LLC, Trucost ESG Analysis, and FactSet. Data from Sept. 21, 2007, to June 29, 2018. Data for China from March 18, 2011, to June 29, 2018. Average active sector weights of semiannual carbon-efficient factor portfolios and pure factor portfolios were considered versus the base universe. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance. Please refer to Appendix B for indices used for each region. The most and least represented sector by weight in each market is highlighted in green and yellow, respectively.

Appendix G: Average Active Sector Weights of Pure Factor and Carbon-Efficient Factor Portfolios over Base Universe (%) (cont.)

PORTFOLIO	CONSUMER DISCRETIONARY	CONSUMER STAPLES	ENERGY	FINANCIALS	HEALTH CARE	INDUSTRIALS	INFORMATION TECHNOLOGY	MATERIALS	REAL ESTATE	TELECOM-MUNICATION SERVICES	UTILITIES
INDIA											
Pure Quality	5.9	16.3	-2.7	-17.9	1.8	-0.7	6.7	0.8	-0.2	-2.1	-8.0
Carbon-Efficient Quality	10.4	11.7	-5.8	-17.2	3.5	2.6	10.2	-7.3	-0.2	-1.5	-6.5
Pure Value	-4.5	-8.0	10.3	15.6	-8.4	-4.6	-5.3	3.9	-0.2	-0.1	1.2
Carbon-Efficient Value	1.9	-7.8	-3.4	32.8	-6.9	-2.2	-2.3	-12.7	-0.0	2.4	-1.8
Pure Momentum	1.0	5.2	-1.1	-1.8	4.3	-3.9	0.6	0.8	-0.0	-0.3	-4.8
Carbon-Efficient Momentum	2.6	3.6	-6.0	9.2	6.1	-2.3	1.6	-9.4	0.1	0.3	-5.8
Pure Low Volatility	-0.8	14.3	-1.8	-12.6	9.1	-6.6	2.6	-1.7	-0.2	-3.5	1.3
Carbon-Efficient Low Volatility	5.9	9.0	-5.7	-9.4	9.8	-3.3	6.6	-8.8	-0.2	-2.8	-1.1
JAPAN											
Pure Quality	4.7	0.1	-0.4	-2.6	3.9	-5.7	6.4	-3.3	-0.2	0.1	-2.8
Carbon-Efficient Quality	7.9	-2.1	-1.3	-0.6	7.0	-7.5	8.2	-9.3	-0.2	0.6	-2.7
Pure Value	-0.8	-1.7	3.5	3.1	-3.6	4.7	-6.9	3.0	-0.1	-0.3	-0.8
Carbon-Efficient Value	9.8	-4.5	-1.0	15.2	-3.4	0.4	-3.0	-11.0	0.1	0.2	-2.9
Pure Momentum	0.6	3.5	-0.5	-6.5	2.2	0.9	1.8	-1.1	-0.2	0.4	-1.2
Carbon-Efficient Momentum	6.2	-1.3	-1.3	-1.6	4.3	-0.3	4.5	-9.4	0.1	1.1	-2.3
Pure Low Volatility	-2.5	13.8	0.1	-7.2	5.3	1.1	-8.2	-8.0	-0.1	1.3	4.4
Carbon-Efficient Low Volatility	6.6	3.4	-1.4	-1.7	9.7	-0.3	-5.5	-11.3	0.3	2.0	-1.7
SOUTH KOREA											
Pure Quality	11.9	4.0	-0.9	-9.6	0.2	-4.3	3.4	-1.1	0.0	-1.7	-1.9
Carbon-Efficient Quality	10.6	1.5	-3.2	-5.1	1.6	0.9	3.8	-9.8	0.0	1.8	-2.2
Pure Value	-5.0	-8.4	2.5	5.9	-2.3	3.9	-5.4	2.1	0.0	0.7	5.9
Carbon-Efficient Value	1.1	-8.0	-3.2	19.0	-2.3	2.9	-5.8	-6.1	0.0	2.9	-0.4
Pure Momentum	2.1	2.8	-0.8	-9.1	1.8	-4.0	3.6	3.2	0.0	0.0	0.3
Carbon-Efficient Momentum	3.7	1.9	-3.2	0.1	3.1	0.2	2.6	-9.3	0.0	2.6	-1.7
Pure Low Volatility	-2.2	6.2	1.8	11.0	-0.9	-20.4	-4.9	-4.2	0.0	9.9	3.8
Carbon-Efficient Low Volatility	1.3	1.3	-3.2	22.8	-0.8	-17.7	-3.5	-9.2	0.0	10.3	-1.2
TAIWAN											
Pure Quality	1.8	1.8	-0.1	-9.8	-0.3	-3.8	12.3	-4.6	-0.1	2.8	0.0
Carbon-Efficient Quality	0.2	0.7	-0.7	-9.2	0.4	-5.7	20.9	-11.1	-0.1	4.4	0.0
Pure Value	1.8	-1.8	-0.7	-3.2	-0.8	-1.0	11.1	-3.2	0.1	-2.2	0.0
Carbon-Efficient Value	3.2	-1.8	-0.7	7.0	-0.8	-8.7	14.7	-11.1	0.4	-2.2	0.0
Pure Momentum	-0.3	1.4	0.0	-2.7	0.2	-0.6	0.3	0.6	-0.1	1.2	0.0
Carbon-Efficient Momentum	-1.7	1.3	-0.7	8.6	0.5	-6.9	8.0	-11.1	0.3	1.6	0.0
Pure Low Volatility	-0.6	1.2	0.5	14.5	-0.8	1.0	-33.0	11.6	-0.2	6.0	0.0
Carbon-Efficient Low Volatility	0.8	1.4	-0.7	29.3	-0.8	-4.0	-21.8	-10.9	0.2	6.6	0.0

