STOCK MARKET INDICES AND SUSTAINABILITY. A COMPARISON BETWEEN THEM

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Abstract
In this paper we examine the issue of sustainability in the stock markets by comparing various statistical properties of the classical stock market indexes against the recent sustainable ones. Daily, weekly and monthly data from Dow Jones, Eurostoxx and Hang Seng indexes were collected, and fractional integration methods were used to analyze differences in terms of persistence and mean reversion for both sustainable and common indexes. The results indicate high levels of persistence in all cases, observing almost no differences across the markets. Long memory is also detected in the absolute and squared returns in both markets.

Keywords: Sustainability; fractional integration; persistence; stock markets; long memory

JEL Classification: C22; G15

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1. Introduction

Corporate Social Responsibility (CSR) is an economic concept that has generated an extensive academic bibliography (De Dios Alija, 2018) since the mid-20th century. It was initially proposed by Bowen (1954), expressing a fundamental morality in the way a company behaves toward society, appealing to the social responsibility of corporations to produce not only goods and services but also to return to society part of what it had provided them. Other classical authors such as Drucker (1984) indicated that "Social Responsibility of Business" in the years to come will no longer mean "Doing Good" or "Not Doing Harm", it will have come to mean converting social problems into opportunities for profitable business. Accordingly, institutions are responsible for the community as a whole, and leaders need to exhibit high levels of integrity in their moral and ethical conduct, to meet the requirements of stakeholders, thereby ultimately serving the common good (Hesselbein, 2010).

Since the UN Assembly of 1979, the Brundtland Report (1987), and during the 1990s as a result of the Kyoto Protocol, environmental problems have also been included in the equation and the relationship between social factors, natural resource consumption and dioxide emissions have also been studied to define the concept of sustainability or sustainable development (SD). Van Marrewijk (2003) clarified these two concepts as being the two sides of the same coin. In the past, sustainability was related only to environmental issues, while CSR referred to social aspects such as human rights. However, nowadays CSR is associated with the communion aspects of people such as transparency, stakeholder dialogue or sustainability reporting, while SD is focused more on value creation, environmental management and friendly production systems, human capital management and so forth.

Thus, business success is evolving towards seeking more “sustainable” competitive advantages, analyzing how CSR fits into the corporate strategy to meet the needs of customers and ensuring resources to build and sustain these long-term competitive advantages. In fact, several taxonomies of CSR/SD approaches have been proposed which observe this corporate behavior (Pistoni et al., 2016), assuming that this should also be related to social and environmental issues. Thus, today corporate social responsibility (CSR) and sustainable development (SD) are seen as two of the main drivers for businesses over the past decade (Elmualim, 2017). The need to advance in sustainable development is gaining increasing importance due to the desire to balance the threatening implications of global warming and the long-term perspective of corporate strategies.

Despite the great academic development and the standardization of reporting requirements in big-sized corporations, the role of sustainability in the real economy still appears unclear. Today, the indexes that measure sustainability are more focused on measuring the creation of value associated with companies with socially responsible practices than on the degree of compliance of these practices themselves. Thus, this paper focuses on the study of the shareholder added value creation of these SD companies by comparing the performance of sustainable indexes versus traditional ones as arbitrage opportunities might arise. The aim of the analysis is to provide evidence about some of its statistical properties, in particular their degree of persistence and mean reversion, by applying fractional integration techniques to a set of long term data from the US (Dow Jones), Europe (Eurostoxx) and Asia (Hang Seng), respectively, from the inception of these sustainability indexes to the current day.

The layout of the paper is the following: Section 2 reviews the relevant literature regarding sustainable stock market indexes; Section 3 describes the data and the econometric framework; Section 4 discusses the empirical findings; finally, Section 5 offers some concluding remarks.

2. Sustainable stock market indices

2.1 A brief history of the Sustainability concept

The concept of Sustainability was first officially raised at the United Nations General Assembly in 1979. It was first taken onboard by governments and multilateral organizations in 1987 with the UN Report on Environment and Development "Our Common Future" or Brundtland with a definition that has already become classic: "*sustainable is development that meets current needs, without compromising the ability of future generations to meet their own needs*". However, this concept has a history of more than three centuries as it was initially used by Carlowitz (1713) with the expression *"nachhaltendes wirtschaften"* or sustainable yield. The idea behind that concept was the perception of scarcity resulting from the industrial revolution, in which the need for wood was so great that the effects of deforestation began to be intuited.

Since its inception, the sustainability concept has been linked to the term Corporate Social Responsibility (CSR). This arose in the last century as a result of certain world conflicts that aroused the interest of citizens to find out the repercussions of certain economic practices employed to maintain various objectionable political regimes. As a consequence, society began to ask for changes in the way businesses were managed and for a greater commitment of the business environment to social problems. These social implications of business activity became evident in the wake of the acceleration of economic activity in a capitalist framework, with the arrival of globalization, and the development of new technologies against the backdrop of the emergence of a strong ecological awareness worldwide.

