Industry Classification and Environmental, Social and Governance (ESG) Standards

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Abstract

The paper explores a comparison between traditional classification systems and classification systems that take sustainability risks into account. GICS is the standard in the industry for sector allocation and risk management in portfolio construction. The Sustainable Industry Classification System (SICS) scheme, created by the Sustainability Accounting Standards Board (SASB), presents an alternative to GICS by aggregating companies that share similar resource intensity, sustainability risks, and opportunities. The better a system is in grouping companies with strong stock return correlations, the more relevant it will be for portfolio risk management and sector allocation. The paper will start by describing what classification systems are and why they are important. In the second part, attention is devoted to showing why sustainability concerns are important when talking about sector classifications. The third part calculates and compares the difference between the average within-industry and between-industry correlation of stock returns using GICS and SICS definitions. Also, attention is devoted to analyzing the effect of using the SICS on large-cap and small-cap companies and their comparison to the GICS. The fourth and final part presents the results showing that integrating sustainability factors on sector classification generates substantial positive impact. Given the ubiquitous implementation of GICS in the industry, the outperformance of this classification lowering the average correlation

between each stock *i*'s return and the returns of all other stocks not in its industry could lead to a major shifting of standards in the industry, enabling better risk management and portfolio diversification, as well as better classification standards for stocks.

Introduction

As of April 2018, world equity markets stood at an impressive $78 trillion without accounting for derivatives on those underlying assets. In order to manage this asset class more efficiently, fund managers and business analysts separate companies into different sectors. Being able to aggregate companies that share similar characteristics together while separating companies that do not share those characteristics improves managers' understanding of their portfolio allocation and risk management. With a clear sector breakdown, managers can decide to focus investments in only specific sectors, divest from others, or improve their risk-return profile by diversifying their risk among many sectors. Today, most classification systems only group companies based on their financial risks, like revenues and line of business. Material systemic risks that directly impact financial performance, like climate change, are not being considered. In this paper, we will argue that by integrating material sustainability issues into the classification systems, we can achieve better results. GICS is the incumbent classification system being utilized in today's financial markets for sector allocation and risk management in portfolio construction and is mainly driven by major source of revenue and line of business. The Sustainable Industry Classification System (SICS), created by the Sustainability Accounting Standards Board (SASB) in 2011, presents an alternative by grouping companies that share similar sustainability risks and opportunities, rather than by major sources of revenue. First, a general discussion concerning classification systems is needed to display how classification systems function and why they are important. Next, we will provide an explanation of how sustainability can have a material impact on traditional classification systems. Finally, we report the results of a study that provides empirical evidence on the strength of each classification system. The better a system is in grouping companies with strong stock return correlations, the more relevant it will be for portfolio risk management and sector allocation. With these results, we intend to present an answer to the question, "Is SICS a better way to classify industries than GICS?" The outperformance of any other classification system could lead to a major shifting of classification standards for stocks.

What are Classification Systems?

Classification systems are a type of classification that organizes companies that are similar into industry groups. There are a number of prominent schemes used to classify stocks, dating back to Elton and Gruber (1970) and Farrell (1974). More recently, Fama and French (1997) organized the market into 48 industry groups based on Standard Industrial Classification (SIC) codes, which aggregate companies selling related end-products or using similar production processes. Chan, Lakonishok and Swaminathan (2007) compared the effectiveness of the Fama and French (FF) classification system against that of the Global Industry Classification Standard (GICS). The GICS, currently used to classify more than 95% of the world's market capital, is mainly driven by the major source of revenue and line of business.

Classification systems may have one level of grouping or multiple levels that attempt to define deeper levels of granularity amongst peer companies.

Why Classification Schemes are Important

Classification systems can be very useful when managing a portfolio. Modern Portfolio Theory suggests that holding a portfolio of multiple securities, when those securities have a positive expected value, can be advantageous on a risk-adjusted basis (Kaplan, 2014).