All portfolios shown are hypothetical.
Source: S&P Dow Jones Indices LLC, Trucost ESG Analysis, and FactSet. Data from Sept. 21, 2007, to June 29, 2018. Data for China from March 18, 2011, to June 29, 2018. Average active sector weights of semiannual carbon-efficient factor portfolios and pure factor portfolios were considered versus the base universe. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance. Please refer to Appendix B for indices used for each region. The most and least represented sector by weight in each market is highlighted in green and yellow, respectively.

Appendix H: Sensitivity Analysis of Carbon-Efficient Screening of Common Risk Factors

PORTFOLIO		ANNUALIZED RETURN (%)	ANNUALIZED VOLATILITY (%)	RISK-ADJUSTED RETURNS	INFORMATION RATIO	WEIGHTED AVERAGE CARBON INTENSITY	REDUCTION IN CARBON INTENSITY (%)
AUSTRALIA							
Quality	Unscreened	0.4	19.1	0.02	-0.39	290	-
	Decile Exclusion	1.3	18.6	0.07	-0.26	169	-41.6
	Quintile Exclusion	1.1	17.8	0.06	-0.27	114	-60.8
	Tertile Exclusion	1.9	17.0	0.11	-0.14	69	-76.3
Value	Unscreened	-2.4	21.8	-0.11	-0.54	325	-
	Decile Exclusion	-1.2	21.3	-0.06	-0.43	170	-47.5
	Quintile Exclusion	-0.5	20.9	-0.03	-0.37	127	-61.0
	Tertile Exclusion	1.1	20.0	0.06	-0.20	86	-73.4
Momentum	Unscreened	6.7	19.4	0.34	0.44	406	-
	Decile Exclusion	5.4	18.7	0.29	0.30	192	-52.8
	Quintile Exclusion	6.0	17.3	0.35	0.43	133	-67.2
	Tertile Exclusion	4.6	16.1	0.29	0.23	75	-81.6
Low Volatility	Unscreened	6.8	13.4	0.51	0.43	305	-
	Decile Exclusion	6.8	13.5	0.50	0.42	140	-54.2
	Quintile Exclusion	6.3	13.6	0.46	0.37	103	-66.2
	Tertile Exclusion	5.8	13.6	0.43	0.32	74	-75.9
CHINA							
Quality	Unscreened	7.2	25.0	0.29	0.31	416	-
	Decile Exclusion	9.0	24.7	0.36	0.58	176	-57.6
	Quintile Exclusion	8.9	24.5	0.36	0.57	119	-71.4
	Tertile Exclusion	8.6	24.9	0.34	0.56	70	-83.2
Value	Unscreened	9.0	23.8	0.38	0.40	1371	-
	Decile Exclusion	10.0	23.8	0.42	0.53	171	-87.5
	Quintile Exclusion	11.1	23.6	0.47	0.65	82	-94.0
	Tertile Exclusion	11.1	23.7	0.47	0.68	61	-95.6
Momentum	Unscreened	6.3	27.2	0.23	0.15	631	-
	Decile Exclusion	6.3	27.0	0.23	0.15	200	-68.3
	Quintile Exclusion	6.7	26.6	0.25	0.20	111	-82.5
	Tertile Exclusion	6.5	26.5	0.24	0.19	69	-89.0
Low Volatility	Unscreened	11.7	21.9	0.54	0.71	1242	-
	Decile Exclusion	12.6	22.0	0.57	0.82	158	-87.3
	Quintile Exclusion	12.8	21.8	0.59	0.86	99	-92.0
	Tertile Exclusion	13.0	22.3	0.59	0.90	58	-95.4