After the Second World War a framework for action evolved to fight for social responsibility, which began with the adoption of the Universal Declaration of Human Rights Treaty in 1948, which would eventually become the instigator and driving force for multiple social changes. In 1976, the Organization for Economic Cooperation and Development (OECD), set out recommendations and defined the principles and standards characteristic of socially responsible conduct, in order to guarantee that organizational activities were carried out under the guidelines of public policy and therefore would contribute towards the relationship between companies and society becoming based on mutual trust. The OECD guidelines enable companies to create internal guidance and management systems, which help establish commitments with good intentions and following sound practices, in order to guarantee social dialogue regarding what constitutes responsible business conduct. Thus, they have become the institutional, political and legal frame of reference for the efforts of private organizations, aimed at defining and implementing sustainable development and promoting positive contributions to economic, environmental and social progress.

In 1992 the United Nations Conference on Environment and Development held in Rio de Janeiro set out an Action Plan to transform the current development model based on the exploitation of natural resources as unlimited goods, proposing a new model which would meet the needs of both current and future generations. This plan became to be represented by the term sustainable development (SD) or, in other words, the efficient and rational usage of resources with equitable benefits. During the year 2000, the UN member countries agreed on the Millennium Development Goals (MDGs) for 2015. At the end of the period for fulfilling those MDGs, the UN General Assembly established a new global agreement in which the 193 member states around the world pledged to adopt the 2030 Agenda, a program that sets out 17 Sustainable Development Goals (SDGs) and 169 targets

2.2 Sustainable markets

In the field of economic investments, the concept of sustainable development (SD) generated the Socially Responsible Investment (SRI) initiatives, based on the growing awareness among the population, investors, companies and governments of the effects of non-financial MSG risks (environmental, social and good governance). Chatzitheodorou et al. (2019) explain the different perspectives of SRI investments today, as the majority of the literature focuses on SRI performance versus traditional investments (TI), outlining these categories through the orientation of SRIs (social, environmental and financial) and the motivations of investors (socially-oriented, profit-seeking, risk averse).

[Insert Figure 1 about here]

Through the Stock Market, the monetary resources of investors are channeled to companies or governments to finance investment projects through investment funds. There are around 125 stock markets in the world with an estimated total of 3,429 indices in 2017 (Canales, 2017) that monitor changes in the value of traded assets. As the stock index refers to the weighted average of the market capitalization of a specific list of securities (Lo, 2012), it is one of the statistical measures designed for studying the evolution and aggregate behavior of asset value and for making decisions based on said value (Elbaum, 2004).

Sustainable indexes emerged in the 1990s, and since then have been used to record the added, weighted and adjusted value of stock performance (Searcy and Elkhawas, 2012), offering somehow a measurement of stock performance for those companies that meet SR requirements. The CSR approach used by these indices is rooted in the triple bottom line that proposes the generation of three types of results: economic, social and environmental or ESG (Elkington, 1999). This focus is in line with the Brundtland Report (1987), which supports development that meets current needs without compromising the ability of future generations to meet theirs.

The first sustainable stock index traded was the Dow Jones Sustainability Index (DJSI) in New York, formed by more than 300 companies, with a business approach to creating long-term value for shareholders by taking advantage of economic, environmental and social development opportunities (Dow Jones Sustainability Index, 2013). This index is managed by the company RobecoSAM applying its own method for evaluating the environmental, sustainability and good governance policies of each company. After ranking more than 1,000 data points, each company receives a final score. Only the 10% with the highest score are reflected in the Dow Jones Sustainability Index.

Among other sustainability indices, we find the Euro Stoxx Sustainability 40 Index that started in the early 2000s, providing consistent information on the main companies in terms of environmental, social and long-term governance in the Euro area, and the Hang Seng Corporate Sustainability Index that measures the performance of companies with outstanding sustainability practices in the Hong Kong and mainland China markets that started trading in 2008.

Regarding the different performance of these kinds of investments the hypothesis that SRIs outperform “traditional” value driven investments is unclear. Costa-Lourenço et al. (2012) provide empirical evidence on how corporate sustainability performance as proxied by membership of the Dow Jones sustainability index, is reflected in the market value of equity, penalizing large profitable firms with low levels of CSP. Cheung and Roca (2013) found that for the Asian stocks in DJSI that both stock indexes experience a significant decline in returns, an increase in trading volume, and an increase in idiosyncratic risk. Belghitar et al. (2014) found there was a financial price to be paid for socially responsible investing, as zero-cost portfolios created by shorting the SRI indexes and using the proceeds to invest in the conventional indexes generated higher average returns. Fogliano et al. (2013**)** analyzed the Brazilian market and found no evidence of superior performance of SD portfolios. Oberndofer et al. (2013) analyzed the inclusion of German corporations in the Dow Jones STOXX Sustainability Index, finding that stock markets may penalize the inclusion of a firm in sustainability stock indexes and suggesting that the inclusion in a more visible sustainability stock index may have larger negative impacts.

Other studies such as Dam and Scholtens (2015**)** analyzed the literature and did not establish a significant impact of SRI on stock market returns. In this line, Leite and Cortez (2015) analyzed some European SRI fund performances during the financial crisis, finding that French SRI funds underperform conventional funds during non-crisis periods and match the performance of their conventional peers during market downturns. Renneboog et al. (2011) analyzed the money flows of socially responsible investment (SRI) funds around the world, finding that SD investments were less sensitive to past negative returns than Traditional Index conventional fund flows (TI), with no evidence of a smart money effect as the funds that receive more inflows neither outperform nor underperform their benchmarks or conventional funds. Other specific studies such as Schaeffer et al. (2012) for US oil companies also mention that it did not detect any positive impact between the adoption of a proactive environmental posture of these companies reflected by its adhesion to the DJSI, and their stock prices.

