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QF603 Quantitative Analysis of Financial Markets (AY2021/2022)

Research Project: ESG Effect on Shareholder Returns

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1. Introduction

In the past decade, companies' performance on environmental, social and governance (ESG) issues has garnered increasing attention from different parties such as customers, employees, and regulators (Khan, 2019). This phenomenon has translated into a growing demand for sustainable investing strategies from asset owners such as pension funds (Eccles & Klimneko, 2019). Despite this growing interest in ESG and numerous research over the years, the relationship between ESG characteristics and financial performance has been inconclusive as the result varies depending on the various methodologies applied and the different underlying ESG data that was used for the research (Giese et al., 2019).

An example of a positive relationship between ESG and financial performance include results showing that 88% of reviewed sources find that companies with robust sustainability practices demonstrate better operational performance which ultimately translates into cash flows and that 80% of the reviewed studies has demonstrated that prudent sustainability practices have a positive influence on investment performance (Clark et al., 2014). However, it is also important to note that many empirical studies analyzing relationships between ESG, and financial variables do not differentiate between correlation and causality (Krueger, 2013).

In this report, the relationships between Standard & Poor's 500 Index (S&P 500) companies' total shareholders returns (TSR) and their respective ESG scores were chosen to be investigated. S&P 500 companies were chosen as it represents the 500 largest publicly-traded companies in the US which provide a good spectrum of companies across industries/sectors. On the other hand, for ESG scores, to ensure that actual sustainable management practices are underlying to the ESG scores, Eikon's public database for ESG scores were used. Building on this, the companies were filtered into their respective sectors to investigate if ESG can better explain sector performance as compared to the market.

2. Hypotheses Development

Hypothesis 1:
Holistic/Total ESG scores of a company have a relationship with its TSR on a market level

Hypothesis 1 forms the base of the research by first identifying if there is a relationship between ESG and TSR.

Hypothesis 2a:
Environmental scores of a company have a relationship with its TSR on a market level

Hypothesis 2b:
Social scores of a company have a relationship with its TSR on a market level

Hypothesis 2c:
Governance scores of a company have a relationship with its TSR on a market level

Hypothesis 2 breaks up ESG factors into their sub-components. This is to identify if any of the components in the ESG factor exhibits a stronger / weaker relationship on TSR as compared to the others. According to (Nollet et al., 2016), the Governance component should exhibit a stronger relationship on TSR among the three components. In the journal, it was concluded that disclosure on governance practices proved significant to financial performance among S&P 500 firms.

Hypothesis 3a:
Holistic ESG scores of a company have a relationship with its shareholder returns on a sector level

Hypothesis 3b:
Individual components Environmental, Social and Governance scores of a company have a relationship with its shareholder returns on a sector level

Hypothesis 3 differentiates the companies on a sector level of the ESG scores, as well as individual Environmental, Social and Governance scores. This is to identify if a certain sector shows a stronger relationship between ESG and TSR. If this is true, certain components of ESG will be more prevalent in certain sectors as compared to the others. For example, the environmental component is much more prevalent in the energy sector as compared to the financial sector.

3. Methodology

3.1. Sample Selection

The S&P 500 was used as a proxy for the US market as it has been the world's biggest and most developed financial market consistently. Investors from around the world choose to flood the developed markets instead of the developing markets with capital is known as Lucas Paradox (Lucas, 1990). This specific reason is why researching the US financial market reflects most of the international investors' sentiment more accurately.

In addition, different from their European peers where corporate sustainability has been imposed in policies since the 1990s and the idea of stakeholder's interest is traditionally upheld (Strand et al., 2014), the US market has been famous for limited government intervention and the idea that a company should only be responsible with its shareholders (Friedman, 1970). S&P 500 includes large-cap companies from different sectors and has covered approximately 80% of available market capitalization. Quarterly data will be used for this research.

3.2. Measurements

Variables	**Symbol**	**Description**
Total Shareholder Return	TSR	Firm's risk-adjusted total shareholder return
Beta	BETA	Firm's market beta
Market Capitalization	M-CAP	Firm's market capitalization value
Market-To-Book Ratio	MTB	Firm's market value to book value
Sales	SALES	Firm's sales values
Environmental Scores	ESG_E	Eikon scores based on the extent of a firm's environmental scores
Social Scores	ESG_S	Eikon scores based on the extent of a firm's social scores
Governance Scores	ESG_G	Eikon scores based on the extent of a firm's governance scores
Total ESG Scores	ESG	Eikon scores based on environmental, social, and governance (ESG)
Lagged TSR	TSR (t-1)	TSR from the previous quarter
Sample Period: 2014Q4 – 2021Q2		

The table above contains the descriptions of the different variables.

3.3. Independent variables

Eikon has been providing ESG scores for companies listed in S&P 500 since 2003. Reuters's analysts collect and verify ESG data from annual reports, company websites, NGO websites, stock exchange filings, and CSR reports to create their proprietary ESG scores. There are three pillars of Environmental, Social, Governance scores published, and their value ranged from 0 to 100. Eikon turns empirical data such as the CO2 emitted from a company production into quantifiable scores through comparison with industry peers. Companies with non-transparent and unsustainable practices will be penalized in their rating.

3.4. Dependent Variable

Total shareholder return was selected as a proxy of the company's performance as well as market sentiment toward a company. The returns are not only risk-adjusted that penalize firms that have high returns by taking a higher market risk but also include both dividends and changes in stock prices.

3.5. Control Variables

The Fama–French Three-Factor Model (Fama & French, 1993) was used as a base control variable for market risk using each firm beta with the market (BETA), size risk using each firm market capitalization (M-CAP), and value risk by using each firm Price-To-Book ratio (MTB). Additional research on this topic considers sales (SALES) to be a major contribution to returns (Nollet et al., 2016). Lastly, to control for the heteroscedastic problem that comes with panel regression, lagged variables of TSR were included (Wooldridge, 2019).

4. Econometric Model

4.1. Model Development

Model 1 (H1):
$(TSR)it = \beta 0 + \beta 1\ (BETA)it + \beta 2\ (M\text{-}CAP)it + \beta 3\ (MTB)it + \beta 4\ (SALES)it + \beta 5\ (ESG)\ it + \beta 6\ TSR\ (t\text{-}1) + \varepsilon it$

Model 2 (H2a to H2c):
$(TSR)it = \beta 0 + \beta 1\ (BETA)it + \beta 2\ (M\text{-}CAP)it + \beta 3\ (MTB)it + \beta 4\ (SALES)it + \beta 5\ (ESG\_E)it + \beta 6\ (ESG\_S)it + \beta 7\ (ESG\_\ G)it + \beta 8\ TSR\ (t\text{-}1) + \varepsilon it$

Regression Estimator: Least Squares Dummy Variable
Model Specification: Two-Way Fixed Effect (Cross Section & Period)

4.2. Data Wrangling

The data was drawn firstly from Eikon and further filled with Capital IQ for standard variables like SALES and M-CAP. To ensure fairness in the ESG data, it was only from a single source Eikon. Firms that did not have full data were removed to have complete (balanced) panel data.

4.3. Panel Data

Several pre-tests were conducted to ensure that the panel regression does not break major regression assumptions and that the model is valid.

A standard pooled OLS cannot be used as it will mask both the individual firm-specific cross-sectional characteristics and time-period characteristics which will then be reflected in the error terms instead. As a result, the error terms will be correlated with the independent variables.

The following 2 models are proposed to effectively model panel data more accurately:

1. Fixed Effect Model accounts for the characteristics by including a fixed effect term. It uses dummy variables to allow for different intercepts in the model. Hence, these differences capture the unique firm characteristics.

2. Random Effects Model resolves serially correlated errors by using the Generalized-Least Square (GLS) estimation approach. It determines the degree of serial correlation and then uses some weighted estimation approach to adjust for it.

The Hausman test (1978) was conducted to determine if a fixed effect or random effect model should be used on the panel regression. The null hypothesis of the Hausman test is that the Random Effect model is the better estimator. It is revealed that a fixed-effects model is more applicable than a random-effects model ($p < 0.001$).

Correlated Random Effects - Hausman Test
Equation: Hausman Test
Test cross-section and period random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section and period random	529.171674	6	0.0000

Cross-section and period random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
BETA	3.142853	2.196542	0.155474	0.0164
M_CAP	0.000000	0.000000	0.000000	0.0170
MTB	0.000901	0.000962	0.000000	0.7520
SALES	-0.000000	-0.000000	0.000000	0.0002
ESG	-0.005674	-0.029641	0.000150	0.0506
TSR(-1)	-0.056959	-0.016824	0.000003	0.0000

Fig 4.3.1 Hausman Test

4.4. Autocorrelation

The Durbin-Watson (1971) test for autocorrelation had a value of 2, indicating the absence of autocorrelation in the error terms for both regression models.

