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Circular Economy, Stock Volatility, and Resilience to the COVID-19 Shock: Evidence from European Companies

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Agenda

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Background and object

Background

Circular Economy (CE) is a powerful opportunity for economic agents to hedge against *"linear" risk factors:*

- it decouples economic growth from an intensive use of resources;
- it prevents the impairment of natural capital;
- it enhances resilience to system-wide shocks.

For businesses, the benefits of transitioning toward a CE business model are the following:

- it helps shielding against the risk of assets becoming stranded;
- it can generate fresh and non-speculative demand for investments;
- it can improve companies' results at both individual and portfolio level.

Object of the research

- The degree of a company's transition toward a circular business model, proxied by the **Circularity Score (CS)**;
- Stock market effects of the COVID-19 crisis in terms of **risk, either total** (σ) **or systematic** (β).

RQ, hypotheses, contribution

❖ **Research question** **From an investor's perspective, are more *circular* companies less risky?**

❖ **Hypothesis 1** **The stocks of companies with a better (worse) circular performance exhibit lower (higher) risk, either total or systematic**

❖ **Hypothesis 2** **The negative association between circular performance and risk is robust to heavy exogenous shocks.**

- The extant literature basically agrees in suggesting that **CE is a driver of enhanced long-term stability and resilience**. Our paper contributes to the debate in a twofold manner:
- we apply a thorough quantitative approach — based on current methodologies underpinning *ESG performance indicators* — to measure the *degree of circularity* of a company's operations;
- we use the financial turmoil upon the *COVID-19 outbreak* as a "natural experiment", contributing to the literature on the relationship between sustainability and the extent whereto the shock was resented.

Literature review

- By making their business models more circular, companies may get a competitive advantage **(1)** and higher profitability **(2)**.
- During the COVID-19 crisis, adopting CE practices enabled organizations to flexibly address urgent shortages at local level **(3)**. Also, this proved to be an effective channel for achieving sustainable global economic growth in the post-COVID recovery **(4)**.
- More in general, the adoption of sustainable business practices is beneficial to financial performance **(5)**.
- These benefits include higher stock returns **(6)** and lower risk, either systematic **(7)** or downside **(8)**.

Ref.	Author(s)	Year
1	Giuntini & Gaudette	2003
	Heese *et al.*	2005
	Stahel	2008
	Webster	2013

Ref.	Author(s)	Year
2	Ellen MacArthur Foundation	2013
3	Wuyts *et al.*	2020
4	Ellen MacArthur Foundation	2020
	Ibin-Mohammed *et al.*	2020
	Material Economics	2020
	Sarkis *et al.*	2020
5	Friede et al.	2015
	Huang	2019
6	Friede et al.	2015
	Huang	2019
7	Giese *et al.*	2019
8	Hoepner *et al.*	2019

Literature review

- During 2020Q1, the association between firms' environmental commitment and their stock market performance was either positive **(1)** or negative **(2)**.
- During market turmoil, as for the Social pillar, the association with market results was generally positive **(3)**.
- However, considering the whole of the ESG framework, evidence on how sustainability related to the COVID-19 shock has hitherto been quite inconclusive, with (at most) partial results on one or two pillars.
- Even considering a broader timespan may fail to give clear answers: for instance, in a multi-factor model, an ESG-based factor is significantly associated with excess returns, but the sign varies across industries **(4)**.

Ref.	Author(s)	Year
1	Ding et al.	2020
	Garel and Petit Romec	2020
2	Bongiovanni and Fiandrino	2020
3	Albuquerque et al.	2020
	Ding et al.	2020
4	Diaz et al.	2020

Sample construction

Our sample is made of 644 companies, selected out of 2,028 initially drawn from the Orbis database. We applied the following criteria:

- listed in EU-15 markets, plus Switzerland;
- operating in these sectors, pursuant to the **Standard Industry Classification (SIC)** system:
  - Manufacturing;
  - Construction;
  - Metal Mining;
  - Oil & Gas Extraction;
  - Utilities.
- having accounts available over the 2016-19 time horizon, albeit we would compute the CS for years 2018 and 2019 only.

THE CIRCULARITY SCORE

Originally proposed by **Zara et al. (2020)**, it expresses the **corporate circular performance** through a number ranging from 0 to 1.

It is a **relative measure** that evaluates the performance of a firm compared to the other firms in the same industry, mitigating the biases that should arise due to industry-specific characteristics.