On the other hand, Nakai et al. (2016) compared Socially Responsible Investment (SRI) funds and conventional funds in the Japanese market, and concluded that SRI funds resisted the 2008 financial crisis better than conventional funds. Gjerde et al. (2010) found that SD investment has a superior local performance for the Oslo Stock Exchange. Joliet and Titova (2018) found that SRI funds have a higher economic impact for value rather than growth funds in US markets. Patel and Kumari (2020) analyzed the Indian market, finding a similar performance between SD and TI markets but concluding that SD indices are a better performing tool with which to satisfy the surge of green investment needs.

Due to the differing regional profitability reported across these works, this paper analyzes the different performances of the SRI investments compared with their TI counterparts in terms of persistence and mean reversion. Mynhardt et al. (2017) observed more persistence in the SRI than in the standard markets. Similarly to our study, they compared the behavior of the TI traditional indexes and SR Indexes (in particular, DJSI, Nasdaq CRD SI, FTSE 4Good, MSCI Global ESG and SP500 ESR), and using the Hurst exponent as a measure of their degree of persistence, they found that SR indexes have lower efficiency than traditional ones, thus reducing fundamental predictability of prices and the possibility of arbitrage opportunities with financial assets. As Mynhardt et al. (2017) noted, and despite the considerable amount of research on the differences between the TI and SR Indexes, effectiveness and the nature of changes in the dynamics of indices appears not to have been reviewed. We also focus on this issue, looking for a better measurement of persistence with fractional integration techniques and different sampling periods.

3. Methodology

The techniques used in this work belong to the category of long range dependence, that means that the observations are strongly correlated across time. Within this group we use a particular type of model known as fractionally integrated that basically means that the number of differences required to render a series stationary I(0) is a fractional value. Given a second order (or covariance) stationary process $\{u_t,\ t = 0, \pm 1, ...\}$ with autocovariance function $\gamma_u = E[(u_t - Eu_t)(u_{t+u} - Eu_t)$ we say that u_t is I(0) or short memory if it satisfies the following property:

$$\sum_{u=-\infty}^{\infty} \gamma_u < \infty. \tag{1}$$

Within this context, we say that a process $\{x_t,\ t = 0, \pm 1, ...\}$ is integrated of order d, and denoted as I(d) if it requires d-differences to become I(0), i.e., x_t is I(d) if it can be expressed as:

$$(1 - L)^d x_t = u_t, \qquad t = 1, 2, \ldots, \tag{2}$$

and using a Binomial expansion on the polynomial in L above,

$$(1 - L)^d = \sum_{j=0}^{\infty} \binom{d}{j} (-1)^j L^j = 1 - dL + \frac{d(d-1)}{2} L^2 - \ldots \tag{3}$$

equation (2) can be expressed as

$$x_t = d x_{t-1} - \frac{d(d-1)}{2} x_{t-2} + \ldots + u_t. \tag{4}$$

Thus, if d is a non-integer value, x_t will depend on all its past history and d can be taken as the relevant parameter to measure persistence in the data as the higher the value of d is, the higher the level of persistence or association between the data is.

In the context of stock market data, if d = 1 (and u_t is for example a white noise process), x_t follows a random walk, supporting thus a weak version of the efficiency market hypothesis and implying then that there is no possibility of getting systematic profits from the past history of the data. On the other hand, values significantly different from 1, either from above or from below, suggests the existence of inefficiencies in the markets.

We estimate the differencing parameter d by using an approximation to the likelihood function, named the Whittle function, expressed in the frequency domain as presented in Dahlhaus (1989), and using a simple version of the Lagrange Multiplier (LM) tests of Robinson (1994) which is very appropriate in the context of nonstationary data.[1]

4. Data and results

We use data on daily, weekly and monthly returns from the Reuters Eikon database for the Dow Jones Sustainability Index (.W1SGI) over the period January, 1st 1994 to January, 31st 2020; the Stoxx Sustainability 40 Index (.STOXX50E) from October 15th, 2001 to January, 31st 2020, and Hang Seng Corporate Sustainability index (.HSSUS) from January 2nd, 2008 to January, 31st 2020 Figures 2a, 2b and 2c summarizes the dataset, while Figure 3 compares the performance of the different indexes under study.

[Insert Figures 2a, 2b and 2c and 3 about here]

Figure 4 shows the differential returns between the performance of the sustainability index and its traditional counterpart. It can be seen that the US indexes have a negative relationship, while it is positive in the other two cases.

[Insert Figure 4 about here]

We estimate the following regression model,

$$y_t = \beta_0 + \beta_1 t + x_t; \qquad (1 - L)^d x_t = u_t, \qquad t = 0, 1, ..., \qquad (5)$$

where y_t is each of the observed time series; β_0 and β_1 are unknown coefficients and x_t is supposed to be I(d). We report the results in terms of the estimated values of d for the three standard cases in the unit root literature of: i) no deterministic terms (i.e., $\beta_0 = \beta_1 =$

[1] The estimation of the differencing parameter d is usually conducted on the stationary range (0.5 < d < 0.5). Robinson's (1994) tests, however, allows the examination of d for any real value, including thus those values in the nonstationary range (i.e, d ≥ 0.5).