R-squared	0.353406	Mean dependent var	4.329529
Adjusted R-squared	0.325869	S.D. dependent var	15.71905
S.E. of regression	12.90620	Akaike info criterion	7.993357
Sum squared resid	2010334.	Schwarz criterion	8.297846
Log likelihood	-49779.20	Hannan-Quinn criter.	8.095258
F-statistic	12.83366	Durbin-Watson stat	2.047161
Prob(F-statistic)	0.000000		

Fig 4.4.1 Model 1 Durbin-Watson Test

R-squared	0.353685	Mean dependent var	4.329529
Adjusted R-squared	0.326047	S.D. dependent var	15.71905
S.E. of regression	12.90449	Akaike info criterion	7.993244
Sum squared resid	2009468.	Schwarz criterion	8.298916
Log likelihood	-49776.49	Hannan-Quinn criter.	8.095541
F-statistic	12.79739	Durbin-Watson stat	2.046920
Prob(F-statistic)	0.000000		

Fig 4.4.2 Model 2 Durbin-Watson Test

4.5. Heteroscedasticity

Panel Heteroskedasticity LR Test
Specification: TSR C BETA M_CAP MTB SALES ESG TSR(-1)
Null hypothesis: Residuals are homoskedastic

	Value	df	Probability
Likelihood ratio	0.033221	484	0.9735

Fig 4.5.1 Model 1 Laplace Likelihood Test

Panel Heteroskedasticity LR Test
Specification: TSR C BETA M_CAP MTB SALES ESG_E ESG_S ESG_G TSR(-1)
Null hypothesis: Residuals are homoskedastic

	Value	df	Probability
Likelihood ratio	0.023796	484	0.9810

Fig 4.5.2 Model 2 Laplace Likelihood Test

The p-values of the Laplace Likelihood Ratio tests indicate that the regression analyses do not demonstrate heteroscedasticity (p = 0.98).

4.6. Multicollinearity

Variance Inflation Factors
Sample: 2014Q4 2021Q2
Included observations: 12584

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.917554	69.31915	NA
BETA	0.214131	19.03532	1.010174
M_CAP	6.33E-24	2.628069	1.325939
MTB	7.85E-07	1.001212	1.000390
SALES	3.10E-21	8.267169	1.324839
ESG	0.000198	43.79372	1.004958
TSR(-1)	8.19E-05	1.131237	1.011873

Fig 4.6.1 Model 1 Variance Inflation Factors

Variance Inflation Factors
Sample: 2014Q4 2021Q2
Included observations: 12584

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	1.473598	111.3566	NA
BETA	0.214324	19.05750	1.011351
M_CAP	6.34E-24	2.630756	1.327294
MTB	7.85E-07	1.001312	1.000490
SALES	3.11E-21	8.281456	1.327129
ESG_E	0.000198	39.54505	1.167401
ESG_S	0.000284	78.28381	1.194627
ESG_G	0.000128	35.06729	1.046097
TSR(-1)	8.19E-05	1.131761	1.012341

Fig 4.6.2 Model 2 Variance Inflation Factors

All variance inflation factors (VIFs) do not indicate multicollinearity in the regression analyses as they remain below the critical value of 5 (Wooldridge, 2019).

4.7. Descriptive Statistics & Correlation Matrix

	TSR	BETA	M_CAP	MTB	SALES	ESG_E	ESG_S	ESG_G	ESG
Mean	4.485193	1.051596	5.16E+10	3.762002	5.43E+09	50.42393	59.64744	58.99983	53.12208
Median	4.492414	1.037538	2.06E+10	3.294027	2.04E+09	54.51718	60.84268	61.52505	53.36944
Maximum	232.4481	4.973787	2.29E+12	7264.309	1.52E+11	98.54581	98.11889	99.43764	92.97765
Minimum	-83.53684	-0.422993	55158914	-10036.85	-1.28E+09	0.000000	5.622524	1.872852	2.494841
Std. Dev.	15.61859	0.480793	1.17E+11	131.4216	1.10E+10	26.65362	20.12019	20.28630	17.27692
Skewness	0.732376	0.945944	8.217847	-27.77851	5.479440	-0.299600	-0.246225	-0.400923	-0.150466
Kurtosis	14.36420	6.803031	99.71301	3598.033	46.59267	1.927943	2.266809	2.449668	2.387816
Jarque-Bera	71487.71	9824.023	5240017.	7.04E+09	1100117.	821.2958	424.7513	515.0007	253.3721
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	58612.50	13742.26	6.75E+14	49161.84	7.09E+13	658939.9	779472.8	771009.8	694199.4
Sum Sq. Dev.	3187570.	3020.590	1.79E+26	2.26E+08	1.58E+24	9282999.	5289810.	5377512.	3900394.
Observations	13068	13068	13068	13068	13068	13068	13068	13068	13068

Fig 4.7.1 Descriptive Statistics

	TSR	BETA	M_CAP	MTB	SALES	ESG_E	ESG_S	ESG_G	ESG
TSR	1.000000	0.062881	0.047250	0.015965	-0.023334	-0.027927	-0.007219	-0.018408	-0.023230
BETA	0.062881	1.000000	-0.032043	0.004605	-0.060502	-0.028458	-0.028131	-0.026554	-0.050975
M_CAP	0.047250	-0.032043	1.000000	0.013184	0.537329	0.206409	0.225862	0.102904	-0.039263
MTB	0.015965	0.004605	0.013184	1.000000	0.002585	0.008913	0.006774	0.005050	0.009504
SALES	-0.023334	-0.060502	0.537329	0.002585	1.000000	0.252724	0.204563	0.149659	0.003909
ESG_E	-0.027927	-0.028458	0.206409	0.008913	0.252724	1.000000	0.699029	0.341130	0.676971
ESG_S	-0.007219	-0.028131	0.225862	0.006774	0.204563	0.699029	1.000000	0.327806	0.729245
ESG_G	-0.018408	-0.026554	0.102904	0.005050	0.149659	0.341130	0.327806	1.000000	0.601536
ESG	-0.023230	-0.050975	-0.039263	0.009504	0.003909	0.676971	0.729245	0.601536	1.000000

Fig 4.7.2 Covariance Matrix

The table above shows that the mean differs from the median for many variables, indicating a slight skewness in the data. Among the ESG scores, the median of ESG_G is the highest (61.5).

Surprisingly, the four ESG scores do not show a significantly strong correlation (i.e., close to 1) with each other. Specifically, ESG_E and ESG_S have the lowest correlation with ESG_G at 0.341 and 0.328 respectively.

ESG_E has the most negative correlation (-0.028) with TSR, compared with ESG_S and ESG_G. The four ESG scores also weakly correlate with the control variable M-CAP. Lastly, BETA is positive and most correlated with TSR (0.0629) among other variables.

5. Main Hypothesis

5.1. Hypothesis Testing (Model 1 & 2)

Dependent Variable: TSR
Method: Panel Least Squares
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 484
Total panel (balanced) observations: 12584

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.399326	0.957890	2.504803	0.0123
BETA	3.142853	0.462743	6.791785	0.0000
M_CAP	1.25E-11	2.52E-12	4.980843	0.0000
MTB	0.000901	0.000886	1.017046	0.3092
SALES	-2.74E-10	5.57E-11	-4.919302	0.0000
ESG	-0.005674	0.014085	-0.402802	0.6871
TSR(-1)	-0.056959	0.009049	-6.294516	0.0000

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.353406	Mean dependent var	4.329529
Adjusted R-squared	0.325869	S.D. dependent var	15.71905
S.E. of regression	12.90620	Akaike info criterion	7.993357
Sum squared resid	2010334.	Schwarz criterion	8.297846
Log likelihood	-49779.20	Hannan-Quinn criter.	8.095258
F-statistic	12.83366	Durbin-Watson stat	2.047161
Prob(F-statistic)	0.000000		

Fig 5.1.1 Model 1 Regression Results

Dependent Variable: TSR
Method: Panel Least Squares
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 484
Total panel (balanced) observations: 12584

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.591742	1.213918	2.135022	0.0328
BETA	3.131778	0.462951	6.764811	0.0000
M_CAP	1.29E-11	2.52E-12	5.129248	0.0000
MTB	0.000861	0.000886	0.971579	0.3313
SALES	-2.71E-10	5.57E-11	-4.868363	0.0000
ESG_E	-0.004877	0.014068	-0.346652	0.7289
ESG_S	-0.025023	0.016844	-1.485556	0.1374
ESG_G	0.020787	0.011326	1.835302	0.0665
TSR(-1)	-0.057366	0.009050	-6.338867	0.0000

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.353685	Mean dependent var	4.329529
Adjusted R-squared	0.326047	S.D. dependent var	15.71905
S.E. of regression	12.90449	Akaike info criterion	7.993244
Sum squared resid	2009468.	Schwarz criterion	8.298916
Log likelihood	-49776.49	Hannan-Quinn criter.	8.095541
F-statistic	12.79739	Durbin-Watson stat	2.046920
Prob(F-statistic)	0.000000		

Fig 5.1.2 Model 2 Regression Results

Based on the p-value of the t-statistic obtained which indicates that the ESG and individual ESG_E, ESG_S, ESG_G scores are insignificant, the following hypotheses were rejected:

- Hypothesis 1:
  Holistic/Total ESG scores of a company have a relationship with its TSR on a market level
- Hypothesis 2a:
  Environmental scores of a company have a relationship with its TSR on a market level
- Hypothesis 2b:
  Social scores of a company have a relationship with its TSR on a market level
- Hypothesis 2c:
  Governance scores of a company have a relationship with its TSR on a market level

6. Robustness Checks

6.1. ESG Interaction (Model 3)

The hypothesis is tested further by incorporating the two-way interaction effects of the Environmental, Social, and Governance scores (e.g. including ESG_E*ESG_S as an independent variable). Given the testing results from Model 1 and Model 2, it is expected that partial voluntary disclosure (e.g. only reporting on ESG_E and ESG_G while omitting ESG_S) will not have any significant relationship with TSR.

The integrated ESG scores represent a holistic three-way interaction that was already tested in Model 1.