The baseline is provided by **ASSET 4 (TR-A4)** ESG data and methodology. Some amendments, including CE-specific adjustments, are made.

The Circularity Score: construction

1) **Selection of Indicators** — Identify the Indicators that best reflect the CE features.
2) **Classification of Indicators** — Classify the Indicators in a way that best highlights the CE features.
3) **Classification of Industries** — Develop a classification system for industries that groups companies based on of their exposure to sustainability issues.
4) **Calculation of the Score** — Compute the CS for each company in the sample.
5) **Adjustment for Materiality** — Adjust the CS pursuant to financial materiality criteria.

- **Steps (1), (2), (3)** focus on the definition of the *circularity framework*.
- CS computation is performed in **Steps (4)-(5)**, relying on ESG data retrieved from TR-A4.
- **Step (1)** consists in selecting the TR-A4 measures that best capture the defining aspects of the CE.
  For instance, relevant indicators are those related to the procurement of renewable resources,
  the implementation of product take-back initiatives, the commitment to developing sustainable supply chains.

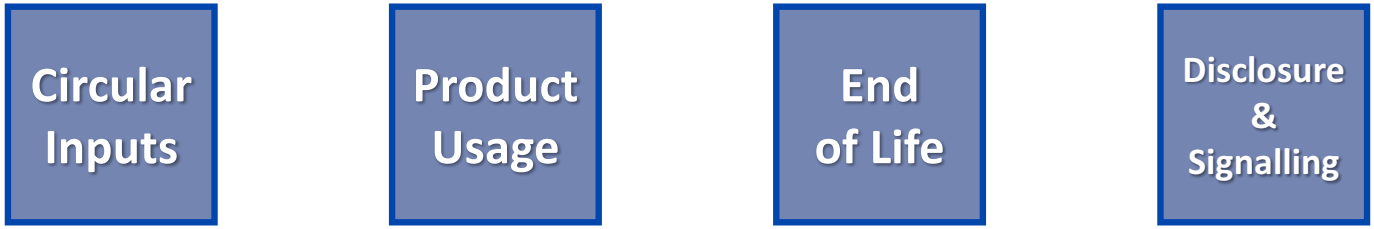
The Circularity Score: construction

- Two relevant aspects of the CE do not receive adequate representation in the TR-A4 ESG database: namely, the longer lifecycle of products and/or assets compared to industry standards (i.e., Time Load) and the intensity of usage of products and/or assets (i.e., Utilization Load).

  This highlights the differences between the ESG framework and the circular one.

- The assessment process results in the selection of **164 Indicators** which pertain to **7 ESG Categories**:
  - Emissions;
  - Resource Use;
  - Innovation;
  - Product Responsibility;
  - Community;
  - Workforce;
  - CSR Strategy.

We constructed a new classification system for Indicators that detaches from the TR-A4's traditional ESG scheme and better represents the CE's distinctive aspects. The 164 Indicators were rearranged into 7 Categories *(left)* and **4 Pillars** *(below)*:



The Circularity Score: construction

The most relevant innovation concerns the replacement of the traditional *Environmental*, *Social* and *Governance* pillars with three new ones that reflect the fundamental phases of circular business models: the procurement of biological materials and renewable resources (Circular Inputs), the sustainable usage of products and/or assets in compliance with circular business practices (Product Usage), and the management of the products and/or assets at the end of their lifecycle (End of Life).

Classification of Industries

- To perform this stage, we adopted the **Sustainable Industry Classification System (SICS)**, developed by the Sustainability Accounting Standards Board (SASB).
- SICS is not guided by financial parameters — e.g., the field where one company makes the most revenue — but focuses on the sustainability-related risks and opportunities that business organisations face when conducting operations.
- We reconciled the SIC system — i.e., the industry classification system adopted to select the investable universe companies from Orbis — with SASB's SICS.