0 in (5)), ii) an intercept (β_1 = 0 in (5)), and iii) an intercept with a linear time trend (β_0 and β_1 unknown), marking in bold in the table the selected model for each series, based on the t-values of the estimated coefficients on the d-differenced series.

Table 1 displays the estimates of d (and their associated 95% confidence intervals) under the assumption that u_t in (5) is a white noise process. The first thing we observe is that the time trend is only required for the Dow Jones indexes, the intercept being sufficient to describe the deterministic part in the rest of cases. While focusing on the estimated values of d, it can be seen that the values are very close to 1 in all cases, with slightly superior numbers for the sustainable indices results and also higher for monthly sampling compared with weekly data. Starting with the Dow Jones, it is observed that the estimated value of d is 1.00 for the DJI and 1.07 for the DJSI market on a monthly sampling, and the values are 0.95 and 0.99 for the weekly sampling. In the case of Eurostoxx, the differences are narrower, ranging between 1.04 for TI and 1.03 for SI in a monthly basis, and 0.94 and 0.95 for a weekly basis sampling. Finally, in the case of Hang Seng, the performance is very similar for both indices, ranging from 1.03 for monthly data and 1.01 for weekly data. As a conclusion of this table we can say that all series display high levels of persistence; the I(1) null hypothesis is almost never rejected, the only two exceptions being Dow Jones and Eurostoxx for a weekly basis for the non-sustainable indices.

[Insert Table 1 about here]

In Table 2 we allow the error term to be autocorrelated. However, instead of imposing a specific modelling assumption for u_t in (5), we use here a non-parametric method due to Bloomfield (1973). It is called non-parametric in the sense that no functional form is explicitly presented for u_t in (5). The model is exclusively defined in terms of its spectral density function through an expression that approximates fairly well a highly parameterized ARMA process. Moreover, this approach accommodates extremely well in I(d) models (see Gil-Alana, 2004). The results, displayed in Table 2, are very similar to those given in Table 1 in the sense that all values are close to 1, but with lower values of d for monthly sampling instead of weekly sampling. It is important to notice that the Hang Seng index displays lower values of d regarding the other cases, as in the weekly sampling case which is 0.85 while for the rest of results range between 0.92 and 1.04. Nevertheless, the unit root null hypothesis cannot be rejected in any single case. From these two tables we can conclude that there is almost no difference between the sustainable and non-sustainable indices in regard to their degree of persistence, finding evidence supporting the I(1) hypothesis in all except a couple of cases with the sustainable indices.

[Insert Table 2 about here]

Next we focus on the volatility issue by proxying it through the absolute and squared returns, obtained these by taking first differences on the logged prices. Tables 3 and 4 report the results (once more in terms of d and the confidence bands) under the assumption of white noise errors. Thought not reported, almost identical results were obtained when the errors were autocorrelated. The first thing we observe across these two tables is that the time trend is required in a number of cases, and the estimates of d are positive (and thus showing long memory, i.e., d > 0) in all except one single case (Hang Seng, with monthly data and sustainable index). In general, the values are very similar in the sustainable and non-sustainable indices, the only significant difference being observed in the Dow Jones index, on a monthly basis with a substantial increase in the estimated value of d in the sustainable index under both monthly and weekly data.

[Insert Tables 3 and 4 about here]

5. Conclusions

In this article we have examined the degree of persistence in the stock market prices and their associated volatility (measured in terms of absolute and squared returns) under both sustainable and non-sustainable indexes. In particular, we have examined the Dow Jones, Hang Seng and Eurostoxx stock indexes on a monthly and weekly basis.

The results indicate almost no difference in the degree of persistence under both scenarios. Thus, the order of integration is very close to 1 in practically all cases, implying high levels of persistence and efficiency in the markets at least in the weak form (if the errors are uncorrelated). Long memory is also observed in the absolute and squared returns, this last result being consistent with previous works conducted on non-sustainable markets by authors such as Ding et al. (1993), Granger and Ding (1996), Anouro and Gil-Alana (2011), Bhattacharaya and Bhattacharya (2012), Gil-Alana et al. (2015) and others. However, it contradicts the findings in Mynhardt et al. (2017) that find different behavior in the two (sustainable and non-sustainable) markets. Note, however, that Mynhardt et al. (2017) use a non-parametric approach based on the H-exponent, while we have used a parametric approach based on fractional integration. Other methods for measuring the degree of persistence can also be implemented and more research in this line should be conducted in future papers.

