An Analysis of Determinants Affecting the Returns of Dow Jones Sustainability Index United States

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ABSTRACT

During the last decades there has been an increased interest regarding socially responsible stock indexes. However, there is a limitless literature body regarding the factors that affect these types of indexes. For this reason, this paper intends to investigate whether consumer sentiment, US dollar value to major currencies and gold prices affecting the returns of Dow Jones sustainability index (DJSI) US from September 1999 to September 2016 using monthly data. The generalized autoregressive conditional heteroskedasticity model is used and revealed that consumer sentiment affect positively the DJSI US, while gold prices and the US dollar value have a negative effect on it. The results of this study add to the international literature by providing important implications for investors and policy makers along with business manager forecasting and planning.

Keywords: Dow Jones Sustainability Index, Consumer Sentiment, Gold, US Dollar, Generalized Autoregressive Conditional Heteroskedasticity Model
JEL Classifications: C58, Q40, Q50, M21

1. INTRODUCTION

A number of empirical studies has been focused to investigate the main determinants of stock indexes (e.g. Samitas and Kenourgios, 2007; Gay, 2008; Tangjitprom, 2012; Khan and Zaman, 2012). In general, share prices can be affected by two main factors: Macroeconomic factors up to 50% on average, while the rest percentage is micro-economic and psychological factors (King, 1966). However, prior empirical studies focused on conventional indexes neglecting firms that follow an ethical behaviour to their stakeholders.

Unlike to prior empirical literature, this study takes into account social responsible firms in order to examine the effect of multiple determinants on socially responsible stock indexes. The concept of socially responsible investment (SRI) is not a new investment type (Lean et al., 2015); it concerns investments in firms that incorporate initiatives that take into account major stakeholders in their business decisions such as society and environment

(Torre Torres and Torre Enciso, 2017). For this reason, DJSI is incorporated in this study as a proxy of socially responsible stock index. It covers firms evaluating the sustainability performance under three main pillars: Economic, environmental, and social. To our knowledge, there is no study that probes the effect of consumer sentiment, US dollar value to major currencies and gold prices on DJSI. In particular, the DJSI US is selected as US is among the most crucial stock market that pioneered in the field of SRI. Since 1994 the total US domiciled assets under management using SRI strategies grew from $6.57 trillion in 2014 to $8.72 trillion in 2016 which means that for more than one out of every of five dollars are under professional management in the United States (Social Investment Forum Foundation, 2016).

As far as consumer sentiment is concerned, it predicts the economic activity and households expenditure considered as important information of the current and future state of the economy (Fisher and Statman, 2003; van Oest and Franses, 2008. The importance of consumer sentiment as determinant factor of

economy is owed to the fact that consumer sentiment explains consumption patterns of households contributing to the largest share of gross domestic product (Paradiso et al., 2014). Recently empirical studies revealed the significant effect on stock indexes. For instance, Singal (2012) illustrated that changes in stock prices of US hospitality firms are predicted by changes in consumer sentiment. Moreover, Fisher and Statman (2003) found a negative relationship between consumer sentiment and stock returns taking into account S&P 500 index from the period 1989-2002. In this study Michigan consumer sentiment index (CSI) is employed because it is considered the most well-known and cited sentiment index and incorporate news for the future productivity affecting aggregate consumption (Ahmed and Cassou, 2016).

Gold is an important commodity referring as an investment hedge against the US dollar (Joy, 2011). Similarly, Baur and Lucey (2010) illustrated that gold providing a haven for bonds and stock markets only after extreme negative market shocks. As gold is among the precious metals (Bilal et al., 2013), Riley (2010) noted the importance of precious metals for investors because it has a negative correlations with other traditional asset classes while Arouri et al. (2015) stated that gold should be taking into account when formulating future stock returns. Hillier et al. (2006) focused on US stock market taking into account the US stock market for the period 1976-2004 so as to examine the relationship between gold and equity markets. Generalized autoregressive conditional heteroskedasticity (GARCH) was applied in the study revealing that gold had a small negative correlation with S&P 500 index. Hood and Malik (2013) evaluated the impact of precious metals as proxies of hedging tool and safe haven provision in different periods of US stock market volatility for the period 1995-2010. In periods of low and high volatility, it was found that there is no negative correlation between gold and stock market.