The Circularity Score: construction

Calculation of the Score

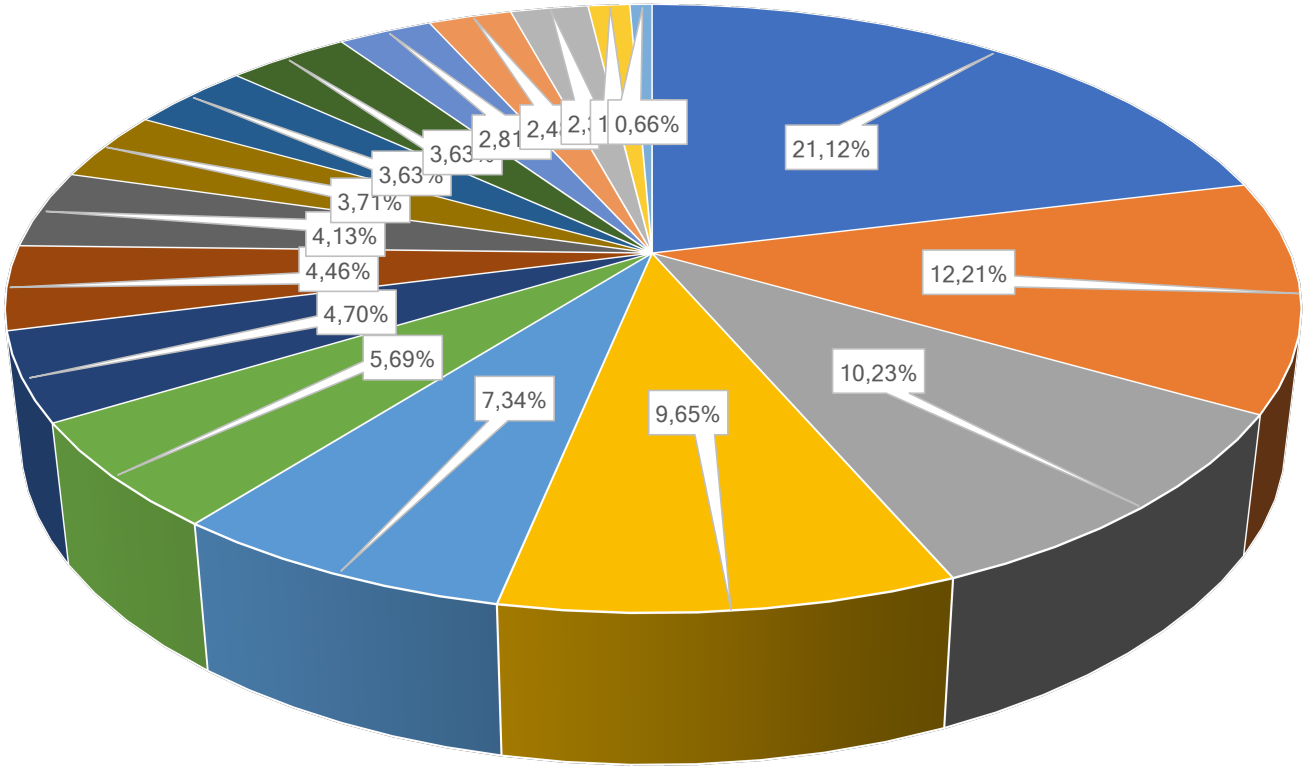
- **Our formula attaches a positive meaning to information disclosure *per se*: *ceteris paribus*, companies that disclose more (less) information are given higher (lower) scores.**
- The score of each Category (Pillar) — namely, the Category Score (Pillar Score) — is defined as the weighted average of the Indicator Scores (Category Scores) pertaining to that Category (Pillar).
- The CS is ultimately yielded by the weighted average of Pillar Scores.
- The weights attached to Category Scores (Pillar Scores) reflects the number of Indicators pertaining to each Category (Pillar), deflated by the number of Indicators in the corresponding Pillar (by the overall number of Indicators).
- The "plain" CS, thereby obtained, gets then adjusted for financial materiality. **An issue or topic is *financially material* for a company when it is likely to impact its financial condition or operating performance.**

The Circularity Score: construction

Calculation of the Score

- The identification of financially material issues relies on the **Materiality Map developed by the SASB**. The Materiality Map provides information on the sustainable topics (Disclosure Topics) that are most relevant for a given industry, in light of investor-related opinions and expectations (**Zara *et al.*, 2020**).
- Each industry is assigned a unique set of Disclosure Topics, depending on its specific features.
- The materiality adjustment results in an increased Category Score for those categories that address the issues highlighted by the Disclosure Topics.
- Since each industry has its own set of Disclosure Topics, **the Category Score adjustments are industry-specific**; also, the CS figure is positively affected by the outperformance that a company should exhibit on "material" Categories.
- Pursuant to this methodology, **we computed the CS relative to years 2018 and 2019**.