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Table 1: Estimates of d under the assumption of white noise errors

Panel i) No sustainable indexes				
	Series	No regressors	An intercept	A time trend
Monthly data	Dow Jones	0.99 (0.92, 1.07)	1.00 (0.93, 1.08)	**1.00 (0.93, 1.08)**
	Hang Seng	0.97 (0.87, 1.11)	**1.03 (0.90, 1.18)**	1.03 (0.90, 1.18)
	Eurostoxx	0.99 (0.90, 1.10)	**1.04 (0.95, 1.15)**	1.04 (0.94, 1.15)
Weekly data	Dow Jones	1.00 (0.96, 1.04)	0.95 (0.91, 0.99)	**0.95 (0.91, 0.99)**
	Hang Seng	0.99 (0.93, 1.05)	**1.01 (0.95, 1.06)**	1.01 (0.95, 1.06)
	Eurostoxx	1.00 (0.96, 1.05)	**0.94 (0.90, 0.99)**	0.94 (0.90, 0.99)
Panel ii) Sustainable indexes				
	Series	No regressors	An intercept	A time trend
Monthly data	Dow Jones	0.99 (0.92, 1.08)	**1.07 (0.99, 1.16)**	1.07 (0.99, 1.16)
	Hang Seng	0.97 (0.87, 1.12)	**1.03 (0.90, 1.19)**	1.03 (0.90, 1.19)
	Eurostoxx	0.99 (0.90, 1.10)	**1.03 (0.94, 1.14)**	1.03 (0.94, 1.14)
Weekly data	Dow Jones	1.00 (0.96, 1.04)	**0.99 (0.95, 1.03)**	0.99 (0.95, 1.03)
	Hang Seng	0.99 (0.93, 1.05)	**1.01 (0.96, 1.07)**	1.01 (0.96, 1.07)
	Eurostoxx	1.00 (0.96, 1.05)	**0.95 (0.91, 1.00)**	0.95 (0.91, 1.00)

Table 2: Estimates of d under the assumption of autocorrelated noise errors

Panel i) No sustainable indexes				
	Series	No regressors	An intercept	A time trend
Monthly data	Dow Jones	0.98 (0.87, 1.12)	1.00 (0.88, 1.13)	**1.00 (0.89, 1.12)**
	Hang Seng	0.93 (0.75, 1.18)	**0.92 (0.62, 1.28)**	0.92 (0.51, 1.28)
	Eurostoxx	0.96 (0.83, 1.14)	**0.96 (0.81, 1.17)**	0.96 (0.81, 1.17)
Weekly data	Dow Jones	0.99 (0.94, 1.06)	0.99 (0.94, 1.05)	**0.99 (0.94, 1.05)**
	Hang Seng	0.98 (0.88, 1.08)	**1.04 (0.95, 1.14)**	1.04 (0.95, 1.14)
	Eurostoxx	1.00 (0.91, 1.06)	**1.00 (0.93, 1.06)**	1.00 (0.93, 1.06)
Panel ii) Sustainable indexes				
	Series	No regressors	An intercept	A time trend
Monthly data	Dow Jones	0.97 (0.86, 1.13)	**1.02 (0.88, 1.19)**	1.02 (0.89, 1.19)
	Hang Seng	0.93 (0.74, 1.17)	**0.85 (0.60, 1.22)**	0.84 (0.40, 1.22)
	Eurostoxx	0.95 (0.82, 1.15)	**1.00 (0.85, 1.22)**	1.00 (0.85, 1.22)
Weekly data	Dow Jones	1.00 (0.94, 1.07)	**1.02 (0.92, 1.09)**	1.02 (0.97, 1.09)
	Hang Seng	0.98 (0.90, 1.08)	**1.04 (0.95, 1.15)**	1.04 (0.95, 1.15)
	Eurostoxx	1.00 (0.91, 1.07)	**0.99 (0.92, 1.05)**	0.99 (0.91, 1.05)

Table 3: Estimates of d under the assumption of white noise errors (Absolute rtns.)

Panel i) No sustainable indexes				
	Series	No regressors	An intercept	A time trend
Monthly data	Dow Jones	0.15 (0.09, 0.23)	**0.13 (0.07, 0.20)**	0.12 (0.05, 0.19)
	Hang Seng	0.21 (0.10, 0.34)	0.14 (0.06, 0.26)	**0.11 (0.02, 0.24)**
	Eurostoxx	0.20 (0.13, 0.30)	**0.16 (0.10, 0.25)**	0.16 (0.09, 0.24)
Weekly data	Dow Jones	0.22 (0.19, 0.25)	**0.21 (0.18, 0.25)**	0.21 (0.18, 0.25)
	Hang Seng	0.22 (0.18, 0.26)	0.17 (0.13, 0.20)	**0.13 (0.09, 0.17)**
	Eurostoxx	0.23 (0.20, 0.27)	0.21 (0.18, 0.25)	**0.21 (0.18, 0.24)**
Panel ii) Sustainable indexes				
	Series	No regressors	An intercept	A time trend
Monthly data	Dow Jones	0.20 (0.14, 0.28)	**0.20 (0.13, 0.27)**	0.19 (0.13, 0.27)
	Hang Seng	0.21 (0.10, 0.34)	0.14 (0.06, 0.26)	**0.09 (-0.01, 0.23)**
	Eurostoxx	0.22 (0.15, 0.30)	0.17 (0.11, 0.25)	**0.15 (0.08, 0.23)**
Weekly data	Dow Jones	0.22 (0.19, 0.25)	**0.22 (0.19, 0.25)**	0.22 (0.19, 0.25)
	Hang Seng	0.23 (0.19, 0.27)	0.17 (0.13, 0.21)	**0.12 (0.09, 0.17)**
	Eurostoxx	0.23 (0.20, 0.27)	0.21 (0.18, 0.24)	**0.20 (0.17, 0.23)**

Table 4: Estimates of d under the assumption of white noise errors (Squared rtns.)

