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Analysis of Global Green Indices for Hedging Climate Risk

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Introduction of Green Indices

The principle governing the indices, instead of a regional or global concentration, is that some concentrate on clean energy technologies while others concentrateon alternative energy system. Other factors which differentiate the indices are below:

- Focus oncompanies – that are on companies which are principally engaged in the field of alternative energy and excludes those companies for which alternative energy is optional to their main business.
- Use a rule based approach – that is obviously defined rules-based methodology, usually overseen by an impartial Index Committee, employing a pre-defined screening methodology ensures that the procedure is persistent and transparent.
- Are inclusive – that strives to involve all companies that are principally engaged in the domain of alternative energy within a given market, a given region, or globally. Some indices set a liquidity or market capitalization filter while others track just a predetermined number of companies (i.e. the top 15 or the top 20).

The scientific consensus is done unanimously on global warming , the evidence on rising global average temperatures is mounting, yet the media continues to be filled with political debates between climatic change sceptics and a wide spectrum of political alert.
With various degrees of alarm about the catastrophic consequences of unchecked global warming. These debates are incited by three important aspects.

The first reason is that not all nations are equally affected by climatic change. While some nati**ons are** suffering the result of droughts, bigger storm systems with heavier precipitations, and increased deluge, others have benefited from temperatures. Not all industries are equally affected by climate change mitigation policies.

The second reason is that climate mitigation is typically not a “front burner” policy issue and short-sighted politicians tend to prefer to “kick the can down the road” rather than introduce policies that are costly in the short run and risk alienating their constituencies. This is easier to do if there is a perception among voters that it is not yet fully settled that there is a climate change problem that is in need of urgent attention.
The third reason is that, although the scientific research on the link between CO_2 emissions and the greenhouse effect is overwhelming, there is uncertainty regarding the rate of increase in global temperatures in future and the effects on climate change.

Research Objectives

1. To study correlation between Global Green Indices.
2. To Perform Descriptive analytics for Global Green Indices.
3. To understand distributional properties of Global Green Indices.
4. To study Causality amongst Global Green Indices.

Research Methodology

Research Design

The research is an Empirical study based on secondary data with cause and effect outcomes.

Data Collection

The daily closing prices' data was collected for ISE Global Wind energy Index, World Alternative Energy Index, I shares Clean Energy Index, DAX Global Alternative Energy Index, Ardour Solar Index over a period ranging from April 1st 2012 to 31st March, 2017.

Research Tools

Research Objective	Tools used
1. To study correlation between Global Green Indices.	**Correlation**
2. To Perform Descriptive analytics for Global Green Indices.	**Standard deviation, Mean**
3. To understand distributional properties of Global Green Indices.	**JarqueBera, Box-Ljung, ADF Test**
4. To study Causality amongst Global Green Indices.	**Granger Causality Test**

Data Analysis & Discussion

Correlation Analysis

INDICES	DAX_GLOBAL_ALT	FAN	ICLN	WORLD_ALT_ENERGY	ARDOUR_SOLAR
DAX_GLOBAL_ALT	1.00	0.83	0.53	0.93	-0.19
FAN(ISE_GLO_WIND)	0.83	1.00	0.70	0.78	0.17
ICLN (ISHARE_GLO_CLEAN)	0.53	0.70	1.00	0.56	0.77
WORLD_ALT_ENERGY	0.93	0.78	0.56	1.00	-0.08
ARDOUR_SOLAR	-0.19	0.17	0.77	-0.08	1.00

In the study the correlation was found to be the highest as 93% between DAX Global and World Alternative Energy and the lowest was between Ardour Solar and Dax Global Index.

From the study it was found that the average of DAX Global Alternative Index was 123.54, FAN was 10.45, ICLN was 9.35, World Alternative Energy was 1679.12 and ARDOUR Solar was 596.99.

DESCRIPTIVES

	DAX_GLOBAL_ALT	FAN	ICLN	WORLD_ALT_ENERGY	ARDOUR_SOLAR
Mean	123.54	10.45	9.35	1679.12	596.99
Median	127.55	11.12	9.29	1683.63	568.67
Maximum	167.10	13.74	13.02	2192.90	1073.54
Minimum	83.13	5.62	6.17	1195.62	299.14
Std. Dev.	22.09	2.17	1.56	243.44	199.63
Skewness	-0.09	-0.76	0.02	0.04	0.31
Kurtosis	1.85	2.32	2.27	2.24	1.94
Jarque-Bera	71.75	146.75	28.05	31.68	70.26
Probability	0.00	0.00	0.00	0.00	0.00
Sum Sq. Dev.	618001.2	5938.753	3068.251	77040389	44036062
Observations	1268	1258	1258	1301	1106

Jarque Bera suggested that the data was non-normal as P values were less than 0.05 for almost all of the selected Indices. The average performance was maximum for World Alternative Index and least for ICLN Index.