Source: S&P Dow Jones Indices LLC, Trucost ESG Analysis, and FactSet. Data from Sept. 21, 2007, to June 29, 2018. Data for China from March 18, 2011, to June 29, 2018. Performance based on total return in local currency. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance. Please refer Appendix B for indices used for each region.

Appendix H: Sensitivity Analysis of Carbon-Efficient Screening of Common Risk Factors (cont.)

PORTFOLIO		ANNUALIZED RETURN (%)	ANNUALIZED VOLATILITY (%)	RISK-ADJUSTED RETURNS	INFORMATION RATIO	WEIGHTED AVERAGE CARBON INTENSITY	REDUCTION IN CARBON INTENSITY (%)
HONG KONG							
Quality	Unscreened	7.2	22.1	0.33	0.11	589	-
	Decile Exclusion	7.3	21.9	0.33	0.13	168	-71.5
	Quintile Exclusion	7.9	21.8	0.36	0.20	115	-80.5
	Tertile Exclusion	7.9	21.7	0.36	0.21	78	-86.8
Value	Unscreened	12.5	27.3	0.46	0.77	1272	-
	Decile Exclusion	13.1	26.7	0.49	0.88	246	-80.6
	Quintile Exclusion	12.4	26.2	0.47	0.84	119	-90.7
	Tertile Exclusion	12.6	25.5	0.49	0.88	78	-93.9
Momentum	Unscreened	5.5	26.3	0.21	-0.10	1020	-
	Decile Exclusion	6.3	25.8	0.24	-0.02	206	-79.8
	Quintile Exclusion	7.7	25.4	0.30	0.16	115	-88.7
	Tertile Exclusion	8.8	25.6	0.34	0.28	74	-92.8
Low Volatility	Unscreened	8.8	15.5	0.56	0.18	1008	-
	Decile Exclusion	9.0	16.2	0.55	0.22	161	-84.0
	Quintile Exclusion	9.0	16.5	0.55	0.23	110	-89.1
	Tertile Exclusion	9.4	17.2	0.55	0.28	69	-93.2
INDIA							
Quality	Unscreened	18.8	16.2	1.16	0.72	910	-
	Decile Exclusion	20.2	16.1	1.26	0.85	393	-56.8
	Quintile Exclusion	20.5	16.0	1.29	0.85	195	-78.5
	Tertile Exclusion	19.4	16.3	1.19	0.76	116	-87.2
Value	Unscreened	9.9	29.3	0.34	-0.10	1731	-
	Decile Exclusion	9.8	29.4	0.33	-0.12	673	-61.1
	Quintile Exclusion	9.5	28.4	0.33	-0.15	173	-90.0
	Tertile Exclusion	8.5	28.4	0.30	-0.24	64	-96.3
Momentum	Unscreened	14.5	22.4	0.64	0.29	1097	-
	Decile Exclusion	14.1	21.5	0.65	0.26	402	-63.4
	Quintile Exclusion	15.7	21.3	0.74	0.41	159	-85.5
	Tertile Exclusion	15.8	21.3	0.74	0.45	87	-92.1
Low Volatility	Unscreened	19.7	14.5	1.36	0.70	1296	-
	Decile Exclusion	19.5	14.1	1.38	0.66	352	-72.8
	Quintile Exclusion	19.3	14.3	1.35	0.65	188	-85.5
	Tertile Exclusion	18.0	14.7	1.22	0.56	109	-91.6