Panel i) No sustainable indexes				
	Series	No regressors	An intercept	A time trend
Monthly data	Dow Jones	0.14 (0.07, 0.22)	**0.13 (0.07, 0.21)**	0.13 (0.06, 0.21)
	Hang Seng	0.21 (0.10, 0.36)	0.18 (0.08, 0.32)	**0.14 (0.02, 0.29)**
	Eurostoxx	0.19 (0.12, 0.28)	**0.18 (0.11, 0.27)**	0.16 (0.09, 0.26)
Weekly data	Dow Jones	0.18 (0.14, 0.21)	**0.18 (0.14, 0.21)**	0.17 (0.14, 0.21)
	Hang Seng	0.18 (0.14, 0.22)	0.16 (0.13, 0.20)	**0.14 (0.09, 0.18)**
	Eurostoxx	0.15 (0.11, 0.19)	**0.15 (0.11, 0.18)**	0.14 (0.11, 0.18)
Panel ii) Sustainable indexes				
	Series	No regressors	An intercept	A time trend
Monthly data	Dow Jones	0.21 (0.14, 0.29)	**0.21 (0.14, 0.29)**	0.21 (0.14, 0.29)
	Hang Seng	0.20 (0.09, 0.35)	0.17 (0.07, 0.31)	**0.12 (0.01, 0.23)**
	Eurostoxx	0.21 (0.15, 0.30)	0.20 (0.14, 0.28)	**0.17 (0.10, 0.23)**
Weekly data	Dow Jones	0.20 (0.17, 0.24)	**0.20 (0.17, 0.24)**	0.20 (0.17, 0.24)
	Hang Seng	0.18 (0.14, 0.22)	0.16 (0.12, 0.20)	**0.12 (0.09, 0.17)**
	Eurostoxx	0.16 (0.13, 0.20)	0.16 (0.12, 0.19)	**0.15 (0.12, 0.19)**

Figure 1. Different types of SRI investors (Chatzitheodorou et Al., 2019)

Types of investors	SRI focus			Investors' motivations			Potential Investors
	Social	Environmental	Financial	Social-oriented	Profit-seeking	Risk averse	
Social-based investments							
Idealistic investors,	x			x			Religious investors, charities
Socially Opportunistic	x		x		x		Social Investors
Prudent investors	x		x		x	x	Conventional Investors
Environmental-based investments							
Shareholder activist		x		x			NGOs
Environmentally Opportunistic		x			x		Conventional investors
Environmentally-risk avoider		x			x	x	Conventional Investors
Social-Environmental-based investment							
Collaborative investors	x	x			x		Conventional investors, NGOs
Socio-greener-oriented Crowd funders	x	x		x			Social investors
Eco-angels/ Philanthropic venture capitalists	x	x		x	x		NGOs, social investors
Sustainability Territory							
Sustainable investors	x	X	x	x	x		Institutional investors