As seen from the regression results below, the three tests exhibit a mix of positive and negative coefficients for the direct effects of ESG_E, ESG_S, and ESG_G. With an Adjusted R-squared of above 30%, the models replicate the tests for Model 2. However, only ESG_G has a significant coefficient in the regression with the explanatory variable, ESG_E*ESG_S.

While the models show that companies that report selectively on only ESG_E and ESG_S, ESG_E and ESG_G, or ESG_S and ESG_G experience significant negative effects on TSR, the p-values obtained indicate that they are not significant.

(Regression results on the next page)

Dependent Variable: TSR
Method: Panel Least Squares
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 484
Total panel (balanced) observations: 12584

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.782870	1.567657	1.137283	0.2554
BETA	3.117898	0.463271	6.730188	0.0000
M_CAP	1.30E-11	2.52E-12	5.163258	0.0000
MTB	0.000861	0.000886	0.971679	0.3312
SALES	-2.70E-10	5.58E-11	-4.835665	0.0000
ESG_E	0.015249	0.028408	0.536790	0.5914
ESG_S	-0.007606	0.027201	-0.279603	0.7798
ESG_G	0.020536	0.011330	1.812451	0.0699
ESG_E*ESG_S	-0.000364	0.000446	-0.815459	0.4148
TSR(-1)	-0.057417	0.009050	-6.344252	0.0000

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.353720	Mean dependent var	4.329529
Adjusted R-squared	0.326029	S.D. dependent var	15.71905
S.E. of regression	12.90467	Akaike info criterion	7.993348
Sum squared resid	2009357.	Schwarz criterion	8.299611
Log likelihood	-49776.14	Hannan-Quinn criter.	8.095842
F-statistic	12.77357	Durbin-Watson stat	2.046762
Prob(F-statistic)	0.000000		

Fig 6.1.1 Model 3 (ESG_E*ESG_S) Regression Results

Dependent Variable: TSR
Method: Panel Least Squares
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 484
Total panel (balanced) observations: 12584

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.466113	1.573598	1.567181	0.1171
BETA	3.132240	0.462985	6.765319	0.0000
M_CAP	1.29E-11	2.52E-12	5.129607	0.0000
MTB	0.000860	0.000886	0.970108	0.3320
SALES	-2.71E-10	5.58E-11	-4.858489	0.0000
ESG_E	-0.002258	0.025165	-0.089746	0.9285
ESG_S	-0.025044	0.016846	-1.486684	0.1371
ESG_G	0.023087	0.021546	1.071494	0.2840
ESG_E*ESG_G	-4.53E-05	0.000361	-0.125473	0.9002
TSR(-1)	-0.057373	0.009050	-6.339275	0.0000

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.353686	Mean dependent var	4.329529
Adjusted R-squared	0.325992	S.D. dependent var	15.71905
S.E. of regression	12.90502	Akaike info criterion	7.993401
Sum squared resid	2009465.	Schwarz criterion	8.299664
Log likelihood	-49776.48	Hannan-Quinn criter.	8.095896
F-statistic	12.77163	Durbin-Watson stat	2.046917
Prob(F-statistic)	0.000000		

Fig 6.1.2 Model 3 (ESG_E*ESG_G) Regression Results

Dependent Variable: TSR
Method: Panel Least Squares
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 484
Total panel (balanced) observations: 12584

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.875659	1.798849	1.042699	0.2971
BETA	3.128051	0.463016	6.755809	0.0000
M_CAP	1.29E-11	2.52E-12	5.139711	0.0000
MTB	0.000851	0.000886	0.960682	0.3367
SALES	-2.71E-10	5.57E-11	-4.862229	0.0000
ESG_E	-0.004787	0.014069	-0.340247	0.7337
ESG_S	-0.012247	0.029063	-0.421384	0.6735
ESG_G	0.034215	0.027349	1.251062	0.2109
ESG_S*ESG_G	-0.000231	0.000427	-0.539435	0.5896
TSR(-1)	-0.057392	0.009050	-6.341470	0.0000

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.353700	Mean dependent var	4.329529
Adjusted R-squared	0.326008	S.D. dependent var	15.71905
S.E. of regression	12.90487	Akaike info criterion	7.993379
Sum squared resid	2009419.	Schwarz criterion	8.299642
Log likelihood	-49776.34	Hannan-Quinn criter.	8.095873
F-statistic	12.77245	Durbin-Watson stat	2.046908
Prob(F-statistic)	0.000000		

Fig 6.1.3 Model 3 (ESG_S*ESG_G) Regression Results

6.2. Reverse Causality (Model 4)

There are published academic papers that address the relationship between a successful company's financial means (i.e. ability) and intrinsic motivation to voluntarily report their ESG efforts. This in turn enables them to solidify their standing and even have an edge over their competitors (Frias-Aceituno et al., 2014).

As such, tests to study the direction of causality were conducted using the commonly accepted reverse regressions (Firk et al., 2016; Wintoki et al., 2012). Given the results of the hypothesis testing for Model 1 and Model 2 (i.e. ESG, ESG_E and ESG_S do not seem to have a positive effect while ESG_G has a positive albeit small effect on our sample companies' TSR), a significant relationship between ESG_G and TSR is expected.

The reverse regression results below indicate that there is no reverse causality between firm performance and ESG, ESG_S and ESG_G scores. But interestingly, there seems to be a negative relationship (though the coefficient is small; -0.00539) between TSR and ESG_E.

(Regression results on the next page)

Dependent Variable: ESG
Method: Panel Least Squares
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 484
Total panel (balanced) observations: 12584

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.126662	0.350256	26.05715	0.0000
TSR	-0.001451	0.003307	-0.438700	0.6609
BETA	-0.039196	0.167956	-0.233370	0.8155
M_CAP	-5.33E-13	9.16E-13	-0.582226	0.5604
MTB	0.000276	0.000322	0.857390	0.3912
SALES	-2.16E-11	2.03E-11	-1.067972	0.2856
ESG(-1)	0.839499	0.005207	161.2260	0.0000

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.928517	Mean dependent var	53.43038
Adjusted R-squared	0.925473	S.D. dependent var	17.20406
S.E. of regression	4.696644	Akaike info criterion	5.971638
Sum squared resid	266223.7	Schwarz criterion	6.276127
Log likelihood	-37058.54	Hannan-Quinn criter.	6.073539
F-statistic	304.9986	Durbin-Watson stat	1.945124
Prob(F-statistic)	0.000000		

Fig 6.2.1 Model 4 (ESG) Regression Results

Dependent Variable: ESG_E
Method: Panel Least Squares
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 484
Total panel (balanced) observations: 12584

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.652779	0.272584	20.73778	0.0000
TSR	-0.005393	0.002879	-1.873253	0.0611
BETA	-0.004173	0.146207	-0.028539	0.9772
M_CAP	8.96E-14	7.96E-13	0.112522	0.9104
MTB	-0.000160	0.000281	-0.570823	0.5681
SALES	-5.64E-13	1.77E-11	-0.031936	0.9745
ESG_E(-1)	0.898215	0.004164	215.7199	0.0000

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.977375	Mean dependent var	50.65850
Adjusted R-squared	0.976412	S.D. dependent var	26.62009
S.E. of regression	4.088448	Akaike info criterion	5.694272
Sum squared resid	201738.3	Schwarz criterion	5.998761
Log likelihood	-35313.36	Hannan-Quinn criter.	5.796173
F-statistic	1014.342	Durbin-Watson stat	2.031930
Prob(F-statistic)	0.000000		

Fig 6.2.2 Model 4 (ESG_E) Regression Results

Dependent Variable: ESG_S
Method: Panel Least Squares
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 484
Total panel (balanced) observations: 12584

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.359538	0.306356	24.02284	0.0000
TSR	-1.70E-05	0.002592	-0.006543	0.9948
BETA	0.137556	0.131629	1.045030	0.2960
M_CAP	9.50E-13	7.17E-13	1.323622	0.1857
MTB	0.000102	0.000253	0.402370	0.6874
SALES	3.62E-12	1.59E-11	0.228252	0.8195
ESG_S(-1)	0.882608	0.004443	198.6736	0.0000

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.967641	Mean dependent var	59.96299
Adjusted R-squared	0.966263	S.D. dependent var	20.03762
S.E. of regression	3.680446	Akaike info criterion	5.484009
Sum squared resid	163482.9	Schwarz criterion	5.788498
Log likelihood	-33990.38	Hannan-Quinn criter.	5.585910
F-statistic	702.1450	Durbin-Watson stat	2.014709
Prob(F-statistic)	0.000000		

Fig 6.2.3 Model 4 (ESG_S) Regression Results

Dependent Variable: ESG_G
Method: Panel Least Squares
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 484
Total panel (balanced) observations: 12584

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.445810	0.394436	23.94761	0.0000
TSR	0.001270	0.004133	0.307314	0.7586
BETA	0.312302	0.209982	1.487281	0.1370
M_CAP	-9.86E-13	1.14E-12	-0.862494	0.3884
MTB	0.000458	0.000403	1.137051	0.2555
SALES	1.25E-11	2.53E-11	0.493840	0.6214
ESG_G(-1)	0.838156	0.005077	165.0730	0.0000

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.918751	Mean dependent var	59.24168
Adjusted R-squared	0.915290	S.D. dependent var	20.16633
S.E. of regression	5.869398	Akaike info criterion	6.417445
Sum squared resid	415775.0	Schwarz criterion	6.721935
Log likelihood	-39863.57	Hannan-Quinn criter.	6.519346
F-statistic	265.5128	Durbin-Watson stat	1.948118
Prob(F-statistic)	0.000000		

Fig 6.2.4 Model 4 (ESG_G) Regression Results

6.3. Effect of Economic Events (Model 5)

The sample period includes the COVID-19 pandemic and a dummy control variable (CRISIS) for the period of 2020Q1 to 2020Q4 was used to assess the impact of the onset of the crisis on the regression. As expected, the COVID-19 pandemic affected the companies in the sample. The variables of interest, ESG for Hypothesis 1, ESG_E, ESG_S and ESG_G for Hypothesis 2 remained significant.