Risk reduction in a portfolio is achieved by adding securities that are less correlated to one another and the greatest diversification will be achieved by adding assets that are perfectly negatively correlated. The reason this happens is because the expected value of the portfolio increases linearly but the standard deviation increases as a function of the square root of the sum of the variances plus two times the covariance. This can be easily noticed by observing the formula for the standard deviation of a two-asset portfolio:

$$\sigma_{portfolio} = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{12}\sigma_1\sigma_2}$$

where:

w_i = weighting of security *i* in the portfolio

σ_i= standard deviation of security *i*

ρ_{ij}= correlation between securities *i* and *j*

If the correlation of the two assets is zero, the entire third term of the equation is eliminated. If the correlation is negative, then the third term is subtracted from the first two and the standard deviation is further reduced.

The ubiquitous application of portfolio theory demonstrates why correlations between assets and, thus, classification systems that group like-assets together are vital to investors and global financial markets.

From a top-down perspective, classification systems can be very helpful for investors as the investor can add additional, non-correlated sectors to their portfolio in order to reduce its overall risk. This prevents the overexposure of a portfolio to a singular source of uncertainty. Through sector allocation, securities can be selected such that there is sufficient diversification of risk amongst the different sectors and industries that the securities belong to. In order to perform sector or industry allocation effectively, it is important to have a classification scheme that can accurately classify firms into sectors and industries where correlation within a sector is as high as possible while correlation between sectors is as low as possible. Investors also use classification systems for benchmarking in order to determine whether the costs incurred for active management are justified by performance. Industry sector exposures and contribution to portfolio performance are compared against peers and sector benchmarks to determine over- or under-performance. A growing portion of financial assets is invested through passive investment strategies (Marks, 2018). These strategies invest in an index that serves as a proxy for the market or a specific portion of the market, such as a sector or industry. The classification systems must allocate securities correctly or these passive strategies could potentially be exposed to unwanted risk factors. As prices change, rebalancing must occasionally occur in order to adjust the weights of the underlying securities back to their index targets. This indexation and the large flow of funds to these kinds of strategies have impacts in how classification systems perform. More will be discussed on this point in later parts of this paper.

Why Sustainability Risks are Important When Considering Sector Classification

Different stakeholders have different motivations for integrating sustainability into their financial analysis. Many professionals look towards sustainability for an informational advantage in their effort to add positive and absolute alpha to their portfolios. Others are searching for better risk-adjusted returns. Last, but not least, there are value investors who are looking to perform well financially while also keeping in mind the long-term sustainability of the business.

While there are many definitions and interpretations of sustainability, a consensus is beginning to form on its financial application. The 1987 Brundtland Commission defined it as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” Likewise, Generation’s David Blood states, “Because sustainability drives the long-term success of businesses, a robust investment process should integrate environmental, social and governance factors into the analysis of business and management quality.” (Bebb, Reichelstein, 2016). Intuitively, the term sustainable, or the ability to maintain something at a certain rate, pairs well with a company’s ability and willingness to prepare for its future needs.

Financial metrics can provide analysts with a robust set of data, but this dataset is incomplete and doesn’t convey the entire picture because some material information is being omitted from the analysis. Adding material non-financial metrics, or sustainability data, completes this dataset and illuminates the current and future growth opportunities and challenges facing firms. Materiality is defined by the U.S. Supreme Court in TSC v. Northway: information is material “if there is a substantial likelihood that the omitted fact would have significantly altered the total mix of information available to the reasonable investor.” Therefore, investment professionals need to consider all material information, whether financial or non-financial, i.e., sustainable, as this is an intrinsic part of their fiduciary duties. In 2005, the United Nations concurred by releasing a report that stated, “In our opinion, it may be a breach of fiduciary duties to fail to take account of [environmental, social, and governance (ESG)] considerations that are relevant and to give them appropriate weight, bearing in mind that some important economic analysis and leading financial institutions are satisfied that a strong link between good ESG performance and good financial performance exists” (UNEP FI, 2005).

When thinking about materiality in the sustainability context, we understand that there are systemic risks, like climate change, that expose industries in different sectors to the same underlying problem. If those risks are not taken into consideration and only a traditional view of sector allocation is used, managers run the risk of believing they did their job of diversifying their portfolio when in fact the whole portfolio might suffer from one single event. With that in mind, integrating material sustainability considerations into sector classification can be very beneficial.