The third determinant incorporated in this study is the US dollar value. In the field of globalized business and economic environment, investors are highly interested to ascertain whether currency fluctuations can affect stock prices (Hughen and Beyer, 2015). In general, the exchange rates are able to affect operations of firms in foreign markets leading to lower levels of profits and, in turn, it is able to affect the stock price. Regarding prior empirical studies, Aggarwal (1981) focused on the US stock market for the period 1974-1978. It was found that that there is a positive relationship between the US stock prices and exchange rate. However, Goodwin et al. (1992) and Soenen and Hennigar (1988) found a negative effect of the US dollar value on the stock prices. In addition, Hughen and Beyer (2015) took into account the US dollar value to other currencies and Thomson Reuters global equity indices in order to examine their relationship from 1973 to 2013. The results showed that equity returns are positively associated with periods when the value of US dollar was appreciated. For the purpose of the study, trade weighted US dollar index (TWUSDI): Major currencies as a proxy for US dollar value in relation to major foreign currencies. This study intends to investigate whether CSI as a proxy of consumer sentiment, gold prices and TWUSDI as a proxy of US dollar to major currencies are able to affect the DJSI US. A GARCH model is applied to US stock firms over the period 31 January, 1999 to 31 May, 2016 using monthly data.

As the majority of the studies focused on conventional stock indexes, the study intends to fill the empirical literature gap on the determinants of socially responsible stock indexes. The results of the study are valuable to investors, corporate managers and traders acquiring crucial knowledge to formulate their strategy against possible losses.

The paper is organized as follows: Section 2 illustrates both the data and methodological approach employed to examine the determinants of DJSI US. Section 3 presents the empirical results followed by concluding remarks in section 4.

2. DATA

A GARCH model is developed by Engle (1982), and extended by Bollerslev (1986) and Nelson (1991) which let the fat tails and imposes an autoregressive structure on the conditional variance. Therefore, it is able to capture the volatility persistence of return series over time and the volatility clustering as well. In addition, the estimation of GARCH approach incorporates the joint estimation of a mean and a conditional variance equation. The GARCH (1,1) model is defined as follows:

The mean equation:

$$Y_t = X_t' b + u_t \tag{1}$$

Where Xt is a vector of exogenous variable.

The conditional variance equation:

$$\sigma_t^2 = c_0 + c_1 u_{t-1}^2 + c_2 \sigma_{t-1}^2 \tag{2}$$

The conditional variance equation is a function of three terms:

C_0: A constant term.

$c_1 u_{t-1}^2$ (the ARCH term): News about volatility from the previous period, measured as the lag of the squared residual

u_{t-1}^2 from the mean equation.

$c_2 \sigma_{(t-1)}^2$ (the GARCH term): Last period's forecast variance as a function of the past residuals u_{t-2}, u_{t-3},…,

$c_1 + c_2 < 1$: It should be noted that this constraint allows the process to remain stationary, with the upper limit $c_1 + c_2 = 1$ which represents an integrated process.

For the empirical analysis, monthly observations of the DJSI, CSI, gold prices and TWUSDI have been employed. These data have been obtained from the Reuters DataLink database of the Thomson Reuters Company. The sample period covers January 1, 2002 to August 31, 2016. Furthermore, Monthly continuously compounded returns for the selected data are calculated as, $R_t = 100*\log (p_t/p_{t-1})$ where R_t and p_t are the monthly returns respectively.

Regarding DJSI, it provides to social responsible investors objective benchmarks so as to manage their investment portfolios[1]. The DJSI's partners RobecoSAM corporate sustainability assessment incorporates approximately 80-120 questions related to economic, environmental and social pillars. The main advantage of this approach is that it considers both general and 59 industry's specifications as categorized by GICS classification. In addition, more than 50% of the questions concerns industry specific risks and opportunities under economic, environmental and social challenges and trends[2]. It is important to mention, that each DJSI's pillar has different importance-weight to the total score. Each of above pillars incorporates on average 6-10 criteria and each one includes 2-10 questions. Therefore, each question receives a score based on number of points received multiple question weight multiple criterion weight. Finally, each company receives a total sustainability score between 0 and 100 based on the addition of total number of questions points received multiplying questions weight multiplying criteria weight[3]. Regarding, DJSI US, RobecoSAM identifies US sustainability leaders which represents the top 20% of the largest 600 US companies in the Dow Jones Sustainability™ North America index based on long-term economic, environmental and social criteria[4]. DJSI US series is retrieved by the of official site of DJSI[5].