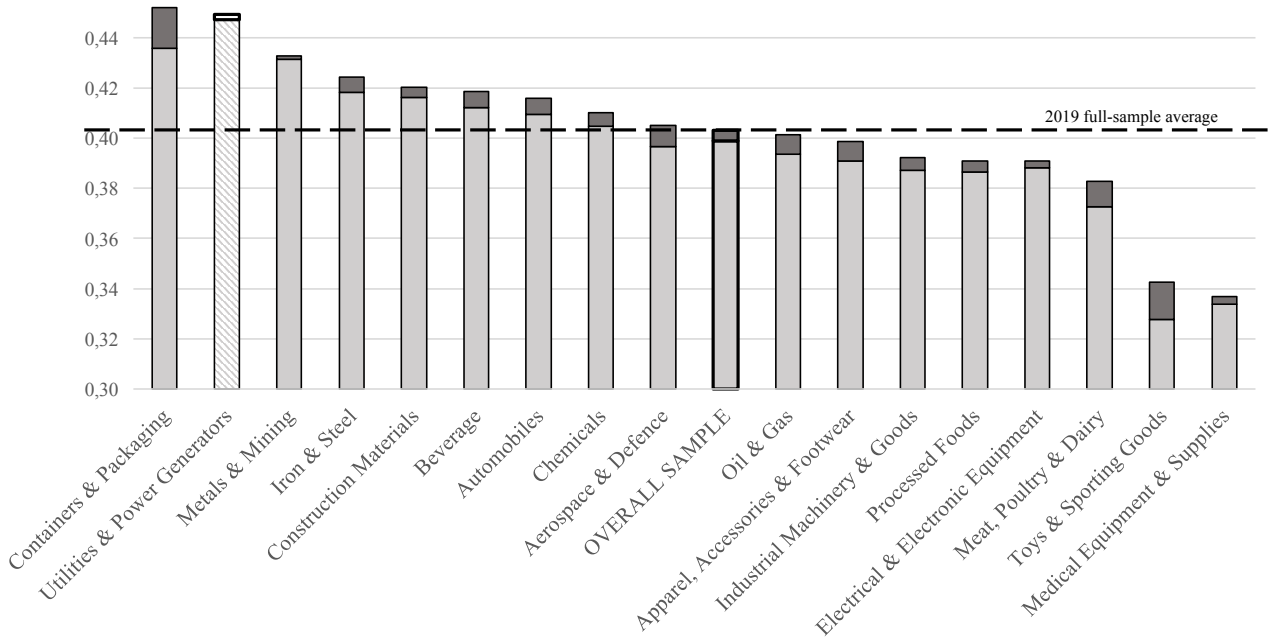
Sample composition



For each industry, observations relative to 2018 and 2019 have been coupled together:
therefore, frequencies — in percentage terms — were computed against the overall number of observations (1,212).

Circularity Score descriptive statistics

	CS 2018	CS 2019
Mean	0.3989	0.4031
Median	0.4018	0.4042
Std. Dev.	0.0905	0.0906
Variance	0.0082	0.0082
Kurtosis	-0.7195	-0.7682
Skewness	-0.1208	-0.0017
Minimum	0.1890	0.2140
Maximum	0.6390	0.6439
1st Quartile	0.3314	0.3328
3rd Quartile	0.4702	0.4740
Obs. (number)	621	591



Industries are ordered by the 2019 average CS. Light grey areas represent the 2018 average CS, dark grey areas the upward shift occurred in 2019. Hence, the height of each bar represents the 2019 average CS by industry. The marked area on top of the Utilities & Power Generators bar represents the downward shift occurred in 2019, as that industry was the only one whose average CS decreased from one year to another; hence, the height of that bar represents the 2018 average CS in that industry. Relative to 2019 data, 9 (8) industries exhibited an average CS above (below) the full-sample figure.

Circularity Score descriptive statistics

- Due to the availability of data, we ultimately analysed 644 companies out of an *investable universe* made of 2,028. This represents just 31.76% coverage. This highlights that **ESG disclosure** remains not particularly granular as of today.
- Companies in the sample are actually **concentrated in a few industries**. The 4 most populated are Chemicals, Industrial Machinery & Goods, Electrical & Electronic Equipment and Construction Materials, which cumulatively constitute an outright majority of the sample (53.62% in 2018, 52.79% in 2019).
- The average firm in the sample has CS ≅ 0.40 in both years of analysis. The interquartile range is relatively narrow: in either year, the 1st (3rd) quartile stands at ~0.33 (~0.47), denoting **little heterogeneity**.
- These descriptive statistics reflect the fact that the CE is at an early stage of implementation and business organisations have not developed a strong CE-oriented strategy yet.
- The industries with the **highest CS mean values** in 2018 and 2019 are Utilities & Power Generators (~0.44) and Containers & Packaging (~0.45), respectively; conversely, those exhibiting the **lowest CS mean values** is Medical Equipment & Supplies (~0.33 in both years).