Integrating sustainability risks into sector classification models could provide the portfolio manager with a better representation of his or her risk exposures and the manager could diligently align desired risk exposures with his or her portfolio views. For example, if a manager invested in a beverage company as part of the consumer staples industry and an apparel company as part of the consumer discretionary industry, the portfolio could still be exposed to a single sustainability risk, water and wastewater management. By ignoring sustainability risks and classifications, the manager added unwanted risk exposures, while potentially reducing risk-adjusted returns.

Investment professionals and firms rely on mathematical calculations to provide feedback on their portfolios. The majority of these calculations, such as the omnipresent Value at Risk (VaR) and its variations, various stress testing and scenario analyses, and expected shortfall all rely on the covariances of the portfolio’s securities. By ignoring sustainability-related systemic risks, the traditional classification system risks underestimating the covariance of sectors. Additionally, by integrating sustainability concepts into the classification scheme and across the portfolio, each security held could demonstrate improving ESG profiles, thus lowering the portfolio’s combined systemic risk.

A more effective classification system could see a very high adoption rate from the market as managers who deploy this system into their strategies will receive the benefit of added alpha and more accurate risk measurements. By integrating material sustainability metrics into the classification scheme and, thus, the market’s risk framework, externalities that were formerly paid for by society will now be internalized by the companies themselves. This notion reinforces the risk framework by incorporating all financial and non-financial risks that companies face into their cost of capital and bottom line. For example, carbon-emitting manufacturers are currently releasing greenhouse gases into the ecosystem, placing numerous charges on society. Under a sustainability framework, these companies would be punished for these externalities and the risk would be internalized by a higher cost of capital and ultimately a lower valuation for the company. This valuation would reflect a more accurate assessment of the firm’s risks and opportunities and those of the entire market once fully implemented. Further, since enhanced risk management is essential across the board, whether or not a manager has a sustainability-based mandate or set of values, mass adoption by financial markets would shine a light on sustainability topics globally.

Comparing Classification Systems

As already mentioned, there are a number of prominent schemes used to classify stocks, but in recent years, the Global Industry Classification Standard (GICS) has been used to classify more than 95% of the world’s market capital. Classification in the GICS is mainly driven by the major sources of revenue. A more effective system would take into consideration systemic sustainability risks. As of now, the most prominent classification system that aims to introduce that concept is SICS,. Its classification is done on the basis of the firm's sustainable value creation. Both the GICS and SICS have a different set of sectors and industries. Since the SICS is fairly nascent, its applications as a classification scheme for sector allocation in portfolio management haven't been extensively integrated in financial markets nor studied in academia. In the following sections, we perform an empirical comparison to examine the homogeneity of stock return movement within sectors when using the GICS and SICS schemes. The study is extended further by examining the homogeneity of stock return movements for large-capitalization and small-capitalization firms.

A good classification system categorizes firms that are considered closely related together. If classified correctly, these firms would have stock returns that experience coinciding movements. Furthermore, correlations with stock returns of firms outside of the group would be relatively weaker. In other words, a good classification system wants to maximize the correlation between firms in a sector and minimize correlation with firms in other sectors.

Previous Work Comparing Classification Systems

Chan, Lakonishok and Swaminathan (2007) compared the GICS and FF classification schemes using procedures to evaluate the degree to which each classification scheme isolates groups of companies that belong to an industry from companies that do not belong to that industry. They measured the homogeneity of a sector in terms of the coincidence of stock price movements. They compared the magnitude of return correlations in order to determine the extent of homogeneity provided by each classification scheme. Apart from this, they also examined different levels of detail in the GICS classification code (sector, industry group, industry and sub-industry) and also performed a comparison of the GICS and FF classification schemes on large-capitalization stocks and small-capitalization stocks. Their results concluded that GICS outperformed FF in terms of aggregating stocks with highly correlated returns within groups, and that large-capitalization firms had an overall higher coincidence of returns within a group when compared to small-capitalization firms.