Covariance Analysis

	DAX_GLOBAL_ALT	FAN	ICLN	WORLD_ALT_ENERGY	ARDOUR_SOLAR
DAX_GLOBAL_ALT	487.38	39.83	18.40	4990.92	-721.73
FAN	39.83	4.72	2.36	408.12	57.60
ICLN	18.40	2.36	2.44	209.75	215.35
WORLD_ALT_ENERGY	4990.92	408.12	209.75	59216.29	-3108.25
ARDOUR_SOLAR	-721.73	57.60	215.35	-3108.25	39815.61

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GRANGER CAUSALITY TEST

Pairwise Granger Causality Tests
Date: 04/11/17 Time: 16:30
Sample: 1 1301
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability	Result
FAN does not Granger Cause DAX_GLOBAL_ALT	1256	4.46108	0.01173	Rejected
DAX_GLOBAL_ALT does not Granger Cause FAN		2.30199	0.10048	Accepted
ICLN does not Granger Cause DAX_GLOBAL_ALT	1256	2.68152	0.06885	Accepted
DAX_GLOBAL_ALT does not Granger Cause ICLN		0.20115	0.81782	Accepted
WORLD_ALT_ENERGY does not Granger Cause DAX_GLOBAL_ALT	1266	1.55270	0.21208	Accepted
DAX_GLOBAL_ALT does not Granger Cause WORLD_ALT_ENERGY		22.7032	0.0000	Rejected
ARDOUR_SOLAR does not Granger Cause DAX_GLOBAL_ALT	1104	0.47045	0.62485	Accepted
DAX_GLOBAL_ALT does not Granger Cause ARDOUR_SOLAR		2.54218	0.07916	Accepted
ICLN does not Granger Cause FAN	1256	2.25645	0.10515	Accepted
FAN does not Granger Cause ICLN		1.03392	0.35592	Accepted
WORLD_ALT_ENERGY does not Granger Cause FAN	1256	0.22937	0.79507	Accepted
FAN does not Granger Cause WORLD_ALT_ENERGY		3.09690	0.04554	Rejected
ARDOUR_SOLAR does not Granger Cause FAN	1104	0.36591	0.69365	Accepted
FAN does not Granger Cause ARDOUR_SOLAR		3.31106	0.03684	Rejected
WORLD_ALT_ENERGY does not Granger Cause ICLN	1256	0.12150	0.88560	Accepted
ICLN does not Granger Cause WORLD_ALT_ENERGY		2.69629	0.06785	Accepted
ARDOUR_SOLAR does not Granger Cause ICLN	1104	0.09729	0.90730	Accepted
ICLN does not Granger Cause ARDOUR_SOLAR		11.6186	0.00000	Rejected
ARDOUR_SOLAR does not Granger Cause WORLD_ALT_ENERGY	1104	58.7875	0.00000	Rejected
WORLD_ALT_ENERGY does not Granger Cause ARDOUR_SOLAR		1.68431	0.18605	Accepted

From the study it was found that the average of DAX Global Alternative Index was 123.54, FAN was 10.45, ICLN was 9.35, World Alternative Energy was 1679.12 and ARDOUR Solar was 596.99. JarqueBera suggested that the data was non-normal as P values were less than 0.05. In the study as per the Granger

Causality it was identified that only FAN causes DAX and DAX causes World Alternative energy index, Fan Granger causes World Alternative energy index, Fan also causes ARDOUR Solar, ICLN causes ARDOUR solar index .Thus we can say that FAN is the root cause of changes in various alternative energy indices' values across the globe. For the study ADF test was used to determine stationary and series were made stationary at lag1. The correlation between DAX and World Alternative index was 93% and the lowest was found between ARDOUR and World Alternative Energy Index. The study suggests that the forecasting for the aforesaid indices can be performed using econometric modelling by implying ARIMA and GARCH models. The returns are very poor from investing into these indices, and therefore a investment provoking model has to be framed in order to enhance green investments.