However, the R-squared has been reduced to 0.0866. This seems to suggest that the independent variables are not able to explain the variance in the dependent variable as well, even though the entire regression is still significant based on the ANOVA F-statistic.

It is conclusive that COVID-19 affected the companies in the sample and these effects seemed to impair the validity of the models.

Dependent Variable: TSR
Method: Panel Least Squares
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 484
Total panel (balanced) observations: 12584

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.727621	1.050101	-3.549775	0.0004
BETA	4.493490	0.533976	8.415153	0.0000
M_CAP	3.37E-11	2.94E-12	11.45230	0.0000
MTB	0.001799	0.001051	1.711395	0.0870
SALES	-3.88E-10	6.53E-11	-5.933364	0.0000
ESG	0.096857	0.015216	6.365390	0.0000
TSR(-1)	-0.175405	0.009093	-19.29003	0.0000
CRISIS	-9.665880	0.537108	-17.99614	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.086621	Mean dependent var	4.329529
Adjusted R-squared	0.049611	S.D. dependent var	15.71905
S.E. of regression	15.32416	Akaike info criterion	8.334975
Sum squared resid	2839799.	Schwarz criterion	8.625275
Log likelihood	-51952.66	Hannan-Quinn criter.	8.432128
F-statistic	2.340503	Durbin-Watson stat	1.956828
Prob(F-statistic)	0.000000		

Fig 6.3.1 Model 5 (Holistic) Regression Results

Dependent Variable: TSR
Method: Panel Least Squares
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 484
Total panel (balanced) observations: 12584

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.802358	1.240462	-7.096033	0.0000
BETA	4.324265	0.532153	8.125986	0.0000
M_CAP	3.05E-11	2.95E-12	10.35105	0.0000
MTB	0.001977	0.001048	1.886626	0.0592
SALES	-4.32E-10	6.54E-11	-6.605433	0.0000
ESG_E	0.067281	0.016242	4.142308	0.0000
ESG_S	0.107396	0.018401	5.836524	0.0000
ESG_G	0.017813	0.013173	1.352231	0.1763
TSR(-1)	-0.180580	0.009088	-19.87007	0.0000
CRISIS	-10.31436	0.541001	-19.06531	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.091955	Mean dependent var	4.329529
Adjusted R-squared	0.055006	S.D. dependent var	15.71905
S.E. of regression	15.28061	Akaike info criterion	8.329435
Sum squared resid	2823213.	Schwarz criterion	8.620917
Log likelihood	-51915.81	Hannan-Quinn criter.	8.426983
F-statistic	2.488672	Durbin-Watson stat	1.957828
Prob(F-statistic)	0.000000		

Fig 6.3.2 Model 5 (Individual) Regression Results

7. Sector Hypothesis

7.1. Hypothesis Testing (Model 6 & 7)

The universe of 484 companies is segregated into their respective sectors to test whether holistic ESG scores (Model 1) or its individual Environmental, Social and Governance components (Model 2) of a company have a stronger positive effect on its TSR on a sector level.

The 484 companies from the S&P 500 dataset are categorized into these 11 sectors:

1. Communication Services
2. Consumer Discretionary
3. Consumer Staples
4. Energy
5. Financials
6. Health Care
7. Industrials
8. Information Technology
9. Materials
10. Real Estate
11. Utilities

Intuitively, the Energy sector should have a strong positive correlation between its TSR and ESG scores because it includes companies involved in the exploration and development of oil or gas reserves, drilling, refining, and integrated power utility companies such as renewable energy and coal. The sector is expected to prevent the environment from being damaged, while at the same time protecting indigenous groups when drilling near their sacred lands. According to Siddiqui and Chauhan (2021), the Energy sector should be more sensitive to the ESG metrics.

Hypothesis 3a: Holistic ESG scores of a company has a relationship with its shareholder returns on a sector level (Model 6)

p-value	Market Index	Communication Services	Consumer Discretionary	Consumer Staples	Energy	Financials	Health Care	Industrials	Information Technology	Materials	Real Estate	Utilities
R2	0.353406	0.374183	0.427799	0.324329	0.699128	0.597446	0.386648	0.48686	0.373792	0.463383	0.501774	0.525145
Adjusted R2	0.325869	0.314791	0.392946	0.268931	0.668066	0.573329	0.3495	0.456871	0.337685	0.411102	0.459417	0.483976
Constant	0.012300	0.008700	0.167700	0.426400	0.123400	0.076700	0.525900	0.003800	0.027800	0.680500	0.648500	0.245500
BETA	0.000000	0.465600	0.449300	0.969800	0.014900	0.631200	0.118500	0.942400	0.418700	0.389300	0.106400	0.000600
M-CAP	0.000000	0.032500	0.196300	0.000100	0.234200	0.000000	0.000000	0.000000	0.165900	0.009600	0.806600	0.002000
MTB	0.309200	0.475400	0.746800	0.587000	0.341400	0.590700	0.099800	0.944000	0.468500	0.759900	0.054500	0.083900
SALES	0.000000	0.059500	0.068000	0.027800	0.043700	0.361700	0.304900	0.000200	0.095100	0.006600	0.823100	0.412600
ESG	0.687100	0.417700	0.830500	0.647300	0.482500	0.385300	0.379300	0.428200	0.752500	0.754200	0.692900	0.514100
TSR (t-1)	0.000000	0.407300	0.721600	0.426600	0.000100	0.003200	0.007500	0.000200	0.111700	0.981000	0.342400	0.017500
ANOVA F-test	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Fig 7.1.1 Model 6 Summary of R2 & Coefficient p-values

As expected, the Energy sector has the highest R-squared value of approximately 0.7, implying that generally, the independent variables can explain the variance in the dependent variable (TSR) for the Energy sector.

Across all sectors, the R-squared and Adjusted R-squared values are very close or approximately the same, it can be inferred that the independent variables used are relevant. This can be backed by the p-value of F-statistic which has a value of 0, implying that overall, the model is significant and there is evidence that there is a linear relationship between all independent variables and the dependent variable.

Despite having a significant F-statistic across all the 11 sectors, ESG p-values are found to greatly exceed 0.05, and thus signify that the ESG scores is insignificant and irrelevant. Also, contrary to expectations, even the Energy sector has an ESG scores p-value of 0.482, showing that ESG is insignificant in explaining the dependent variable TSR.

Hence, hypothesis H3a is rejected as there is insufficient evidence to conclude that Holistic/Total ESG scores of a company have a relationship with its TSR on a sector level.

Hypothesis 3b: Individual components Environmental, Social and Governance scores of a company have a relationship with its shareholder returns on a sector level (Model 7)

p-value	Market Index	Communication Services	Consumer Discretionary	Consumer Staples	Energy	Financials	Health Care	Industrials	Information Technology	Materials	Real Estate	Utilities
R2	0.353685	0.381846	0.430265	0.326021	0.698945	0.598407	0.386887	0.488862	0.373954	0.465094	0.502575	0.527424
Adjusted R2	0.326047	0.320794	0.394752	0.268796	0.666514	0.573804	0.348896	0.458351	0.337107	0.410814	0.458727	0.484913
Constant	0.032800	0.006000	0.751600	0.963000	0.051500	0.039900	0.421400	0.008500	0.032000	0.226800	0.604000	0.417200
BETA	0.000000	0.355400	0.465100	0.982100	0.022800	0.630200	0.116700	0.827700	0.419400	0.549900	0.117500	0.001600
M-CAP	0.000000	0.053600	0.247300	0.000100	0.282100	0.000000	0.000000	0.000000	0.142400	0.008200	0.863500	0.001100
MTB	0.331300	0.445400	0.796700	0.594300	0.335300	0.547300	0.098500	0.971300	0.469000	0.828900	0.068500	0.096800
SALES	0.000000	0.385900	0.078000	0.032600	0.039400	0.377000	0.293300	0.000300	0.096000	0.004900	0.901800	0.374600
ESG_E	0.728900	0.915700	0.335900	0.216500	0.979900	0.215400	0.777000	0.417000	0.969300	0.296400	0.651800	0.156000
ESG_S	0.137400	0.008600	0.319100	0.867900	0.894900	0.890000	0.258700	0.097500	0.051640	0.817200	0.591900	0.611600
ESG_G	0.066500	0.709200	0.027800	0.453900	0.721300	0.130400	0.948600	0.054300	0.917400	0.483600	0.290800	0.122800
TSR (t-1)	0.000000	0.324700	0.617400	0.390500	0.000100	0.002400	0.007400	0.000100	0.111200	0.973500	0.349200	0.014600
ANOVA F-test	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Fig 7.1.2 Model 7 Summary of R2 & Coefficient p-values

The regression yields a similar result as before:

- The Energy sector has the highest R-squared value
- Across the sectors, R-squared and Adjusted R-squared values are very close, implying that the independent variables used are relevant
- ANOVA F-statistic has a p-value of 0, implying that the overall model is significant and there is evidence that there is a linear relationship between all independent variables and the dependent variable
- ESG_E, ESG_S, and ESG_G are found to have p-values that greatly exceed 0.05, implying that they are insignificant and irrelevant

There are 2 sectors with significant for ESG_S and ESG_G; they are the Communication Services and Consumer Discretionary sectors respectively.