Methodology to Compare

The methodology we have implemented to compare the GICS and SICS derives mainly from the work published by Chan, Lakonishok and Swaminathan (2007). We have used the mathematical procedures described by them to compare the magnitude of return correlations from various markets using the GICS and SICS schemes on two levels of details by considering the two-digit and four-digit codes for both schemes.

The return correlations were calculated as follows: Let K be the number of stocks in the sample. The GICS and SICS classification schemes were applied to each stock i=1, 2, …, K to assign it an industry I. Suppose that stock i's industry consists of N stocks (inclusive). Then, the pairwise correlations between stock i's return and the return of each of the other members of its industry were averaged and calculated as follows:

$$\rho_{iI} = \frac{\sum_{j \in I, j \neq i} \rho_{ij}}{N-1},$$

Where ρ_{ij} is the time-series correlation between the return on stocks i and j. Similarly, the average pairwise correlation between stock i's return and the returns of all other stocks not in its industry was computed as follows:

$$\phi_{iI} = \frac{\sum_{j \notin I} \rho_{ij}}{K - N}.$$

Further, the average within-industry correlation over all stocks in the sample was calculated as:

$$\bar{\rho}_I = \frac{\sum_{i=1}^{K} \rho_{iI}}{K}$$

Also, the average correlation between a stock and other stocks not in its industry was calculated as:

$$\bar{\phi}_I = \frac{\sum_{i=1}^{K} \phi_{iI}}{K}.$$

We have used the values of $\bar{\rho}_I$ and $\bar{\phi}_I$ for stocks within GICS and SICS sectors in our empirical study. The average within-industry correlation over all stocks in an index (denoted by $\bar{\rho}_I$ above) is the measure we have used to compare the GICS and SICS schemes in the tables in the Appendix and has been referred to as “WITHIN” in the tables for ease of understanding, as it denotes the average within-industry correlation. Similarly, $\bar{\phi}_I$ has been used as the measure to represent the average correlation between a stock and stocks not in its sector and has been denoted as “BETWEEN” in the tables. The difference between the values of $\bar{\rho}_I$ and $\bar{\phi}_I$ has been referred to as “DIFF”.

The two-digit GICS and SICS codes have been denoted by GICS2 and SICS2, respectively, in the analysis, while the four-digit GICS and SICS codes have been denoted by GICS4 and SICS4. The two-digit codes for each of the schemes represents only the sector that the security belongs to, while the four-digit codes consider a finer level of detail based on the taxonomy of the classification schemes. For the GICS scheme, GICS4 represents a combination of the sector and the industry group of the security, while the SICS4 represents a combination of the sector and the sub-sector of the security. Classification schemes that lead to groups with stronger commonalities will tend to produce larger positive differences between the within-industry and between-industry differences.

For the purpose of the empirical study, we have calculated the average pairwise correlations between individual stocks' returns and returns of within-industry or between industry stocks. We also evaluated how large-capitalization stocks perform in comparison to small capitalization stocks.

Data Source and Reasoning

We used monthly stock returns obtained from the Bloomberg Terminal Professional Services. In particular, we used data from 2011 to 2018 for stocks in the S&P 500 and S&P 1500 and for equities traded on stock exchanges in the United Kingdom. We used Python to implement the methodology described previously. Apart from stock returns, we also used the GICS classification codes and market capitalization as of July 2018 as provided by Bloomberg and SICS classification codes provided through a licensed agreement with SASB. We eliminated stocks that were not listed on an exchange in the period of 2011 to 2018 for any month. When defining the threshold for qualifying a firm as a large-capitalization or small-capitalization firm, we computed the median market-capitalizations for the set of firms in each market taken into consideration. This median value was $16.6 billion for the S&P 500, $3.94 billion for the S&P 1500 and £93 million for UK securities. The median value was used as setting the threshold too high would lead to an extremely low number of firms being classified as large-cap, which would have created biases in the results and problems in the computations.

Comparing SICS and GICS

The GICS system, which was developed in 1999, is one of the primary global classification systems in use today. It has been used to classify 50,000 trading securities over 125 countries, which represent approximately 95% of the world's equity market capitalization. GICS is universal, flexible as it has 4 levels of specialization, and is frequently updated based on the evolution of firms. The MSCI and S&P Global use revenues as a key factor in determining a firm's principal activity. However, earnings and market are also considered as important factors for classification purposes.