Source: S&P Dow Jones Indices LLC, Trucost ESG Analysis, and FactSet. Data from Sept. 21, 2007, to June 29, 2018. Data for China from March 18, 2011, to June 29, 2018. Performance based on total return in local currency. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance. Please refer Appendix B for indices used for each region.

Appendix H: Sensitivity Analysis of Carbon-Efficient Screening of Common Risk Factors (cont.)

PORTFOLIO		ANNUALIZED RETURN (%)	ANNUALIZED VOLATILITY (%)	RISK-ADJUSTED RETURNS	INFORMATION RATIO	WEIGHTED AVERAGE CARBON INTENSITY	REDUCTION IN CARBON INTENSITY (%)
JAPAN							
Quality	Unscreened	5.7	23.4	0.24	-0.12	154	-
	Decile Exclusion	6.0	23.1	0.26	-0.05	117	-24.0
	Quintile Exclusion	6.8	23.1	0.29	0.13	95	-38.5
	Tertile Exclusion	6.8	22.5	0.30	0.14	74	-51.9
Value	Unscreened	7.7	26.5	0.29	0.21	390	-
	Decile Exclusion	7.9	26.3	0.30	0.26	159	-59.3
	Quintile Exclusion	8.0	26.3	0.30	0.28	99	-74.6
	Tertile Exclusion	7.9	26.1	0.30	0.28	70	-82.0
Momentum	Unscreened	3.0	22.9	0.13	-0.39	276	-
	Decile Exclusion	3.7	22.9	0.16	-0.33	148	-46.3
	Quintile Exclusion	3.4	22.9	0.15	-0.38	110	-60.2
	Tertile Exclusion	3.7	22.5	0.16	-0.36	81	-70.7
Low Volatility	Unscreened	7.2	17.6	0.41	0.09	326	-
	Decile Exclusion	7.6	18.0	0.42	0.14	147	-55.0
	Quintile Exclusion	7.7	18.3	0.42	0.16	102	-68.7
	Tertile Exclusion	7.4	18.7	0.40	0.13	79	-75.9
SOUTH KOREA							
Quality	Unscreened	7.4	21.2	0.35	0.55	211	-
	Decile Exclusion	8.1	20.9	0.39	0.61	134	-36.4
	Quintile Exclusion	6.7	21.6	0.31	0.43	90	-57.4
	Tertile Exclusion	5.6	21.6	0.26	0.31	68	-67.9
Value	Unscreened	5.9	25.6	0.23	0.32	456	-
	Decile Exclusion	6.6	25.9	0.25	0.39	121	-73.5
	Quintile Exclusion	5.9	25.2	0.23	0.33	85	-81.3
	Tertile Exclusion	5.9	24.9	0.24	0.31	58	-87.2
Momentum	Unscreened	1.4	24.7	0.05	-0.10	287	-
	Decile Exclusion	1.5	23.8	0.06	-0.09	153	-46.5
	Quintile Exclusion	1.7	22.4	0.08	-0.07	100	-65.3
	Tertile Exclusion	1.7	22.4	0.08	-0.08	69	-75.9
Low Volatility	Unscreened	4.5	16.3	0.28	0.15	383	-
	Decile Exclusion	5.7	16.6	0.34	0.25	106	-72.2
	Quintile Exclusion	5.0	17.7	0.28	0.20	67	-82.4
	Tertile Exclusion	3.9	18.5	0.21	0.10	48	-87.4

Source: S&P Dow Jones Indices LLC, Trucost ESG Analysis, and FactSet. Data from Sept. 21, 2007, to June 29, 2018. Data for China from March 18, 2011, to June 29, 2018. Performance based on total return in local currency. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance. Please refer Appendix B for indices used for each region.

Appendix H: Sensitivity Analysis of Carbon-Efficient Screening of Common Risk Factors (cont.)