Figure 2. Performance of different indexes

Figure 2a. Dow Jones Industrial Average and Dow Jones Sustainability Index

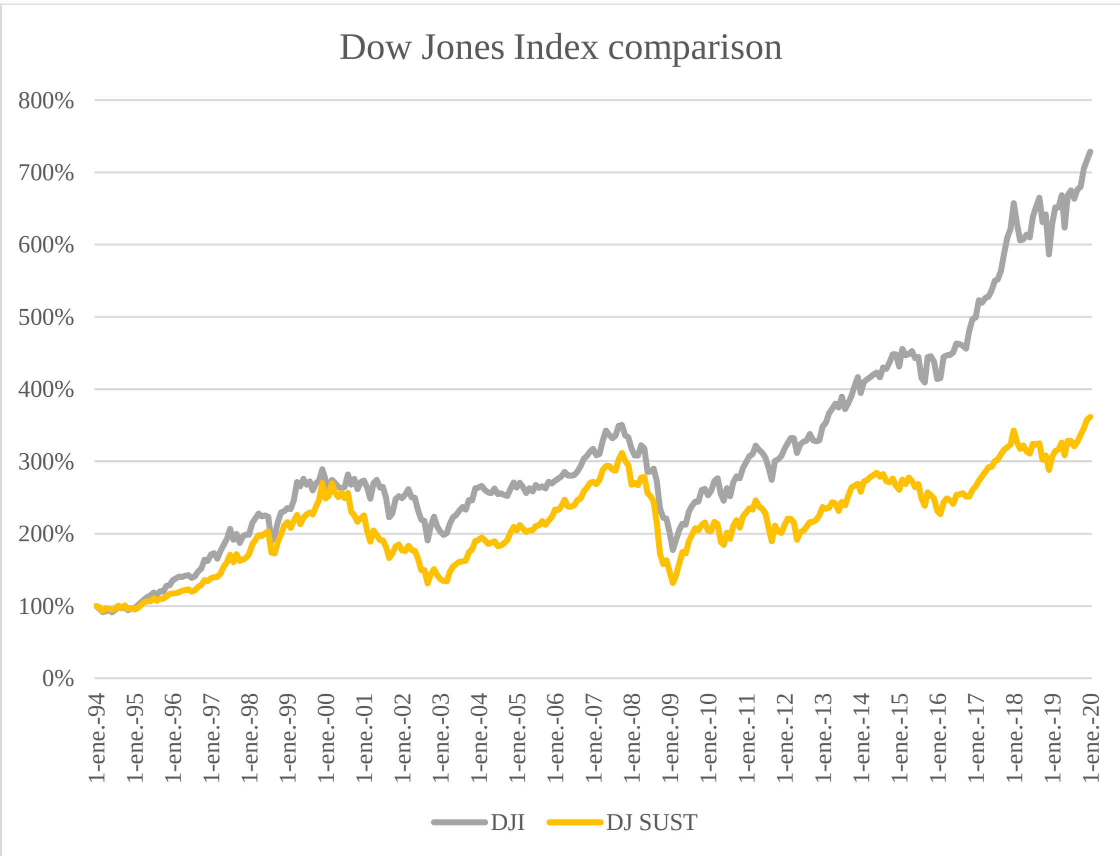

Figure 2b. Eurostoxx 50 and Eurostoxx Sustainability 40 index

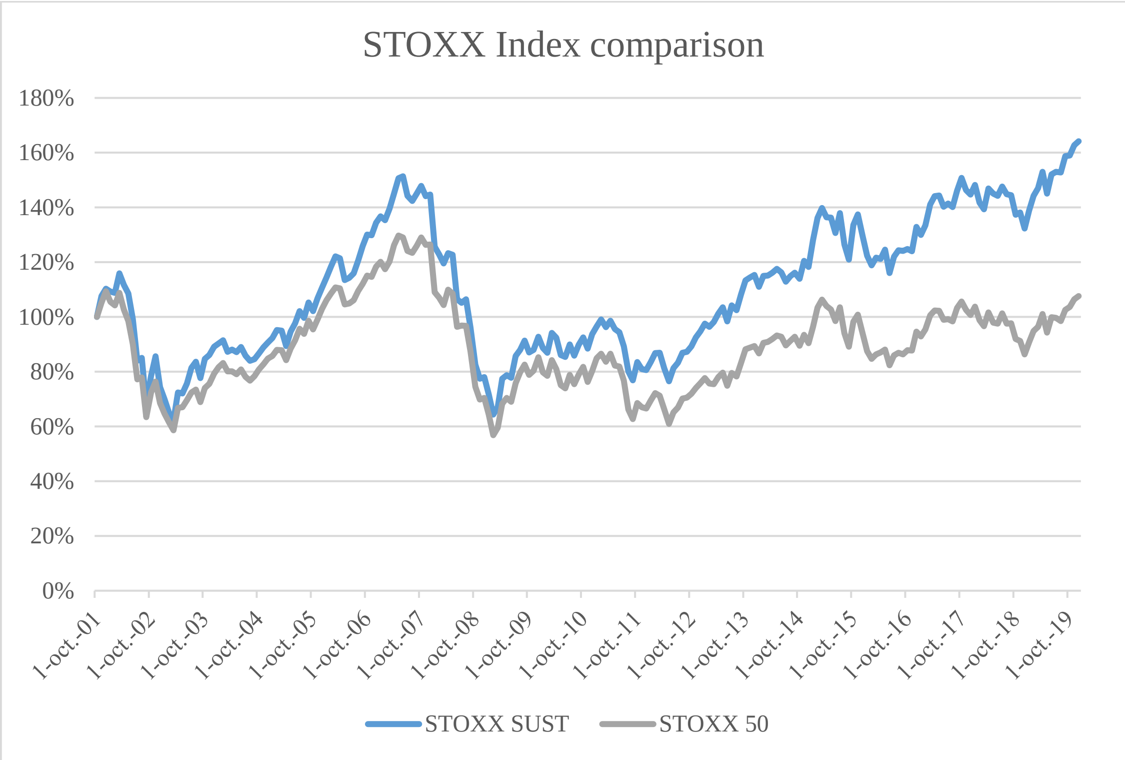