The Communication Services sector has an ESG_S p-value of 0.0086 hence statistically significant. The coefficient is however negative (-0.2686) which could be due to over-reporting and incurring unnecessary agency costs by the sector (Lueg & Pesheva, 2021). The Consumer Discretionary sector has an ESG_G p-value of 0.0278 hence is statistically significant. The coefficient is positive (0.0879) which implies that having good governance does increase TSR for the sector.

Surprisingly, all ESG_E was found to be insignificant, even for the Energy sector. One possible reason could be that companies' environmental policy scrutiny only came to the fore in the last 3 years, before that investors do not place much emphasis on it in the US market (Landau et al., 2020).

Hence, hypothesis H3b is generally rejected as there is insufficient evidence to conclude that individual components Environmental, Social and Governance scores of a company have a relationship with its shareholder returns on a sector level.

8. Concluding Discussion

8.1. Hypothesis Summary

The summary of all the hypothesis testing can be found below:

Hypothesis 1
Market – There is **no** relationship between TSR and ESG scores

Hypothesis 2
Env – There is **no** relationship between TSR and Environmental scores
Soc – There is **no** relationship between TSR and Social scores
Gov – There is **no** relationship between TSR and Governance scores

Robustness Checks
Interaction – There is **no** two-way interaction relationship
Reverse Causality – There is **no** reverse causality relationship
Economic Stress – There is an economic stress relationship

Hypothesis 3
Model 1 – There is **no** relationship between TSR and ESG scores
Model 2 – There is **no** relationship between TSR and individual components Environmental, Social and Governance scores

Based on the overall results, it could be readily conclusive that ESG does not have any relationship to TSR. However, as mentioned in the introduction, the relationship between ESG characteristics and financial performance has been inconclusive as the result varies depending on the various methodologies applied and the different underlying ESG data that was used for the research (Giese et al., 2019).

The report will now investigate the reasons why did the results differ from the majority of 80% of the review studies (Clark et al., 2014).

8.2. Time Frame Selection

According to Marc Lansonneur, Head of Managed Solutions at DBS Private Bank, ESG's benefits are not short-term in nature but are meant to address structural changes that would impact overall portfolio returns (Lee, 2021). Hence, the sample data used in the regression could be too short to capture any statistically significant relationship.

8.3. Limitations on ESG Data

ESG data has been known to have very limited functionality due to the following reasons (Kotsantonis & Serafeim, 2019):

The inconsistency of the data and measures as to how companies report them. For example, there are more than 20 different ways companies report their employee health and safety data. These inconsistencies lead to significantly different results when looking at the same group of companies.

The lack of transparency among data providers about benchmarking/peer group components for ESG metrics creates market-wide inconsistencies and undermines their reliability. In addition, the differences in the imputation methods among data providers cause large “disagreements” among providers, with different gap-filling approaches leading to big discrepancies.

Another possible limitation is the selection bias in the ESG data. As ESG disclosure is not mandated by any forms of regulations in most developed nations, companies will selectively release ESG data only if they are to benefit from it. ESG data that may be detrimental to the company are hence retained and kept from public view. Thus, there could be a form of selection bias in the ESG dataset.

Lastly, the unique characteristics of ESG data structure pose unique challenges to returns analytics. ESG data does not react instantaneously to change in returns (lagged data) and are not updated frequently by data providers (stagnant data).

8.4. Recommendations

While acknowledging the data limitations, investors should not blindly buy into the hype by investing in ESG stocks. Many ESG funds in the market are very similar to the S&P 500 and have high weightage on big-cap stocks due to their strong governance.

Given the mixed results, retail investors should approach ESG with caution. The book “Technological Revolutions and Financial Capital” (Perez, 2002) examined 5 technological revolutions since 1771 and concluded that they follow a similar cycle, starting with hype and frenzy followed by a financial bubble.

Institutional investors should push for more meaningful ESG disclosure by narrowing the demand for ESG data into more standardized, but still manageable metrics.

Leading institutions should take the lead and participate actively in developing best practices for the industry to follow. For example, on 1 November 2021, the CFA Institute issued the “The Global ESG Disclosure Standards for Investment Products”, the first global voluntary standard for disclosing how an investment product considers ESG issues in its objectives, investment strategy, and stewardship activities.

Companies should "take control” by proactively shaping disclosure instead of being overwhelmed by survey requests. To that end, companies should “customize” their metrics to some extent, while at the same time seeking to self-regulate by reaching an agreement with industry peers on a “reasonable baseline” of standardized ESG metrics designed to achieve comparability.

Lastly, Stock exchanges should consider issuing, and perhaps even mandating, guidelines for ESG disclosures designed in collaboration with companies, investors, and regulators. Data providers should agree on best practices and become as transparent as possible about their methodologies and the reliability of their data.

8.5. Future Research

With the conclusion of the 2021 United Nations Climate Change Conference (COP26), it can be expected that more emphasis will be placed on the environmental scores of companies to prevent global warming. As these structural changes take place in the economy, it can be expected that more future research can be conducted on the environmental component specifically.

References

Clark, G. L., Feiner, A., & Viehs, M. (2014). From the Stockholder to the Stakeholder: How Sustainability Can Drive Financial Outperformance. SSRN Electronic Journal. Published. https://doi.org/10.2139/ssrn.2508281

Durbin, J., & Watson, G. S. (1971). Testing for serial correlation in least squares regression. III. Biometrika, 58(1), 1. https://doi.org/10.2307/2334313

Eccles, R. G., & Klimenko, S. (2019). Shareholders are getting serious about sustainability. Harvard Business Review, 106-116.

Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and Bonds. Journal of Financial Economics, 33(1), 3–56. https://doi.org/10.1016/0304-405x(93)90023-5

Firk, S., Schrapp, S., & Wolff, M. (2016). Drivers of value creation—The role of value-based management and underlying institutions. Management Accounting Research, 33, 42–60. https://doi.org/10.1016/j.mar.2016.04.002

Frias-Aceituno, J. V., Rodríguez-Ariza, L., & Garcia-Sánchez, I. M. (2012). Explanatory Factors of Integrated Sustainability and Financial Reporting. Business Strategy and the Environment, 23(1), 56–72. https://doi.org/10.1002/bse.1765

Friedman, M. (1970, September 13). A Friedman doctrine-- The Social Responsibility Of Business Is to Increase Its Profits. The New York Times. Retrieved November 4, 2021, from https://www.nytimes.com/1970/09/13/archives/a-friedman-doctrine-the-social-responsibility-of-business-is-to.html

Giese, G., Lee, L.-E., Melas, D., Nagy, Z., & Nishikawa, L. (2019). Foundations of ESG investing: How ESG affects equity valuation, risk, and performance. The Journal of Portfolio Management, 45(5), 69–83. https://doi.org/10.3905/jpm.2019.45.5.069

Hausman, J. A. (1978). Specification Tests in Econometrics. Econometrica, 46(6), 1251. https://doi.org/10.2307/1913827

Khan, M. (2019). Corporate Governance, ESG, and Stock Returns around the World. Financial Analysts Journal, 75(4), 103–123. https://doi.org/10.1080/0015198x.2019.1654299

Kotsantonis, S., & Serafeim, G. (2019). Four Things No One Will Tell You About ESG Data. Journal of Applied Corporate Finance, 31(2), 50–58. https://doi.org/10.1111/jacf.12346

Krueger, P. (2013). Corporate Goodness and Shareholder Wealth. SSRN Electronic Journal. Published. https://doi.org/10.2139/ssrn.2287089

Landau, A., Rochell, J., Klein, C., & Zwergel, B. (2020). Integrated reporting of environmental, social, and governance and financial data: Does the market value integrated reports? Business Strategy and the Environment, 29(4), 1750–1763. https://doi.org/10.1002/bse.2467

Lee, J. (2021, August 4). ESG as insurance, not for short-term alpha. The Business Times. Retrieved November 3, 2021, from https://www.businesstimes.com.sg/banking-finance/futureproof-an-esg-series/esg-as-insurance-not-for-short-term-alpha.

Lucas, R. E. (1990). Why Doesn't Capital Flow from Rich to Poor Countries? The American Economic Review, 80(2), 92–96. http://www.jstor.org/stable/2006549

Lueg, R., & Pesheva, R. (2021). Corporate sustainability in the Nordic countries – The curvilinear effects on shareholder returns. Journal of Cleaner Production, 315, 127962. https://doi.org/10.1016/j.jclepro.2021.127962

Nollet, J., Filis, G., & Mitrokostas, E. (2016). Corporate social responsibility and financial performance: A non-linear and disaggregated approach. Economic Modelling, 52, 400–407. https://doi.org/10.1016/j.econmod.2015.09.019

Perez, C. (2002). Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages (illustrated edition). Edward Elgar Pub. https://doi.org/10.4337/9781781005323

Siddiqui, A., & Chauhan, S. (2021, September 17). Which sectors are more sensitive to ESG? Kalkine Media. Retrieved November 2, 2021, from https://kalkinemedia.com/news/climate-change/which-sectors-are-more-sensitive-to-esg

Strand, R., Freeman, R. E., & Hockerts, K. (2014). Corporate Social Responsibility and Sustainability in Scandinavia: An Overview. Journal of Business Ethics, 127(1), 1–15. https://doi.org/10.1007/s10551-014-2224-6

Wintoki, M. B., Linck, J. S., & Netter, J. M. (2012). Endogeneity and the dynamics of internal corporate governance. Journal of Financial Economics, 105(3), 581–606. https://doi.org/10.1016/j.jfineco.2012.03.005

Wooldridge, J. M. (2019). Introductory Econometrics: A Modern Approach (MindTap Course List) (7th ed.). Cengage Learning.