PORTFOLIO		ANNUALIZED RETURN (%)	ANNUALIZED VOLATILITY (%)	RISK-ADJUSTED RETURNS	INFORMATION RATIO	WEIGHTED AVERAGE CARBON INTENSITY	REDUCTION IN CARBON INTENSITY (%)
TAIWAN							
Quality	Unscreened	2.5	19.9	0.12	-0.14	225	-
	Decile Exclusion	1.9	19.8	0.09	-0.24	150	-33.3
	Quintile Exclusion	1.7	20.1	0.08	-0.26	106	-52.6
	Tertile Exclusion	2.5	19.8	0.13	-0.13	86	-61.9
Value	Unscreened	3.3	21.2	0.16	-0.01	211	-
	Decile Exclusion	3.2	21.4	0.15	-0.04	142	-32.7
	Quintile Exclusion	2.8	21.4	0.13	-0.10	88	-58.4
	Tertile Exclusion	2.4	21.4	0.11	-0.16	64	-69.6
Momentum	Unscreened	4.4	21.3	0.21	0.13	375	-
	Decile Exclusion	4.6	21.2	0.22	0.17	161	-57.0
	Quintile Exclusion	4.2	21.0	0.20	0.11	115	-69.3
	Tertile Exclusion	2.1	21.0	0.10	-0.19	79	-79.0
Low Volatility	Unscreened	7.5	15.8	0.48	0.50	461	-
	Decile Exclusion	7.0	16.1	0.44	0.45	145	-68.6
	Quintile Exclusion	6.2	16.4	0.38	0.36	90	-80.4
	Tertile Exclusion	4.8	17.5	0.27	0.20	53	-88.5

Source: S&P Dow Jones Indices LLC, Trucost ESG Analysis, and FactSet. Data from Sept. 21, 2007, to June 29, 2018. Data for China from March 18, 2011, to June 29, 2018. Performance based on total return in local currency. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance. Please refer Appendix B for indices used for each region.

APPENDIX I1: Active Factor Exposures for Factor Portfolios in Australia (Averaged Quarterly)

FACTOR	RISK MODEL FACTOR DEFINITION	QUALITY		VALUE		MOMENTUM		LOW VOLATILITY	
		PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT
Quality	ROE, ROA, Cash Flow to Assets, Cash Flow to Income, Gross Margin, and Sales to Assets	0.51	0.46	0.02	0.03	0.15	0.18	0.12	0.12
	Total Debt to Assets and Total Debt to Equity	-0.50	-0.36	-0.04	0.02	-0.07	0.07	0.35	0.32
Value	Book to Price, Earnings to Price, and Estimated Earnings to Price	-0.16	-0.14	0.87	0.73	-0.36	-0.33	-0.09	-0.11
	Dividend Yield	0.12	0.36	0.54	0.77	-0.44	-0.13	0.42	0.45
Momentum	Past One-Year Return (Excluding Most Recent Month)	0.07	0.03	-0.39	-0.27	0.74	0.51	0.07	0.06
Volatility (High)	Six-Month Average of Absolute Returns over Cross-Sectional Standard Deviation	-0.03	-0.11	0.23	0.05	-0.00	-0.16	-0.54	-0.51
Size (Large)	Natural Logarithm of Market Capitalization	-0.03	-0.03	-0.21	-0.16	0.08	0.08	0.38	0.34
Growth	Sales Growth, Estimated Sales Growth, Earnings Growth, Estimated Earnings Growth	0.08	0.03	-0.23	-0.16	0.22	0.12	-0.05	-0.03
Liquidity	Natural Logarithm of (Three-Month Average Daily Volume) Divided by (One-Month Average Market Cap)	0.07	-0.00	0.16	0.05	-0.00	-0.13	-0.17	-0.20
Exchange Rate Sensitivity	Two-Year Weekly Beta to Returns of USD	0.02	-0.17	0.05	-0.06	0.03	-0.20	-0.27	-0.27

Source: S&P Dow Jones Indices LLC, FactSet, and Axioma. Data from Sept. 21, 2007, to June 28, 2018. The Axioma Australia Fundamental Equity Risk Model MH 4 is used for the comparison of the factor portfolios against the base universe for Australia. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