The GICS classification system assigns each firm an 8-digit classification code. This code represents the sector, industry group, industry and the sub-industry that the firm belongs to according to the classification scheme. According to this four-level hierarchy, there are 11 sectors, 24 industry groups, 68 industries and 157 sub-industries.

The omnipresence of the GICS classification scheme in the financial world lends itself to a bias in the data that will later be presented. It is vital to consider that it is very likely a feedback loop is occurring: portfolio managers and investors look to the GICS classification for direction on risk classifications so they can diversify their portfolio accordingly in an effort to produce the best risk-adjusted returns. Buying and selling of securities within the same industry classification will then become more correlated as more investment managers utilize this methodology. The inverse is true for securities in different industries, namely, they will become less correlated to one another. These associations are further amplified by passive funds and through benchmarking. In other words, if active managers are currently bidding up prices within a sector, passive funds will follow suit and further move these securities in the same direction, and thus, increase their correlation to one another. To complete the loop, other active managers who are benchmarked to and tracking the sector's index, will further amplify these effects by following the passive funds' movements.

When SASB created SICS in 2011, it was in response to growing investor interest in ESG investing. Companies face an ever-expanding list of risks and opportunities, many of which are not captured by traditional financial statements, that have profound effects on business outcomes (FSA Study Guide). Therefore, new standards and a classification system needed to be created in order to properly measure and group these sustainability risks together. Instead of using major revenue sources, SASB argues that material sustainability metrics should be the primary focus for classification purposes. Additionally, the similarity of companies' sustainability challenges and innovation opportunities is considered, rather than other traditional financial factors.

The SICS system assigns a 6-digit code to firms, using a three-level hierarchy. This hierarchy consists of 10 thematic sectors, 35+ sub-sectors and 80+ industries. For example, under the traditional GICS classification, Oil, Gas & Coal are categorized under Energy while Metals & Mining is categorized under Materials. From a sustainability viewpoint, all are extractive industries that rely on finite resources and have similar impacts on the environment and communities.

As previously mentioned, integrating sustainability into the investment process is of utmost importance in an effort to achieve an efficient portfolio with optimal risk-adjusted returns. In order to produce such a portfolio, the classification schemes investors use need to be properly defined. While GICS uses revenue as its main source of classification and SICS uses sustainability value, this study attempts to prove that a combined financial and sustainability classification scheme is ideal.

This paper has explained that the GICS classification system is inefficient as it completely ignores sustainability and its potential impacts on financial valuations. SICS, on the other hand, significantly stresses sustainability factors in its classification. The main issue with this is that it relies on self-reported company data that is often incomplete, biased, or delayed. SASB acknowledges that it currently only has about 8% coverage on its reported materiality metrics. Therefore, proper classification of risk factors based on this data could very well be challenging. Nonetheless, SICS is currently the most adopted sustainability classification system so this paper has relied on it to show that a sustainability overlay can have benefits for classification and portfolio management.

Study Outcome & Conclusions

When looking at Table 8, we see that GICS performed better when comparing the top line index and also when using a breakdown of large and small caps for the S&P 500 and S&P 1500. When looking at UK stocks, SICS actually performed better when comparing the top line index, but GICS performed better when using a breakdown of large and small caps. Overall, as a direct comparison, SICS classifications did not fare as well quantitatively as GICS classifications, albeit not by a large margin.

Given that the GICS and SICS systems differ based on how they classify firms into sectors, we conducted a study by integrating the two systems. This study is significant as there is no direct means of sector-by-sector comparison between the two classification schemes since they have entirely different classification parameters, and therefore, different sectors. The GICS classification system has 11 sectors, while the SICS system has 10 sectors – thus, integrating them would give rise to potentially 110 new sectors. These new sectors will be combinations of GICS and SICS sectors. For example, Real Estate (60) - Consumption (CN) will be one of the sectors in the new system. However, not every cross-sector from the GICS and SICS integration will contain companies. For example, combining the GICS sector of real estate with the SICS sector of healthcare produces a null sector with zero members. Thus, the actual number of new sectors created by our integrated classification system varied from 30 to 40 in our analysis.