Appendix

1. S&P 500 Market Index

Dependent Variable: TSR
Method: Panel Least Squares
Market
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 484
Total panel (balanced) observations: 12584

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.399326	0.957890	2.504803	0.0123
BETA	3.142853	0.462743	6.791785	0.0000
M_CAP	1.25E-11	2.52E-12	4.980843	0.0000
MTB	0.000901	0.000886	1.017046	0.3092
SALES	-2.74E-10	5.57E-11	-4.919302	0.0000
ESG	-0.005674	0.014085	-0.402802	0.6871
TSR(-1)	-0.056959	0.009049	-6.294516	0.0000

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.353406	Mean dependent var	4.329529
Adjusted R-squared	0.325869	S.D. dependent var	15.71905
S.E. of regression	12.90620	Akaike info criterion	7.993357
Sum squared resid	2010334.	Schwarz criterion	8.297846
Log likelihood	-49779.20	Hannan-Quinn criter.	8.095258
F-statistic	12.83366	Durbin-Watson stat	2.047161
Prob(F-statistic)	0.000000		

Fig A.1.1 Market (Holistic) Regression Results

Dependent Variable: TSR
Method: Panel Least Squares
Market
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 484
Total panel (balanced) observations: 12584

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.591742	1.213918	2.135022	0.0328
BETA	3.131778	0.462951	6.764811	0.0000
M_CAP	1.29E-11	2.52E-12	5.129248	0.0000
MTB	0.000861	0.000886	0.971579	0.3313
SALES	-2.71E-10	5.57E-11	-4.868363	0.0000
ESG_E	-0.004877	0.014068	-0.346652	0.7289
ESG_S	-0.025023	0.016844	-1.485556	0.1374
ESG_G	0.020787	0.011326	1.835302	0.0665
TSR(-1)	-0.057366	0.009050	-6.338867	0.0000

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.353685	Mean dependent var	4.329529
Adjusted R-squared	0.326047	S.D. dependent var	15.71905
S.E. of regression	12.90449	Akaike info criterion	7.993244
Sum squared resid	2009468.	Schwarz criterion	8.298916
Log likelihood	-49776.49	Hannan-Quinn criter.	8.095541
F-statistic	12.79739	Durbin-Watson stat	2.046920
Prob(F-statistic)	0.000000		

Fig A.1.2 Market (Individual) Regression Results

2. S&P 500 Communication Services Index

Dependent Variable: TSR
Method: Panel Least Squares
Communication Services
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 24
Total panel (balanced) observations: 624

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.92460	4.150318	2.632231	0.0087
BETA	-1.708423	2.339760	-0.730170	0.4656
M_CAP	2.49E-11	1.16E-11	2.143844	0.0325
MTB	-0.010169	0.014237	-0.714272	0.4754
SALES	-5.60E-10	2.96E-10	-1.888334	0.0595
ESG	-0.060507	0.074611	-0.810970	0.4177
TSR(-1)	-0.034376	0.041450	-0.829333	0.4073

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.374183	Mean dependent var	4.343774
Adjusted R-squared	0.314791	S.D. dependent var	15.79701
S.E. of regression	13.07635	Akaike info criterion	8.063500
Sum squared resid	97293.86	Schwarz criterion	8.454507
Log likelihood	-2460.812	Hannan-Quinn criter.	8.215443
F-statistic	6.300206	Durbin-Watson stat	1.980693
Prob(F-statistic)	0.000000		

Fig A.2.1 Communication (Holistic) Regression Results

Dependent Variable: TSR
Method: Panel Least Squares
Communication Services
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 24
Total panel (balanced) observations: 624

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	18.97530	6.884084	2.756402	0.0060
BETA	-2.163992	2.339551	-0.924960	0.3554
M_CAP	2.25E-11	1.17E-11	1.934463	0.0536
MTB	-0.010830	0.014182	-0.763663	0.4454
SALES	-2.74E-10	3.15E-10	-0.867660	0.3859
ESG_E	-0.006717	0.063421	-0.105910	0.9157
ESG_S	-0.268629	0.101872	-2.636935	0.0086
ESG_G	0.020046	0.053733	0.373066	0.7092
TSR(-1)	-0.040830	0.041421	-0.985725	0.3247

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.381846	Mean dependent var	4.343774
Adjusted R-squared	0.320794	S.D. dependent var	15.79701
S.E. of regression	13.01894	Akaike info criterion	8.057589
Sum squared resid	96102.45	Schwarz criterion	8.462814
Log likelihood	-2456.968	Hannan-Quinn criter.	8.215057
F-statistic	6.254418	Durbin-Watson stat	1.985248
Prob(F-statistic)	0.000000		

Fig A.2.2 Communication (Individual) Regression Results

3. S&P 500 Consumer Discretionary Index

Dependent Variable: TSR
Method: Panel Least Squares
Consumer Discretionary
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 61
Total panel (balanced) observations: 1586

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.551949	3.297645	1.380364	0.1677
BETA	1.068212	1.411373	0.756860	0.4493
M_CAP	1.47E-11	1.14E-11	1.292784	0.1963
MTB	0.000826	0.002558	0.322921	0.7468
SALES	-3.62E-10	1.98E-10	-1.826641	0.0680
ESG	0.011379	0.053135	0.214157	0.8305
TSR(-1)	-0.009281	0.026044	-0.356365	0.7216

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.427799	Mean dependent var	4.845686
Adjusted R-squared	0.392946	S.D. dependent var	19.93043
S.E. of regression	15.52853	Akaike info criterion	8.379492
Sum squared resid	360255.9	Schwarz criterion	8.690933
Log likelihood	-6552.937	Hannan-Quinn criter.	8.495191
F-statistic	12.27442	Durbin-Watson stat	2.054449
Prob(F-statistic)	0.000000		

Fig A.3.1 C.Discretionary (Holistic) Regression Results

Dependent Variable: TSR
Method: Panel Least Squares
Consumer Discretionary
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 61
Total panel (balanced) observations: 1586

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.375926	4.345470	0.316635	0.7516
BETA	1.031052	1.411129	0.730657	0.4651
M_CAP	1.33E-11	1.15E-11	1.157438	0.2473
MTB	0.000658	0.002554	0.257695	0.7967
SALES	-3.52E-10	2.00E-10	-1.763547	0.0780
ESG_E	0.059486	0.061792	0.962673	0.3359
ESG_S	-0.069443	0.069675	-0.996662	0.3191
ESG_G	0.087926	0.039935	2.201728	0.0278
TSR(-1)	-0.013019	0.026058	-0.499614	0.6174

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.430265	Mean dependent var	4.845686
Adjusted R-squared	0.394752	S.D. dependent var	19.93043
S.E. of regression	15.50541	Akaike info criterion	8.377695
Sum squared resid	358703.4	Schwarz criterion	8.695906
Log likelihood	-6549.512	Hannan-Quinn criter.	8.495909
F-statistic	12.11572	Durbin-Watson stat	2.053717
Prob(F-statistic)	0.000000		

Fig A.3.2 C.Discretionary (Individual) Regression Results

4. S&P 500 Consumer Staples Index

Dependent Variable: TSR
Method: Panel Least Squares
Consumer Staples
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 31
Total panel (balanced) observations: 806

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.199386	2.763802	0.795783	0.4264
BETA	0.061172	1.614164	0.037897	0.9698
M_CAP	7.61E-11	1.95E-11	3.907509	0.0001
MTB	-0.001806	0.003323	-0.543362	0.5870
SALES	-2.83E-10	1.28E-10	-2.204575	0.0278
ESG	-0.015164	0.033130	-0.457706	0.6473
TSR(-1)	-0.029271	0.036794	-0.795521	0.4266

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.324329	Mean dependent var	2.708758
Adjusted R-squared	0.268931	S.D. dependent var	10.14579
S.E. of regression	8.674907	Akaike info criterion	7.232550
Sum squared resid	55988.99	Schwarz criterion	7.593479
Log likelihood	-2852.718	Hannan-Quinn criter.	7.371154
F-statistic	5.854551	Durbin-Watson stat	1.996543
Prob(F-statistic)	0.000000		

Fig A.4.1 C.Staples (Holistic) Regression Results

Dependent Variable: TSR
Method: Panel Least Squares
Consumer Staples Staples
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 31
Total panel (balanced) observations: 806

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.231718	4.997661	-0.046365	0.9630
BETA	0.036311	1.619860	0.022416	0.9821
M_CAP	7.83E-11	1.98E-11	3.959445	0.0001
MTB	-0.001770	0.003321	-0.532893	0.5943
SALES	-2.76E-10	1.29E-10	-2.140788	0.0326
ESG_E	0.056320	0.045532	1.236930	0.2165
ESG_S	-0.009397	0.056489	-0.166347	0.8679
ESG_G	-0.027320	0.036458	-0.749353	0.4539
TSR(-1)	-0.031653	0.036840	-0.859187	0.3905