APPENDIX I2: Active Factor Exposures for Factor Portfolios in China (Averaged Quarterly)

FACTOR	RISK MODEL FACTOR DEFINITION	QUALITY		VALUE		MOMENTUM		LOW VOLATILITY	
		PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT
Quality	ROE, ROA, Cash Flow to Assets, Cash Flow to Income, Gross Margin, and Sales to Assets	0.76	0.47	-0.12	-0.11	0.30	0.19	0.05	-0.00
	Total Debt to Assets and Total Debt to Equity	-0.81	-0.79	0.32	0.06	-0.13	-0.24	0.09	-0.14
Value	Book to Price, Earnings to Price, and Estimated Earnings to Price	-0.30	-0.21	1.23	1.10	-0.39	-0.24	0.73	0.64
	Dividend Yield	0.19	0.11	0.82	0.74	-0.26	-0.16	0.76	0.62
Momentum	Past One-Year Return (Excluding Most Recent Month)	0.09	0.05	-0.17	-0.12	0.76	0.59	-0.12	-0.07
Volatility (High)	Six-Month Average of Absolute Returns over Cross-Sectional Standard Deviation	0.04	0.02	-0.45	-0.41	0.41	0.29	-0.68	-0.55
Size (Large)	Natural Logarithm of Market Capitalization	0.03	0.00	0.27	0.27	0.07	0.07	0.33	0.31
Growth	Sales Growth, Estimated Sales Growth, Earnings Growth, Estimated Earnings Growth	0.13	0.09	-0.13	0.02	0.24	0.27	-0.21	-0.08
Liquidity	Natural Logarithm of (Three-Month Average Daily Volume) Divided by (One-Month Average Market Cap)	0.01	-0.02	-0.08	-0.08	0.16	0.08	-0.42	-0.36
Exchange Rate Sensitivity	Two-Year Weekly Beta to Returns of USD	-0.04	0.01	-0.07	-0.05	0.05	0.11	0.01	0.00

Source: S&P Dow Jones Indices LLC, FactSet, and Axioma. Data from March 11, 2011, to June 28, 2018. The Axioma China Fundamental Equity Risk Model MH 4 is used for the comparison of the factor portfolios against the base universe for China. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

APPENDIX I3: Active Factor Exposures for Factor Portfolios in India (Averaged Quarterly)

FACTOR	RISK MODEL FACTOR DEFINITION	QUALITY		VALUE		MOMENTUM		LOW VOLATILITY	
		PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT
Quality	ROE, ROA, Cash Flow to Assets, Cash Flow to Income, Gross Margin, and Sales to Assets	0.92	0.75	-0.41	-0.47	0.26	0.20	0.60	0.53
	Total Debt to Assets and Total Debt to Equity	-1.01	-0.94	0.34	0.26	-0.05	-0.03	-0.70	-0.65
Value	Book to Price	-0.48	-0.45	1.03	0.80	-0.34	-0.37	-0.38	-0.40
	Earnings to Price and Estimated Earnings to Price	-0.11	-0.13	0.65	0.51	-0.14	-0.12	-0.12	-0.13
	Dividend Yield	0.19	0.05	0.35	0.29	-0.17	-0.19	0.07	-0.01
Momentum	Past One-Year Return (Excluding Most Recent Month)	0.11	0.09	-0.23	-0.24	0.69	0.57	0.07	0.06
Volatility (High)	Six-Month Average of Absolute Returns over Cross-Sectional Standard Deviation	-0.20	-0.15	0.22	0.19	-0.05	-0.07	-0.47	-0.41
Size (Large)	Natural Logarithm of Market Capitalization	0.04	0.01	-0.11	-0.10	0.06	0.06	0.09	0.08
Growth	Sales Growth, Estimated Sales Growth, Earnings Growth, Estimated Earnings Growth	-0.05	0.00	-0.20	-0.19	0.16	0.20	-0.05	0.02
Liquidity	Natural Logarithm of (Three-Month Average Daily Volume) Divided by (One-Month Average Market Cap)	-0.20	-0.16	0.16	0.19	-0.03	-0.03	-0.24	-0.20
Exchange Rate Sensitivity	Two-Year Weekly Beta to Returns of USD	-0.02	-0.04	0.10	0.13	-0.10	-0.06	-0.10	-0.14