The results for this study were presented in the form of a table, where each of the SICS sectors were arranged row-wise and the GICS sectors were arranged along columns. This results in a 11x10 matrix with each entry corresponding to the calculated average pairwise correlation between individual stocks' returns and returns of within-industry or between-industry stocks.

The methodology we used to calculate within-industry and between-industry correlations for these new sectors was derived from the methodology used while comparing the GICS and SICS classification systems. Each firm was classified as belonging to one of the 110 possible sectors, where each of the 110 sectors was a combination of a GICS and SICS sector. The pairwise correlations between each stock *i*'s return and the return of each of the other members of its industry were averaged and then the average within-industry correlation over all stocks in the sample was calculated. Previously, "members of its industry" would have meant a specific sector like Utilities (55) or Financials (FN). Now, it refers to all firms which have the same combination of a GICS and SICS sector, like Utilities (55) - Financials (FN). Tables 5-7 show the results for the S&P 1500, while similar results (not displayed) were also found for the S&P 500 and UK securities. Likewise, on Tables 2-4, we calculate the average pairwise correlation between each stock *i*'s return and the returns of all other stocks not in its industry. Once again, we found similar results for the S&P 500 and UK securities.

When combining the two classification systems, we learned that breaking down the top line index into small and large caps can materially improve the correlation within stocks in a given sector. That makes intuitive sense when understanding that the dominating factor of within-industry classification is that the dynamics, challenges and opportunities of small companies are much different than large ones. Therefore, the correlation between a small and large company should not be as strong when compared to the correlation of similarly sized companies. More interesting, by integrating sustainability risks in the classification system, there was an apparent improvement in between-sector correlations, with a substantial number of sectors decreasing or maintaining their correlation when compared to other sectors. This is also intuitive as the risk deriving from sustainability tends to be systemic in nature. We found improvements in all indices analyzed when integrating sustainability issues. Table 1 show that from 272 sectors analyzed, we found improvement in 254 of them. On average, the number of sectors that saw improvement was 95%. An improvement in between-sector correlation means that we are minimizing the correlation between sectors by integrating sustainability factors. Here, the largest possible improvement is 100%. For example, a sector that decreases its between-sector correlation from 0.2 to 0.0 when integrating sustainability factors realizes an improvement of 100%. From the sectors that saw improvement, the enhancement was on average on the order of 51%.

Sustainability is intuitively, anecdotally, and now empirically proven to act as a good complement to traditional fundamental analysis. When sustainability classification systems are overlapped with conventional financial classification systems, there are positive additions to correlations in certain sectors, primarily coinciding with sustainability materiality for that sector.

Better data creates better classification systems. This hypothetical, yet quintessential, classification system that properly integrates and balances financial and non-financial metrics in an effort to provide the full scope of information for all stakeholders has strong potential to change the landscape of modern finance.

APPENDIX

Table 1: Summary of Results from Aggregating GICS & SICS: Average Correlation Between a Sector and Other Sectors in the Index.

	Aggregated Results			
	A	B		
Tested Indices	# of aggregated GICS/SICS sectors	# of sectors with lower correlation	Column B/A	Average % of Decreased Correlation
S&P 500 Small Cap	22	21	0.95	0.55
S&P 500 Large Cap	22	21	0.95	0.44
S&P 1500 Small Cap	34	33	0.97	0.49
S&P 1500 Large Cap	32	31	0.97	0.53
UK Small Cap	79	72	0.91	0.52
UK Large Cap	83	76	0.92	0.51

Notes: Taking the example of the S&P 500 Small Cap: when combining GICS/SICS, we arrived at 22 sectors; we saw lower correlation in 21 of 22 sectors which accounts for 95% of the sample; the average magnitude of decreased correlation was 55% out of a 100% maximum.