As far as US dollar value is concerned, TWUSDI is used as a proxy of the US dollar value to major currencies. It is a weighted average of the individual exchange rates of a particular country with its main trading partners. The bilateral exchange rates are weighted according to the importance of each partner country's share of the trade with the reporting country. Regarding consumer sentiment, in the literature there are two well-known followed measures of the consumer expectations: University of Michigan Survey Research Center and the Conference Board as they attract the interest of different bodies such as policymakers and financial analysts. The most common proxy of consumer sentiment is the CSI as formulated by University of Michigan, probably, because of its long time series (Bram and Ludvigson, 1998). For the purposes of the study, the University of Michigan's index of consumer sentiment is employed as a proxy for the US future consumer purchases. It is expected that consumer purchases will be an extensive decision making process. For instance, Housing, automobiles, and non-automobile durables could be the best candidates for prediction, whilst nondurables could be less likely to indicate a relationship with the consumer attitude and expectation indexes. The monthly survey incorporates a least

500 interviews conducted by telephone using multistage area probability sampling. There are five main questions that judge the respondents' assessment of current business and employment conditions, and expectations of future economic conditions, while the answers are categorized into three responds: Positive, neutral, and negative (Huth et al., 1994; Singal, 2012). Finally, gold price is defined as the US Dollar per Troy Ounce. All three explanatory variables of DJSI US are retrieved from the Bloomberg online platform.

3. EMPIRICAL FINDINGS

Table 1 presents summary statistics for DJSI US, gold, TWUSDI, and CSI series. Specifically, the DJSI, gold and CSI series show negative asymmetry while series of TWUSDI illustrates positive asymmetry. Also, the returns series seem to have a leptokurtic distribution with fat tails (kurtosis > 3), which confirm the results of Jarque Bera statistics about the non-normality of the examined series. We have to point out that the asymmetry and the kurtosis of the gold series is not far from zero and three, indicating that the distribution approaches normal one, which is why the corresponding statistical analysis by Jarque Bera marginally does not indicate normal allocation. Finally, the augmented dickey-fuller test, allowing for both an intercept and a time trend, showed that the sample series had been produced by stationary series.

Table 2 shows the sample autocorrelation function and partial autocorrelation function for daily returns and squared daily returns of the DJSI series. It can be observed that the Ljung-Box (LB) statistics although provide no evidence of autocorrelation on monthly returns, present strong evidence of autocorrelations in the squared daily returns, indicating conditional heteroskedasticity (Bollerslev, 1987).

Table 3 represents the correlation of the used variables in the model. To correlation coefficients between the different independent variables is low indicating that there is no tendency in the examined model to present a multicollinearity problem.

In summary, it seems the DJSI return series is best described by an unconditional leptokurtic distribution and possesses significant conditional heteroskedasticity. This renders the ARCH models a very good choice for modelling the DJSI return series.

Table 1: Sample statistics

Statistical measures	DJSI US	Gold	TWUSDI	CSI
Mean	0.00326	0.00799	0.0002	−0.0007
Median	0.00881	0.00663	−8E−05	−0.0033
Maximum	0.09910	0.15568	0.0642	0.1276
Minimum	−0.18769	−0.185	−0.0331	−0.1992
SD	0.04477	0.05039	0.0123	0.0533
Skewness	−0.66053	−0.12005	0.6316	−0.3574
Kurtosis	4.30611	3.68089	5.8264	3.8132
Jarque-bera	29.48	4.45245	81.86	10.01
Observations	205	205	205	205
ADF	−13.56	−16.40	−9.49	−12.17

SD: Standard deviation, DJSI US: Dow Jones sustainability index US, CSI: Consumer sentiment index, ADF: Augmented dickey-fuller, TWUSDI: Trade weighted US dollar index

1   Dow Jones Sustainability Index - Dow Jones Sustainability Indices Methodology, available at: http://djindexes.com/sustainability/?go=literature (accessed on 9 February, 2017).

2   DJSI assessment, available at: http://www.sustainability-indices.com/sustainability-assessment/corporate-sustainability-assessment.jsp (accessed on 9 February, 2017).