Conclusion

It can be concluded from the study that as per the Granger Causality it was identified that only FAN causes DAX and DAX causes World Alternative energy index, Fan Granger causes World Alternative energy index, Fan also causes ARDOUR Solar, ICLN causes ARDOUR solar index. In order to forecast these Indices ARIMA Model of Order AR(1) I(2) and MA(22) could be applied and series would be stationary at second lag which could be observed from the ADF test (Refer Appedix)

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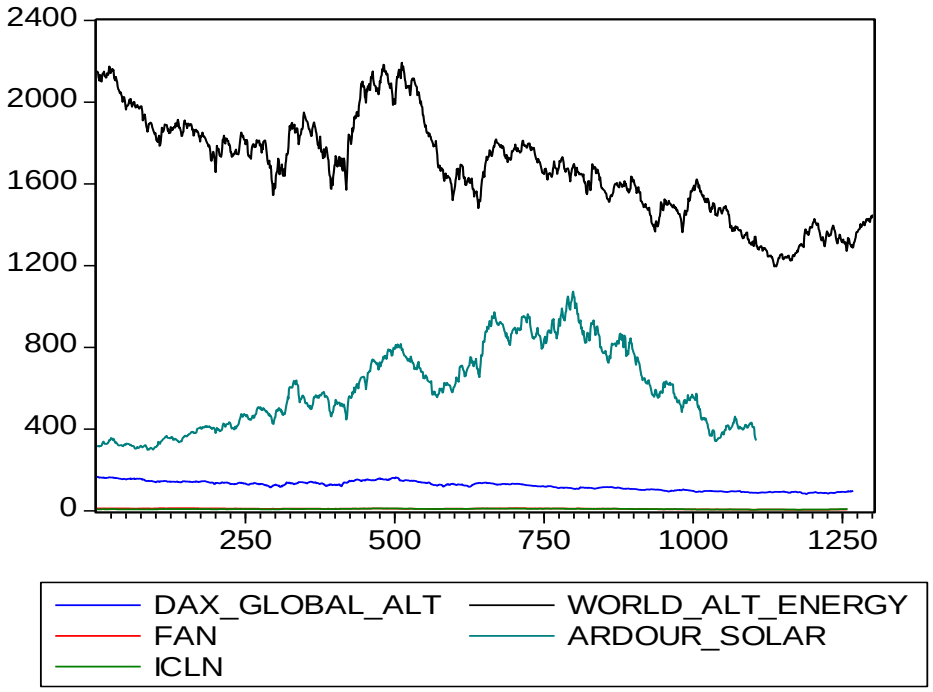
Appendix



Augmented Dickey-Fuller Test Equation
Dependent Variable: D(WORLD_ALT_ENERGY)
Method: Least Squares
Date: 04/11/17 Time: 16:59
Sample (adjusted): 3 1301
Included observations: 1299 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
WORLD_ALT_ENERGY(-1)	-0.004354	0.002129	-2.044732	0.0411
D(WORLD_ALT_ENERGY(-1))	0.141789	0.027466	5.162371	0.0000
C	6.847022	3.612554	1.895341	0.0583

R-squared	0.022869	Mean dependent var	-0.539877
Adjusted R-squared	0.021361	S.D. dependent var	18.85222
S.E. of regression	18.64978	Akaike info criterion	8.691853
Sum squared resid	450767.3	Schwarz criterion	8.703791
Log likelihood	-5642.358	F-statistic	15.16614
Durbin-Watson stat	1.995889	Prob(F-statistic)	0.000000

Null Hypothesis: D(WORLD_ALT_ENERGY) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=22)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-31.26758	0.0000
Test critical values:	1% level	-3.435173	
	5% level	-2.863557	
	10% level	-2.567894	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(WORLD_ALT_ENERGY,2)
Method: Least Squares
Date: 04/11/17 Time: 16:59
Sample (adjusted): 3 1301
Included observations: 1299 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(WORLD_ALT_ENERGY(-1))	-0.859586	0.027491	-31.26758	0.0000
C	-0.463452	0.518301	-0.894176	0.3714

R-squared	0.429805	Mean dependent var	0.004403
Adjusted R-squared	0.429366	S.D. dependent var	24.71876
S.E. of regression	18.67264	Akaike info criterion	8.693534
Sum squared resid	452221.5	Schwarz criterion	8.701493
Log likelihood	-5644.450	F-statistic	977.6616
Durbin-Watson stat	1.995461	Prob(F-statistic)	0.000000

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.535342	0.638604	-0.838299	0.4020
AR(1)	0.138399	0.027524	5.028378	0.0000
MA(22)	0.064655	0.027823	2.323820	0.0203

R-squared	0.023363	Mean dependent var	-0.539877
Adjusted R-squared	0.021855	S.D. dependent var	18.85222
S.E. of regression	18.64507	Akaike info criterion	8.691347
Sum squared resid	450539.7	Schwarz criterion	8.703286
Log likelihood	-5642.030	F-statistic	15.50114
Durbin-Watson stat	1.994800	Prob(F-statistic)	0.000000