Source: S&P Dow Jones Indices LLC, FactSet, and Axioma. Data from Sept. 21, 2007, to June 28, 2018. The Axioma Emerging Markets Fundamental Equity Risk Model MH 4 is used for the comparison of the factor portfolios against the base universe for India. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

APPENDIX I4: Active Factor Exposures for Factor Portfolios in Hong Kong (Averaged Quarterly)

FACTOR	RISK MODEL FACTOR DEFINITION	QUALITY		VALUE		MOMENTUM		LOW VOLATILITY	
		PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT
Quality	ROE, ROA, Cash Flow to Assets, Cash Flow to Income, Gross Margin, and Sales to Assets	0.69	0.59	-0.18	-0.10	0.17	0.23	0.21	0.22
	Total Debt to Assets and Total Debt to Equity	-0.67	-0.70	0.31	-0.00	-0.01	-0.21	-0.28	-0.31
Value	Book to Price	-0.56	-0.49	0.98	0.76	-0.45	-0.38	0.04	0.10
	Earnings to Price and Estimated Earnings to Price	-0.04	-0.05	0.61	0.72	-0.18	-0.09	0.22	0.33
	Dividend Yield	0.13	0.07	0.21	0.27	-0.23	-0.20	0.30	0.31
Momentum	Past One-Year Return (Excluding Most Recent Month)	0.08	0.09	-0.33	-0.21	0.97	0.78	-0.12	-0.13
Volatility (High)	Six-Month Average of Absolute Returns over Cross-Sectional Standard Deviation	0.01	-0.00	-0.04	-0.12	0.23	0.17	-0.69	-0.61
Size (Large)	Natural Logarithm of Market Capitalization	0.04	0.04	-0.13	-0.06	0.07	0.08	0.17	0.17
Growth	Sales Growth, Estimated Sales Growth, Earnings Growth, Estimated Earnings Growth	0.12	0.11	-0.22	-0.16	0.25	0.24	-0.20	-0.16
Liquidity	Natural Logarithm of (Three-Month Average Daily Volume) Divided by (One-Month Average Market Cap)	-0.07	-0.09	0.03	-0.04	0.02	-0.01	-0.21	-0.18
Exchange Rate Sensitivity	Two-Year Weekly Beta to Returns of USD	0.07	0.06	-0.07	-0.04	0.05	-0.03	0.17	0.08

Source: S&P Dow Jones Indices LLC, FactSet, and Axioma. Data from Sept. 21, 2007, to June 28, 2018. The Axioma World-Wide Fundamental Equity Factor Risk Model MH 4 is used for the comparison of the factor portfolios against the base universe for Hong Kong. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

APPENDIX I5: Active Factor Exposures for Factor Portfolios in Taiwan (Averaged Quarterly)

FACTOR	RISK MODEL FACTOR DEFINITION	QUALITY		VALUE		MOMENTUM		LOW VOLATILITY	
		PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT
Quality	ROE, ROA, Cash Flow to Assets, Cash Flow to Income, Gross Margin, and Sales to Assets	0.68	0.58	-0.09	-0.09	0.21	0.17	-0.08	-0.11
	Total Debt to Assets and Total Debt to Equity	-0.59	-0.60	0.08	0.03	-0.03	-0.08	0.14	0.10
Value	Book to Price	-0.43	-0.38	0.58	0.43	-0.32	-0.26	0.13	0.13
	Earnings to Price and Estimated Earnings to Price	0.18	0.16	0.23	0.28	0.05	0.06	0.16	0.17
	Dividend Yield	0.38	0.40	0.30	0.36	-0.26	-0.20	0.31	0.20
Momentum	Past One-Year Return (Excluding Most Recent Month)	0.10	0.06	-0.17	-0.16	0.71	0.51	-0.01	-0.01
Volatility (High)	Six-Month Average of Absolute Returns over Cross-Sectional Standard Deviation	0.11	0.14	-0.13	-0.11	0.28	0.15	-0.74	-0.61
Size (Large)	Natural Logarithm of Market Capitalization	0.04	0.01	-0.06	-0.05	0.08	0.07	0.06	0.05
Growth	Sales Growth, Estimated Sales Growth, Earnings Growth, Estimated Earnings Growth	0.16	0.12	-0.10	-0.06	0.24	0.27	-0.06	0.08
Liquidity	Natural Logarithm of (Three-Month Average Daily Volume) Divided by (One-Month Average Market Cap)	0.07	0.10	-0.04	-0.02	0.11	0.10	-0.37	-0.29
Exchange Rate Sensitivity	Two-Year Weekly Beta to Returns of USD	0.04	0.00	0.02	-0.05	0.01	-0.03	0.13	0.09