3   CSA Guide - RobecoSAM's Corporate Sustainability Assessment Methodology, available at: http://www.sustainability-indices.com/images/corporate-sustainability-assessment-methodology-guidebook.pdf (accessed on 9 February, 2017).

4   Dow Jones Sustainability™ United States Index – Fact Sheet, available at: http://djindexes.com/mdsidx/downloads/fact_info/Dow_Jones_Sustainability_United_States_Index_Fact_Sheet.pdf (accessed on 9 February, 2017).

5   DJSI US series, available at: http://www.sustainability-indices.com/index-values (accessed on 9 February, 2017).

Table 2: Test for serial dependence in first and second moments of DJSI US series

Returns				Squared returns			
Lags	Autocorrelation	Partial correlation	LB (n)	Lags	Autocorrelation	Partial correlation	LB (n)
1	0.059	0.059	0.7296	1	0.231	0.231	11.122
2	−0.048	−0.052	1.2211	2	0.1	0.049	13.215
3	0.097	0.103	3.1796	3	0.145	0.118	17.625
4	0.069	0.055	4.1966	4	0.227	0.179	28.549
5	0.08	0.084	5.5493	5	0.209	0.125	37.816
6	−0.083	−0.098	7.009	6	0.138	0.05	41.859
12	0.037	0.056	11.017	12	0.064	0.062	46.536
24	0.074	0.048	27.103	24	−0.003	−0.074	58.008
36	−0.013	−0.002	35.946	36	0.016	0.019	65.807

DJSI US: Dow Jones sustainability index US. LB (n) are the n-lag Ljung-Box statistics for DJSI USt and respectively. LB (n) follows Chi-square distribution with n degree of freedom; the sample period contains 205 monthly returns

Table 3: Correlation matrix

Variables	DJSI US	Gold	TWUSDI	CSI
DJSI US	1	−0.0026	−0.3748	0.1740
Gold	−0.0026	1	−0.2722	0.0096
US all	−0.3748	−0.2722	1	−0.04635
CSI	0.1740	0.0096	−0.0464	1

DJSI US: Dow Jones sustainability index US, CSI: Consumer sentiment index, TWUSDI: Trade weighted US dollar index

The preliminary statistical results and the application of the likelihood ratio tests (LR) test on the GARCH (p,q) model demonstrated the final specification for the estimation of the mean and volatility for the DJSI series. The specification is:

Mean equation:

$$DJSI\ US_t = b_1 + b_2\ GOLD_{t-1} + b_3\ TWUSDI_t + b_4 CSI_t + u_t \qquad (3)$$

Variance equation:

$$\sigma_t^2 = c_0 + c_1 u_{t-1}^2 + c_2 \sigma_{t-1}^2 \qquad (4)$$

$u_t \sim GED\ (0,\ \sigma_t^2)$,

Some diagnostic tests were performed to establish goodness of fit and appropriateness of the model. First, it was examined whether the standardized residuals and squared standardized residuals of the estimated model were free from serial correlation. As we can see from Table 4, the LB(n) statistics for standardized residuals are not statistically significant and the LB(n) statistics for standardized squared residuals show no ARCH remaining structure. Furthermore, the coefficient estimation $v = 1.59$ for tail thickness regulator with 0.3 standard error, confirms the adoption of the generalized error distribution (GED) assumption. Specifically, the assumption of normal distribution is rejected, a fact that verifies the theory for thick tails in the stock returns. An LR test of the restriction $v = 2$ (for $v = 2$ the GED distribution is essentially the normal distribution) against the unrestricted models clearly supports this conclusion.

Results presented in Table 5 show that gold as proxy for economic and political risks being statistically significant at 1% level seems to affect negatively the stock returns of DJSI US. Furthermore, a strong dollar negatively affects the shares of DJSI US index

indicating the significant role of monetary policy in the profitability and growth of large companies, as DJSI US index consists mainly of large multinational corporations based on the US. Finally, the CSI is statistically significant at 5% level (P = 0.094) suggested the vital gravity of consumer sentiment on the mean return of the DJSI US variable. The positive coefficient illustrates the significant effect of consumer psychology in broad investment climate.