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.326021	Mean dependent var	2.708758
Adjusted R-squared	0.268796	S.D. dependent var	10.14579
S.E. of regression	8.675708	Akaike info criterion	7.235005
Sum squared resid	55848.79	Schwarz criterion	7.607578
Log likelihood	-2851.707	Hannan-Quinn criter.	7.378080
F-statistic	5.697214	Durbin-Watson stat	1.998261
Prob(F-statistic)	0.000000		

Fig A.4.2 C.Staples (Individual) Regression Results

5. S&P 500 Energy Index

Dependent Variable: TSR
Method: Panel Least Squares
Energy
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 21
Total panel (balanced) observations: 546

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-9.273360	6.008727	-1.543315	0.1234
BETA	5.518936	2.258460	2.443673	0.0149
M_CAP	4.89E-11	4.10E-11	1.191047	0.2342
MTB	0.160850	0.168919	0.952231	0.3414
SALES	4.51E-10	2.23E-10	2.022436	0.0437
ESG	-0.051993	0.073973	-0.702866	0.4825
TSR(-1)	-0.179700	0.045817	-3.922154	0.0001

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.699128	Mean dependent var	3.215058
Adjusted R-squared	0.668066	S.D. dependent var	26.07348
S.E. of regression	15.02189	Akaike info criterion	8.347287
Sum squared resid	111474.7	Schwarz criterion	8.757060
Log likelihood	-2226.809	Hannan-Quinn criter.	8.507471
F-statistic	22.50775	Durbin-Watson stat	2.068951
Prob(F-statistic)	0.000000		

Fig A.5.1 Energy (Holistic) Regression Results

Dependent Variable: TSR
Method: Panel Least Squares
Energy
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 21
Total panel (balanced) observations: 546

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-13.99791	7.169606	-1.952395	0.0515
BETA	5.357342	2.346461	2.283159	0.0228
M_CAP	4.49E-11	4.17E-11	1.076703	0.2821
MTB	0.163931	0.169980	0.964413	0.3353
SALES	4.65E-10	2.25E-10	2.065613	0.0394
ESG_E	0.002435	0.096584	0.025215	0.9799
ESG_S	0.013253	0.100294	0.132143	0.8949
ESG_G	0.019984	0.055991	0.356919	0.7213
TSR(-1)	-0.178606	0.045963	-3.885871	0.0001

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.698945	Mean dependent var	3.215058
Adjusted R-squared	0.666514	S.D. dependent var	26.07348
S.E. of regression	15.05697	Akaike info criterion	8.355221
Sum squared resid	111542.5	Schwarz criterion	8.780755
Log likelihood	-2226.975	Hannan-Quinn criter.	8.521566
F-statistic	21.55194	Durbin-Watson stat	2.070178
Prob(F-statistic)	0.000000		

Fig A.5.2 Energy (Individual) Regression Results

6. S&P 500 Financials Index

Dependent Variable: TSR
Method: Panel Least Squares
Financials
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 64
Total panel (balanced) observations: 1664

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.609905	2.602296	1.771476	0.0767
BETA	-0.607937	1.266251	-0.480108	0.6312
M_CAP	5.70E-11	1.33E-11	4.274277	0.0000
MTB	0.000716	0.001332	0.537868	0.5907
SALES	-2.47E-10	2.71E-10	-0.912373	0.3617
ESG	-0.030594	0.035227	-0.868500	0.3853
TSR(-1)	-0.075227	0.025456	-2.955138	0.0032

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.597446	Mean dependent var	3.892715
Adjusted R-squared	0.573329	S.D. dependent var	14.31506
S.E. of regression	9.350605	Akaike info criterion	7.364156
Sum squared resid	137183.7	Schwarz criterion	7.673419
Log likelihood	-6031.978	Hannan-Quinn criter.	7.478769
F-statistic	24.77251	Durbin-Watson stat	1.999534
Prob(F-statistic)	0.000000		

Fig A.6.1 Financials (Holistic) Regression Results

Dependent Variable: TSR
Method: Panel Least Squares
Financials
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 64
Total panel (balanced) observations: 1664

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.326991	3.077061	2.056180	0.0399
BETA	-0.611591	1.270078	-0.481538	0.6302
M_CAP	5.81E-11	1.34E-11	4.339895	0.0000
MTB	0.000803	0.001334	0.601868	0.5473
SALES	-2.40E-10	2.71E-10	-0.883750	0.3770
ESG_E	-0.031585	0.025484	-1.239410	0.2154
ESG_S	0.005506	0.039817	0.138290	0.8900
ESG_G	-0.037778	0.024966	-1.513214	0.1304
TSR(-1)	-0.077403	0.025468	-3.039244	0.0024

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.598407	Mean dependent var	3.892715
Adjusted R-squared	0.573804	S.D. dependent var	14.31506
S.E. of regression	9.345398	Akaike info criterion	7.364170
Sum squared resid	136856.2	Schwarz criterion	7.679944
Log likelihood	-6029.990	Hannan-Quinn criter.	7.481196
F-statistic	24.32251	Durbin-Watson stat	1.994692
Prob(F-statistic)	0.000000		

Fig A.6.2 Financials (Individual) Regression Results

7. S&P 500 Health Care Index

Dependent Variable: TSR
Method: Panel Least Squares
Health Care
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 62
Total panel (balanced) observations: 1612

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.494009	2.355069	-0.634380	0.5259
BETA	2.015976	1.290498	1.562169	0.1185
M_CAP	7.29E-11	1.74E-11	4.188783	0.0000
MTB	0.001833	0.001113	1.646926	0.0998
SALES	-1.06E-10	1.03E-10	-1.026340	0.3049
ESG	0.026748	0.030416	0.879413	0.3793
TSR(-1)	-0.068660	0.025656	-2.676209	0.0075

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.386648	Mean dependent var	4.602065
Adjusted R-squared	0.349500	S.D. dependent var	13.98524
S.E. of regression	11.27960	Akaike info criterion	7.739830
Sum squared resid	193261.5	Schwarz criterion	8.050516
Log likelihood	-6145.303	Hannan-Quinn criter.	7.855155
F-statistic	10.40820	Durbin-Watson stat	1.990692
Prob(F-statistic)	0.000000		

Fig A.7.1 Health Care (Holistic) Regression Results

Dependent Variable: TSR
Method: Panel Least Squares
Health Care
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 62
Total panel (balanced) observations: 1612

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.461785	3.061290	-0.804166	0.4214
BETA	2.028869	1.292641	1.569553	0.1167
M_CAP	7.40E-11	1.75E-11	4.225197	0.0000
MTB	0.001843	0.001115	1.652969	0.0985
SALES	-1.08E-10	1.03E-10	-1.051274	0.2933
ESG_E	-0.009785	0.034537	-0.283321	0.7770
ESG_S	0.041500	0.036731	1.129838	0.2587
ESG_G	0.001814	0.028157	0.064440	0.9486
TSR(-1)	-0.068836	0.025682	-2.680332	0.0074

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.386887	Mean dependent var	4.602065
Adjusted R-squared	0.348896	S.D. dependent var	13.98524
S.E. of regression	11.28483	Akaike info criterion	7.741921
Sum squared resid	193186.0	Schwarz criterion	8.059289
Log likelihood	-6144.988	Hannan-Quinn criter.	7.859726
F-statistic	10.18362	Durbin-Watson stat	1.990183
Prob(F-statistic)	0.000000		

Fig A.7.2 Health Care(Individual) Regression Results

8. S&P 500 Industrials Index

Dependent Variable: TSR
Method: Panel Least Squares
Industrials
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 69
Total panel (balanced) observations: 1794

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.837471	2.359989	2.897247	0.0038
BETA	-0.085078	1.177612	-0.072246	0.9424
M_CAP	9.40E-11	1.93E-11	4.863647	0.0000
MTB	0.000270	0.003845	0.070255	0.9440
SALES	-8.36E-10	2.20E-10	-3.796570	0.0002
ESG	-0.024575	0.031013	-0.792404	0.4282
TSR(-1)	-0.089786	0.023926	-3.752618	0.0002

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.486860	Mean dependent var	4.264133
Adjusted R-squared	0.456871	S.D. dependent var	14.36255
S.E. of regression	10.58481	Akaike info criterion	7.610845
Sum squared resid	189792.7	Schwarz criterion	7.916987
Log likelihood	-6726.928	Hannan-Quinn criter.	7.723873
F-statistic	16.23477	Durbin-Watson stat	2.020548
Prob(F-statistic)	0.000000		

Fig A.8.1 Industrials (Holistic) Regression Results

Dependent Variable: TSR
Method: Panel Least Squares
Industrials
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 69
Total panel (balanced) observations: 1794

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.597523	2.885095	2.633370	0.0085
BETA	-0.256466	1.178022	-0.217709	0.8277
M_CAP	9.44E-11	1.93E-11	4.884594	0.0000
MTB	0.000138	0.003840	0.035981	0.9713
SALES	-7.99E-10	2.21E-10	-3.625017	0.0003
ESG_E	-0.025766	0.031737	-0.811882	0.4170
ESG_S	-0.059400	0.035823	-1.658146	0.0975
ESG_G	0.047052	0.024430	1.925962	0.0543
TSR(-1)	-0.092856	0.023930	-3.880399	0.0001

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.488862	Mean dependent var	4.264133
Adjusted R-squared	0.458351	S.D. dependent var	14.36255
S.E. of regression	10.57038	Akaike info criterion	7.609165
Sum squared resid	189052.2	Schwarz criterion	7.921431
Log likelihood	-6723.421	Hannan-Quinn criter.	7.724454
F-statistic	16.02238	Durbin-Watson stat	2.021006
Prob(F-statistic)	0.000000		