Table 2: Aggregating GICS and SICS Sectors: Average Correlations <u>Between</u> Sectors for <u>Small S&P1500 Firms</u>

		SICS Sectors									
GICS Sectors	**Average Correlation BETWEEN GICS Sectors**	**Consumption**	**Financials**	**Healthcare**	**Infrastructure**	**Non Renewable**	**Renewable**	**Resource Transformation**	**Services**	**Telecommunication**	**Transport**
Energy	0.22					0.10	0.18				
Materials	0.26	0.15				0.13	0.29	0.13			
Industrials	0.26	0.17			0.13	0.20		0.13	0.16	0.21	0.11
Consumer Discretionary	0.20	0.10			0.14				0.09	0.08	0.14
Consumer Staples	0.17	0.07									
Healthcare	0.16			0.06					0.11	0.11	
Financials	0.26		0.11						0.04		
IT	0.21	0.17					0.10	0.14	0.05	0.11	0.11
Telecom	0.17									0.13	
Utilities	0.13				0.04						
Real Estate	0.22				0.09		0.10				

Notes: Taking the first line as an example: the average correlation between the GICS sector Energy companies and all other sectors' companies using the GICS classification system is 0.22; when integrating GICS & SICS, the Energy sector becomes 2 new sectors, Energy/Non-Renewable and Energy/Renewable; the correlation between the GICS/SICS sector Energy/Renewable companies and all other sectors' companies using the combined GICS/SICS classification system is 0.18. The same process applies to the rest of table 2 and tables 3-7. Tables 4-7 are not directly used in the analysis of this paper and are included only for completeness.

Table 3: Aggregating GICS and SICS Sectors: Average Correlations Between Sectors for Large S&P1500 Firms

		SICS Sectors									
GICS Sectors	**Average Correlation BETWEEN GICS Sectors**	**Consumption**	**Financials**	**Healthcare**	**Infrastructure**	**Non Renewable**	**Renewable**	**Resource Transformation**	**Services**	**Telecommunication**	**Transport**
Energy	0.23					0.12					
Materials	0.28	0.07				0.11		0.15			
Industrials	0.27	0.12			0.12	0.07		0.16	0.09		0.13
Consumer Discretionary	0.22	0.08			0.14				0.12	0.10	0.14
Consumer Staples	0.16	0.08									
Healthcare	0.22			0.12					0.05	0.01	
Financials	0.28		0.15						0.19		
IT	0.24	0.03	0.26				0.05	0.13	0.19	0.11	0.05
Telecom	0.10									0.02	
Utilities	0.10				0.06						
Real Estate	0.22				0.12		0.19				

Table 4: Aggregating GICS and SICS Sectors: Average Correlations Between Sectors for All S&P1500 Firms

		SICS Sectors									
GICS Sectors	**Average Correlation BETWEEN GICS Sectors**	**Consumption**	**Financials**	**Healthcare**	**Infrastructure**	**Non Renewable**	**Renewable**	**Resource Transformation**	**Services**	**Telecommunication**	**Transport**
Energy	0.22					0.23	0.18				
Materials	0.26	0.21				0.24	0.29	0.28			
Industrials	0.29	0.29			0.25	0.27		0.28	0.25	0.21	0.24
Consumer Discretionary	0.23	0.19			0.28				0.21	0.18	0.27
Consumer Staples	0.16	0.16									
Healthcare	0.20			0.19					0.16	0.12	
Financials	0.31		0.27						0.23		
IT	0.25	0.19	0.26				0.15	0.28	0.24	0.22	0.15
Telecom	0.15									0.15	
Utilities	0.10				0.09						
Real Estate	0.22				0.21		0.29				

Table 5: Aggregating GICS and SICS Sectors: Average Correlations <u>Within</u> Sectors for <u>Small S&P1500 Firms</u>

		SICS Sectors									
GICS Sectors	**Average Correlation WITHIN GICS Sectors**	**Consumption**	**Financials**	**Healthcare**	**Infrastructure**	**Non Renewable**	**Renewable**	**Resource Transformation**	**Services**	**Telecommunication**	**Transport**
Energy	0.48					0.24					
Materials	0.35	0.19				0.21	0.61	0.17			
Industrials	0.34	0.26			0.19	0.30		0.18	0.20	0.33	0.16
Consumer Discretionary	0.21	0.12			0.31				0.10	0.11	0.21
Consumer Staples	0.18	0.07									
Healthcare	0.17			0.07					0.23	0.23	
Financials	0.40		0.19						0.04		
IT	0.24	0.24						0.23	0.08	0.12	
Telecom	0.32									0.19	
Utilities	0.62				0.14						
Real Estate	0.50				0.21		0.36				