Empirical strategy

[1] $$y_{it} = \alpha + \beta\ \mathrm{CS}_{i(t-1)} + \mathbf{CONTROLS}_{i(t-1)}\boldsymbol{\gamma} + \mathbf{D\_INDUSTRY}_i\boldsymbol{\delta} + \tau\ \mathrm{D\_YEAR}_t + \varepsilon_{it}$$

$t = \{2019; 2020\}$

[2] $$y_{i\tilde{t}} = \alpha + \beta\ \mathrm{CS}_{i2019} + \mathbf{CONTROLS}_{i2019}\boldsymbol{\gamma} + \mathbf{D\_INDUSTRY}_i\boldsymbol{\delta} + \varepsilon_{i\tilde{t}}$$

1 = Pooled OLS
2 = Standard OLS

$\tilde{t} \in \{2020\ \text{full}-\text{year};\ 2020\ \textit{pre}-\text{shock};\ 2020\ \text{shock};\ 2020\ \textit{post}-\text{shock}\}$

CS is the Circularity Score, *i.e.*, the focus explanatory variable; **CONTROLS** is a $[1\times h]$ vector of control variables, and $\boldsymbol{\gamma}$ the $[h\times 1]$ vector of related efficients; **D_INDUSTRY** is a $[1\times k]$ vector of industry dummies, and $\boldsymbol{\delta}$ the $[k\times 1]$ vector of related coefficients; D_YEAR is a dummy variable that takes e 1 if the observation on the dependent variable pertains to 2020, and 0 otherwise, and τ the coefficient thereof; ε is the idiosyncratic error term.

d τ the coefficient thereof; ε is the idiosyncratic error term.

τ the coefficient thereof; ε is the idiosyncratic error term.

2020) identify the COVID-19 shock itself, we define the following:

- **ock** = between Monday, 2 January 2020 and Friday, 21 February 2020;
- **hock** = between Monday, 24 February 2020 and Friday, 20 March 2020;

Empirical strategy

- **Risk** is measured by stock price volatility, proxied either in absolute terms (i.e., the *standard deviation of stock returns*) or relative ones, as the sensitivity to system-wide fluctuations (i.e., the *market Beta*).
- STOXX Europe 600 and MSCI World are the two indexes featured in the market Beta computation: the former reflects the geographical area wherein the companies in our sample operate (that is, mostly Europe), whereas the latter represents equity markets across developed countries worldwide.
- Adopting a **global perspective** may provide meaningful insights, given that most trading venues around the world did resent the COVID-19 shock.
- To mitigate **endogeneity issues** (in particular, *reverse causality*) we lagged regressors by 1 period lag vis-à-vis dependent variables: that is, we considered 2020 (2019) risk measures — either over the whole year or just a portion to investigate COVID effects — against 2019 (2018) explanatory variables.
- In the **Appendix**, we report and describe all the variables used in our analyses.

Results

Pooled OLS

Under the Pooled model, **CS exhibits a statistically significant, negative association with equity risk measures**.

Derisking is particularly clear on systematic risk, measured against a global benchmark (i.e., the MSCI World index).

These results arise after controlling for different levels of risk between 2019 and 2020, as the latter resented the COVID-related upward shock.

Standard OLS, 2020 full-year

We investigated the economic significance of our results by applying the estimated coefficients to specific CS figures.

We recorded the following differences as of the levels of risk associated with the **3rd quartile** of the CS distribution, in a comparison to those associated with the **1st quartile**:

- the standard deviation of returns decreases by ~15% of its sample mean;
- the Beta against STOXX Europe 600 decreases by ~9.5% of its sample mean;
- the Beta against MSCI World decreases by ~17% of its sample mean.

Results

2020, COVID segmentation

- As for the pre-shock period, the CS played a negative and statistically significant effect only on total risk, not on systematic one.
- As for the shock period, the effect may be retrieved as of systematic risk too, but only if we use a global benchmark rather than a "local" (i.e., European) one.
- As for the post-shock period, our results suggest that higher (lower) circularity is associated to lower (higher) risk, consistently across the latter's different measures. The magnitude of estimated coefficients is at its highest.
- In other terms, **as the COVID-19 effects were added up (first, news from China; then, the European outbreak; finally, lockdown measures), the derisking effect of adopting circular business models became increasingly evident.**

Focus on the Oil & Gas industry

The relationship between the CS and risk might vary remarkably across industries; hence, we conducted a deeper investigation on one of the most exposed to the circular transformation of business models: namely, Oil & Gas (O&G).