Figure 2c. Hang Seng and Hang Seng Sustainability index

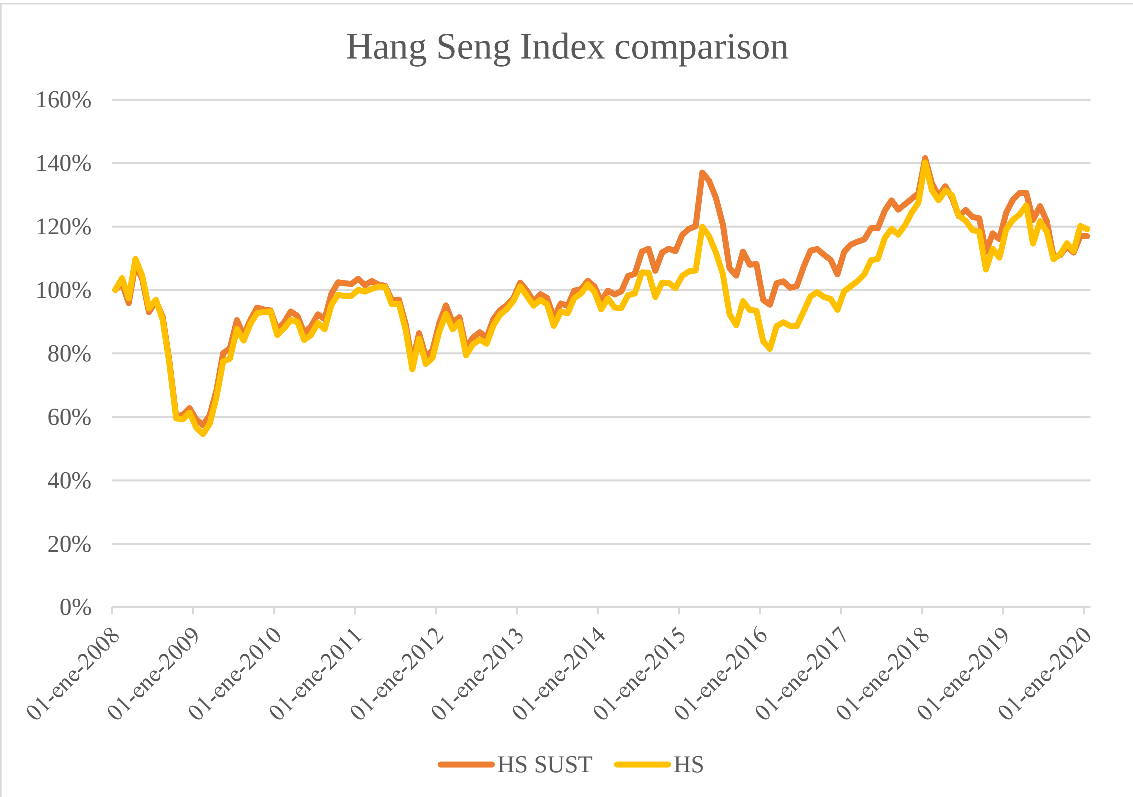

Figure 3. Performance of sustainability indexes

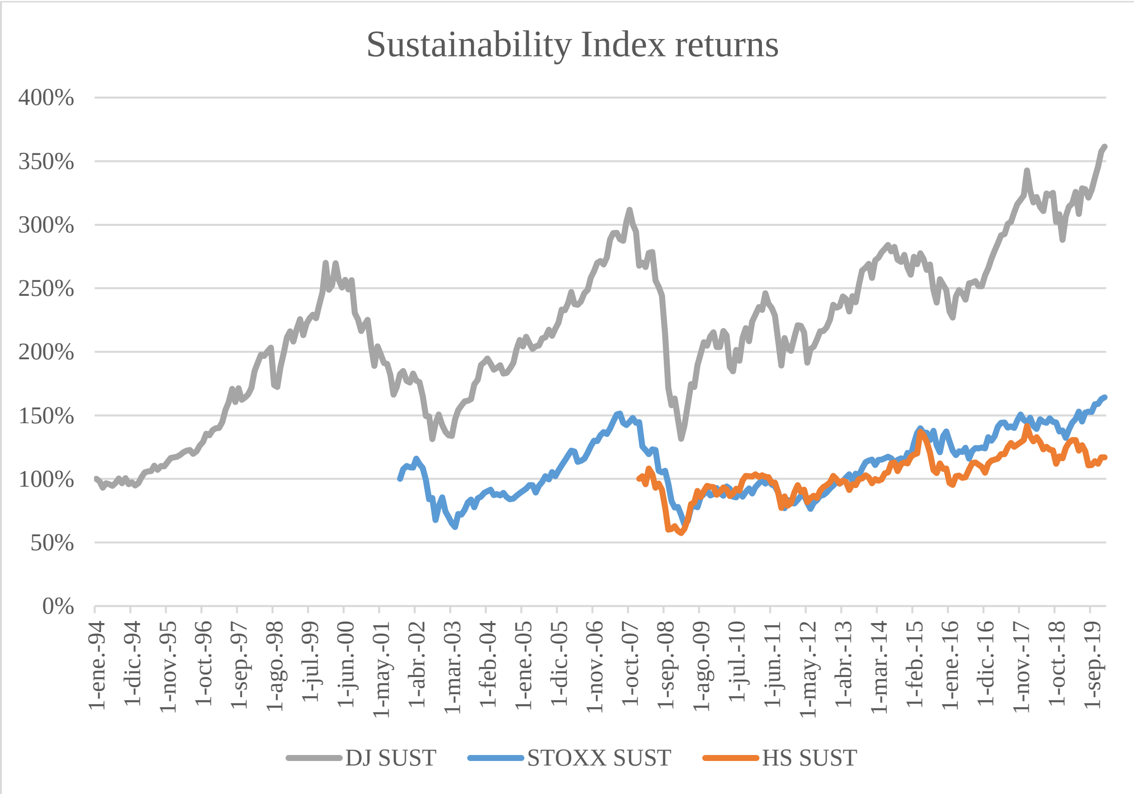

Figure 4. Differential performance of sustainability indexes and traditional indexes