Table 6: Aggregating GICS and SICS Sectors: Average Correlations <u>Within</u> Sectors for <u>Large S&P1500 Firms</u>

		SICS Sectors									
GICS Sectors	**Average Correlation WITHIN GICS Sectors**	**Consumption**	**Financials**	**Healthcare**	**Infrastructure**	**Non Renewable**	**Renewable**	**Resource Transformation**	**Services**	**Telecommunication**	**Transport**
Energy	0.54					0.27					
Materials	0.40	0.07				0.21		0.22			
Industrials	0.39	0.18			0.15	0.09		0.24	0.10		0.20
Consumer Discretionary	0.25	0.10			0.36				0.14	0.18	0.21
Consumer Staples	0.30	0.14									
Healthcare	0.27			0.15					0.11	0.05	
Financials	0.49		0.26						0.36		
IT	0.32	0.04	0.42					0.21	0.29	0.14	
Telecom	0.72									0.05	
Utilities	0.58				0.43						
Real Estate	0.53				0.31		0.67				

Table 7: Aggregating GICS and SICS Sectors: Average Correlations <u>Within</u> Sectors for <u>All S&P1500 Firms</u>

		SICS Sectors									
GICS Sectors	**Average Correlation WITHIN GICS Sectors**	**Consumption**	**Financials**	**Healthcare**	**Infrastructure**	**Non Renewable**	**Renewable**	**Resource Transformation**	**Services**	**Telecommunication**	**Transport**
Energy	0.50					0.51					
Materials	0.36	0.26				0.42	0.61	0.39			
Industrials	0.35	0.43			0.34	0.40		0.42	0.30	0.33	0.36
Consumer Discretionary	0.22	0.23			0.66				0.24	0.29	0.42
Consumer Staples	0.20	0.21									
Healthcare	0.21			0.22					0.34	0.27	
Financials	0.43		0.45						0.41		
IT	0.26	0.28	0.42					0.44	0.37	0.26	
Telecom	0.24									0.24	
Utilities	0.56				0.57						
Real Estate	0.50				0.51						

Table 8: Summary of Mean Average Pairwise Correlations Between Individual Stocks' Returns and Returns of Within-Industry or Outside Industry Stocks Using the GICS and SICS Classification Schemes in Isolation:

INDEX	GICS2			GICS4			SICS2			SICS4		
MEAN	WITHIN	BETWEEN	DIFF	WITHIN	BETWEEN	DIFF	WITHIN	BETWEEN	DIFF	WITHIN	BETWEEN	DIFF
S&P 500	0.37	0.14	0.23	0.42	0.14	0.28	0.27	0.15	0.12	0.24	0.17	0.07
S&P 500 SMALL CAP	0.42	0.23	0.19				0.37	0.24	0.07			
S&P 500 LARGE CAP	0.40	0.20	0.20				0.37	0.23	0.14			
S&P 1500	0.35	0.14	0.23	0.42	0.14	0.28	0.27	0.15	0.12	0.33	0.17	0.17
S&P 1500 SMALL CAP	0.35	0.21	0.14				0.30	0.20	0.10			
S&P 1500 LARGE CAP	0.46	0.21	0.24				0.36	0.21	0.16			
UK	0.10	0.07	0.04	0.11	0.07	0.04	0.10	0.10	0.0	0.11	0.10	0.01
UK SMALL CAP	0.10	0.07	0.10				0.12	0.10	0.02			
UK LARGE CAP	0.11	0.07	0.04				0.09	0.10	0.00			

Notes: Taking the example of S&P 500: the GICS2 average within-sector correlation is 0.37 and SICS2 is 0.27, while the average between-sectors correlation for GICS2 is 0.14 and SICS2 is 0.15; when comparing GICS and SICS in isolation, GICS performs better than SICS in almost all instances. As show before, material improvement happens when aggregating both classification systems, but not in isolation.

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