In Table 6 the results for the variance equation are presented. The value of the c_2 coefficient (0.819), which reflects the influence of σ_{t-1}^2, i.e. the older information (residuals u_{t-2}, u_{t-3},…), is much higher than the value of the c_1 coefficient (0.132), which correlates the price variation of the present month to the price variation of the previous month. Consequently, the volatility shocks (information) are slowly assimilated to the particular market. The sum of the $c_1 + c_2 = 0.132 + 0.819 = 0.951$ is lower than one, but high, a fact that indicates the presence of volatility clustering.

4. CONCLUSION

The aim of this study is to investigate the determinants of the US stock index. The novelty of the study is the employment of socially responsible stock index. Unlike to conventional investments, socially responsible investors intend to incorporate in their portfolios firms that not only under economic criteria but under social and environmental ones. Thus, the novelty of the study is the employment of DJSI as a proxy of socially responsible stock index. In particular, the US market is scrutinized because SRI has been increased dramatically. The main advantages of DJSI are the incorporation of both general and sector-industry criteria and the different weight of each question to the total sustainability score. Regarding the determinants of DJSI US, three variables are selected, namely CSI as a proxy of US consumer sentiment, gold prices and the US dollar value to major currencies taking into account King's (1996) proposal. The econometric analysis that is applies is the GARCH model for the period September 1999-September 2016.

As far as the US dollar value is concerned, it is illustrated that the currency policy of the US dollar value is crucial for the profitability of the US firms. Thus, policy makers should consider the US dollar value to major currencies in the policy formulation their decisions could be destructive for firms' sustainability.

Table 4: Diagnostics on standardized and squared standardized residuals

Residuals				Squared residuals			
Lags	Autocorrelation	Partial correlation	LB (n)	Lags	Autocorrelation	Partial correlation	LB (n)
1	−0.087	−0.087	1.5716	1	−0.049	−0.049	0.497
2	−0.035	−0.042	1.822	2	0.004	0.001	0.4997
3	0.038	0.032	2.1279	3	−0.019	−0.019	0.5754
4	0.069	0.074	3.1225	4	−0.059	−0.061	1.3027
5	0.122	0.14	6.2754	5	0.096	0.091	3.2726
6	−0.095	−0.069	8.2068	6	0.068	0.078	4.2652
12	0.027	0.014	12.389	12	−0.011	−0.02	5.4047
24	0.055	0.015	28.836	24	−0.031	−0.03	10.135
36	0.039	0.046	35.867	36	−0.02	−0.03	20.336

LB (n) are the n-lag Ljung-Box statistics for the residual series. LB (n) follows Chi-square variable with n degree of freedom; the series of residual contains 205 elements

Table 5: Mean equations

$DJSI\ US_t = b_1 + b_2 GOLD_{t-1} + b_3\ TWUSDI_t + b_4 CSI_t + u_t$			
b_1	b_2	b_3	b_4
0.0078*	−0.1595*	−1.2215*	0.0940**
(0.0023)	(0.0454)	(0.1967)	(0.0432)

Standards errors are shown in parentheses. *Indicates statistical significance at the 1% level. **Indicates statistical significance at the 10% level

Table 6: Variance equations

$\sigma_t^2 = c_0 + c_1 u_{t-1}^2 + c_2 \sigma_{t-1}^2$		
c_0	c_1	c_2
6.54E-05	0.132***	0.819*
(5.63E-05)	(0.070736)	(0.081255)

Standards errors are shown in parentheses. *Indicates statistical significance at the 1% level. ***Indicates statistical significance at the 10% level

In addition, US consumer sentiment is an important driver of DJSI US which investors and business manager forecasting, formulating, and strategizing for profit maximization or portfolios. In addition, each consumer is potential investors and when their sentiment is positive for the economy they are also confident in the stock market as well. Thus, as it is expected consumer sentiment can reflect the real economic activity.

Finally, the results found a negative effect of gold prices on socially responsible stock returns. A possible explanation could be that when the US economy faces economic recession or instability, investors see to buy gold commodity as it works not only as a good diversification instrument for stock investments but also as a "safe havens" in times of stress.

Future studies may incorporate both conventional and socially responsible stock indexes in order to ascertain what are the main differences or similarities between two indexes. In addition, alternative socially responsible indexes could be employed such as FTSE4 Good, FTSE/JSE Responsible Investment index and Calvert social index. Furthermore, environmental or pollution indicators are, probably, important to socially responsible investors as they more sensitive to climate changes.

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