Fig A.8.2 Industrials (Individual) Regression Results

9. S&P 500 Information Technology (IT) Index

Dependent Variable: TSR
Method: Panel Least Squares
Information Technology
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 72
Total panel (balanced) observations: 1872

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.231120	2.829547	2.202162	0.0278
BETA	1.123620	1.389007	0.808938	0.4187
M_CAP	4.85E-12	3.50E-12	1.385956	0.1659
MTB	-0.004558	0.006285	-0.725144	0.4685
SALES	-2.70E-10	1.62E-10	-1.669791	0.0951
ESG	-0.012353	0.039171	-0.315354	0.7525
TSR(-1)	0.037733	0.023709	1.591507	0.1117

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.373792	Mean dependent var	6.459702
Adjusted R-squared	0.337685	S.D. dependent var	16.66748
S.E. of regression	13.56445	Akaike info criterion	8.106231
Sum squared resid	325485.8	Schwarz criterion	8.410762
Log likelihood	-7484.433	Hannan-Quinn criter.	8.218423
F-statistic	10.35236	Durbin-Watson stat	2.044919
Prob(F-statistic)	0.000000		

Fig A.9.1 IT (Holistic) Regression Results

Dependent Variable: TSR
Method: Panel Least Squares
Information Technology
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 72
Total panel (balanced) observations: 1872

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.615944	3.548408	2.146299	0.0320
BETA	1.122694	1.389961	0.807716	0.4194
M_CAP	5.10E-12	3.47E-12	1.467631	0.1424
MTB	-0.004554	0.006287	-0.724339	0.4690
SALES	-2.70E-10	1.62E-10	-1.665320	0.0960
ESG_E	0.001748	0.045348	0.038535	0.9693
ESG_S	-0.032495	0.050071	-0.648975	0.5164
ESG_G	-0.003213	0.030981	-0.103700	0.9174
TSR(-1)	0.037781	0.023710	1.593498	0.1112

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.373954	Mean dependent var	6.459702
Adjusted R-squared	0.337107	S.D. dependent var	16.66748
S.E. of regression	13.57037	Akaike info criterion	8.108109
Sum squared resid	325401.6	Schwarz criterion	8.418553
Log likelihood	-7484.190	Hannan-Quinn criter.	8.222479
F-statistic	10.14882	Durbin-Watson stat	2.044839
Prob(F-statistic)	0.000000		

Fig A.9.2 IT (Individual) Regression Results

10. S&P 500 Materials Index

Dependent Variable: TSR
Method: Panel Least Squares
Materials
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 23
Total panel (balanced) observations: 598

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.481362	6.023006	0.411981	0.6805
BETA	2.195266	2.547814	0.861627	0.3893
M_CAP	2.34E-10	9.01E-11	2.597671	0.0096
MTB	0.011497	0.037602	0.305746	0.7599
SALES	-2.87E-09	1.05E-09	-2.728618	0.0066
ESG	0.022271	0.071082	0.313311	0.7542
TSR(-1)	-0.001003	0.042155	-0.023796	0.9810

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.463383	Mean dependent var	4.201073
Adjusted R-squared	0.411102	S.D. dependent var	15.57904
S.E. of regression	11.95531	Akaike info criterion	7.886189
Sum squared resid	77753.63	Schwarz criterion	8.282935
Log likelihood	-2303.970	Hannan-Quinn criter.	8.040657
F-statistic	8.863354	Durbin-Watson stat	1.972035
Prob(F-statistic)	0.000000		

Fig A.10.1 Materials (Holistic) Regression Results

Dependent Variable: TSR
Method: Panel Least Squares
Materials
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 23
Total panel (balanced) observations: 598

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.959092	7.403602	1.210099	0.2268
BETA	1.534379	2.564551	0.598303	0.5499
M_CAP	2.46E-10	9.28E-11	2.651718	0.0082
MTB	0.008204	0.037937	0.216238	0.8289
SALES	-3.01E-09	1.07E-09	-2.823168	0.0049
ESG_E	-0.087480	0.083699	-1.045173	0.2964
ESG_S	-0.018334	0.079286	-0.231240	0.8172
ESG_G	0.035886	0.051187	0.701078	0.4836
TSR(-1)	-0.001399	0.042109	-0.033221	0.9735

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.465094	Mean dependent var	4.201073
Adjusted R-squared	0.410814	S.D. dependent var	15.57904
S.E. of regression	11.95824	Akaike info criterion	7.889684
Sum squared resid	77505.68	Schwarz criterion	8.301124
Log likelihood	-2303.015	Hannan-Quinn criter.	8.049873
F-statistic	8.568400	Durbin-Watson stat	1.972540
Prob(F-statistic)	0.000000		

Fig A.10.2 Materials (Individual) Regression Results

11. S&P 500 Real Estate Index

Dependent Variable: TSR
Method: Panel Least Squares
Real Estate
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 29
Total panel (balanced) observations: 754

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.277347	2.801282	0.455987	0.6485
BETA	2.353506	1.455875	1.616557	0.1064
M_CAP	-1.13E-11	4.62E-11	-0.244899	0.8066
MTB	0.384647	0.199664	1.926475	0.0545
SALES	-2.34E-10	1.04E-09	-0.223638	0.8231
ESG	-0.014487	0.036662	-0.395154	0.6929
TSR(-1)	-0.036574	0.038493	-0.950132	0.3424

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.501774	Mean dependent var	2.928898
Adjusted R-squared	0.459417	S.D. dependent var	11.73916
S.E. of regression	8.631140	Akaike info criterion	7.224861
Sum squared resid	51700.63	Schwarz criterion	7.592929
Log likelihood	-2663.773	Hannan-Quinn criter.	7.366650
F-statistic	11.84646	Durbin-Watson stat	2.047695
Prob(F-statistic)	0.000000		

Fig A.11.1 Real Estate (Holistic) Regression Results

Dependent Variable: TSR
Method: Panel Least Squares
Real Estate
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 29
Total panel (balanced) observations: 754

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.623134	3.128209	0.518870	0.6040
BETA	2.287107	1.459197	1.567374	0.1175
M_CAP	-7.98E-12	4.64E-11	-0.172038	0.8635
MTB	0.369054	0.202347	1.823864	0.0686
SALES	-1.30E-10	1.05E-09	-0.123479	0.9018
ESG_E	-0.014720	0.032609	-0.451418	0.6518
ESG_S	0.020977	0.039109	0.536372	0.5919
ESG_G	-0.029600	0.027998	-1.057216	0.2908
TSR(-1)	-0.036091	0.038530	-0.936694	0.3492

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.502575	Mean dependent var	2.928898
Adjusted R-squared	0.458727	S.D. dependent var	11.73916
S.E. of regression	8.636646	Akaike info criterion	7.228556
Sum squared resid	51617.43	Schwarz criterion	7.608893
Log likelihood	-2663.165	Hannan-Quinn criter.	7.375071
F-statistic	11.46173	Durbin-Watson stat	2.048777
Prob(F-statistic)	0.000000		

Fig A.11.2 Real Estate (Individual) Regression Results

12. S&P 500 Utilities Index

Dependent Variable: TSR
Method: Panel Least Squares
Utilities
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 28
Total panel (balanced) observations: 728

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.571107	3.072401	-1.162318	0.2455
BETA	7.141299	2.058628	3.468960	0.0006
M_CAP	1.22E-10	3.92E-11	3.103473	0.0020
MTB	0.136913	0.079101	1.730865	0.0839
SALES	-4.69E-10	5.72E-10	-0.819911	0.4126
ESG	0.023908	0.036619	0.652883	0.5141
TSR(-1)	-0.091278	0.038320	-2.382009	0.0175

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.525145	Mean dependent var	2.457818
Adjusted R-squared	0.483976	S.D. dependent var	9.107738
S.E. of regression	6.542523	Akaike info criterion	6.672094
Sum squared resid	28636.29	Schwarz criterion	7.044110
Log likelihood	-2369.642	Hannan-Quinn criter.	6.815639
F-statistic	12.75604	Durbin-Watson stat	2.024595
Prob(F-statistic)	0.000000		

Fig A.12.1 Utilities (Holistic) Regression Results

Dependent Variable: TSR
Method: Panel Least Squares
Utilities
Sample (adjusted): 2015Q1 2021Q2
Periods included: 26
Cross-sections included: 28
Total panel (balanced) observations: 728

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.753081	3.391375	-0.811789	0.4172
BETA	6.575482	2.072346	3.172965	0.0016
M_CAP	1.30E-10	3.98E-11	3.273301	0.0011
MTB	0.131523	0.079083	1.663090	0.0968
SALES	-5.14E-10	5.79E-10	-0.888447	0.3746
ESG_E	-0.049388	0.034772	-1.420335	0.1560
ESG_S	0.018241	0.035901	0.508091	0.6116
ESG_G	0.039124	0.025319	1.545223	0.1228
TSR(-1)	-0.093802	0.038300	-2.449142	0.0146

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.527424	Mean dependent var	2.457818
Adjusted R-squared	0.484913	S.D. dependent var	9.107738
S.E. of regression	6.536581	Akaike info criterion	6.672777
Sum squared resid	28498.84	Schwarz criterion	7.057404
Log likelihood	-2367.891	Hannan-Quinn criter.	6.821188
F-statistic	12.40688	Durbin-Watson stat	2.019677
Prob(F-statistic)	0.000000		

Fig A.12.2 Utilities (Individual) Regression Results