Source: S&P Dow Jones Indices LLC, FactSet, and Axioma. Data from Sept. 21, 2007, to June 28, 2018. The Axioma Emerging Markets Fundamental Equity Risk Model MH 4 is used for the comparison of the factor portfolios against the base universe for Taiwan. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

APPENDIX I6: Active Factor Exposures for Factor Portfolios in South Korea (Averaged Quarterly)

FACTOR	RISK MODEL FACTOR DEFINITION	QUALITY		VALUE		MOMENTUM		LOW VOLATILITY	
		PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT	PURE	CARBON EFFICIENT
Quality	ROE, ROA, Cash Flow to Assets, Cash Flow to Income, Gross Margin, and Sales to Assets	0.52	0.45	-0.20	-0.25	0.26	0.26	0.07	0.02
	Total Debt to Assets and Total Debt to Equity	-0.71	-0.76	0.60	0.48	-0.19	-0.26	-0.18	-0.11
Value	Book to Price	-0.55	-0.53	0.92	0.71	-0.38	-0.37	0.36	0.24
	Earnings to Price and Estimated Earnings to Price	0.08	0.04	0.40	0.45	-0.12	-0.11	0.24	0.31
	Dividend Yield	0.09	0.04	0.24	0.26	-0.14	-0.12	0.41	0.29
Momentum	Past One-Year Return (Excluding Most Recent Month)	0.12	0.07	-0.23	-0.21	0.71	0.52	0.11	0.08
Volatility (High)	Six-Month Average of Absolute Returns over Cross-Sectional Standard Deviation	0.09	0.06	-0.12	-0.15	0.24	0.17	0.47	0.39
Size (Large)	Natural Logarithm of Market Capitalization	0.04	0.04	-0.04	-0.01	0.07	0.05	0.09	0.09
Growth	Sales Growth, Estimated Sales Growth, Earnings Growth, Estimated Earnings Growth	0.24	0.21	-0.19	-0.10	0.14	0.21	-0.17	-0.03
Liquidity	Natural Logarithm of (Three-Month Average Daily Volume) Divided by (One-Month Average Market Cap)	-0.07	-0.10	-0.01	-0.05	-0.00	-0.02	-0.21	-0.20
Exchange Rate Sensitivity	Two-Year Weekly Beta to Returns of USD	-0.06	-0.11	-0.03	-0.09	0.00	-0.03	-0.07	-0.10

Source: S&P Dow Jones Indices LLC, FactSet, and Axioma. Data from Sept. 21, 2007, to June 28, 2018. The Axioma Emerging Markets Fundamental Equity Risk Model MH 4 is used for the comparison of the factor portfolios against the base universe for South Korea. Table is provided for illustrative purposes and reflects hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

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The back-test period does not necessarily correspond to the entire available history of the Index. Please refer to the methodology paper for the Index, available at www.spdji.com for more details about the index, including the manner in which it is rebalanced, the timing of such rebalancing, criteria for additions and deletions, as well as all index calculations.

Another limitation of using back-tested information is that the back-tested calculation is generally prepared with the benefit of hindsight. Back-tested information reflects the application of the index methodology and selection of index constituents in hindsight. No hypothetical record can completely account for the impact of financial risk in actual trading. For example, there are numerous factors related to the equities, fixed income, or commodities markets in general which cannot be, and have not been accounted for in the preparation of the index information set forth, all of which can affect actual performance.

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