Results

- Since we are interested in discovering how a theoretically sensitive industry did react to the COVID-19 crisis, we took risk measures (i.e., dependent variables) from year 2020 only, or segments thereof. We added an interaction term between the CS and a dummy variable taking value 1 if the company belongs to the O&G industry, and 0 otherwise.
- If we take dependent variables from **2020 full-year**, every single risk measure is impacted by the CS in a negative and statistically significant way. Coefficients relative to the interaction term are non-zero and negative, too, yet their magnitude is 3-4 times larger vis-à-vis standalone variables: **derisking is remarkably amplified in the O&G industry**.
- The interaction term is negatively and significantly associated with all risk measures both prior to and during the shock; afterwards, however, only the coefficient of total risk retained its statistical significance. Conversely, the standalone CS variable basically follows the same pattern as in specifications without the interaction term.
- The peculiar time-varying pattern of the interaction term could be due to **non-COVID-related shocks affecting oil prices**, mainly because of the trade war erupted in March 2020 between Russia and Saudi Arabia, whose effects were mostly resented during our post-shock period and are likely to have wiped out those associated with the degree of circularity.

Conclusions

- The uptake of circular business practices is associated with a **risk reduction**: in terms of either the total measure or just its systematic component, both in normal times and when a strong shock occurs.
- In terms of magnitude, such derisking tends to be stronger in respect of total risk (i.e., the standard deviation of stock returns) and on systematic risk (i.e., the market Beta), too, but only if computed against a global benchmark.
- Publicly-traded stocks of companies that are actively transitioning toward a circular business model constitute **a low-risk, resilient asset class**; hence, they are particularly suitable for institutional investors.

Contributions to research

❖ We developed a **quantitative and standardized measure for CE at firm level**.

❖ We found that **circular assets are resilient to exogenous shocks of non-financial origin**.

❖ We highlighted **potentially rewarding opportunities for the financial industry**.

Thank you

for your attention.

Comments and suggestions shall always be welcomed.

Appendix — CS by industry, summary

	2018					2019				
Industry	**Tot. obs.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Tot. obs.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Aerospace & Defence	14	0.3965	0.0870	0.2078	0.4983	14	0.4051	0.0349	0.3054	0.5122
Apparel, Accessories & Footwear	22	0.3910	0.0744	0.2301	0.4928	22	0.3987	0.0132	0.2494	0.4876
Automobiles	29	0.4095	0.0875	0.1991	0.5782	28	0.4158	0.0189	0.2206	0.5890
Beverage	15	0.4120	0.0914	0.2378	0.5429	15	0.4185	0.0466	0.3057	0.5359
Chemicals	131	0.4048	0.1049	0.2093	0.6105	125	0.4101	0.0923	0.2283	0.6439
Construction Materials	61	0.4162	0.0701	0.2376	0.5608	56	0.4204	0.0496	0.2651	0.5717
Containers & Packaging	24	0.4357	0.0947	0.2426	0.5483	20	0.4519	0.0521	0.2291	0.5387
Electrical & Electronic Equipment	65	0.3883	0.0924	0.2286	0.5954	59	0.3908	0.0466	0.2513	0.5934
Industrial Machinery & Goods	76	0.3870	0.0754	0.2183	0.5615	72	0.3922	0.0096	0.2140	0.5845
Iron & Steel	23	0.4184	0.1097	0.2470	0.6390	22	0.4243	0.0553	0.2626	0.6377
Meat, Poultry & Dairy	8	0.3725	0.0578	0.3317	0.4860	7	0.3829	0.0329	0.3531	0.4754
Medical Equipment & Supplies	43	0.3337	0.0577	0.2238	0.4426	46	0.3370	0.0146	0.2287	0.4769
Metals & Mining	17	0.4314	0.0865	0.2266	0.5689	17	0.4328	0.0940	0.2522	0.5986
Oil & Gas	36	0.3937	0.0910	0.2355	0.5666	33	0.4014	0.0643	0.2489	0.5520
Processed Foods	26	0.3865	0.0740	0.2370	0.5637	28	0.3909	0.0492	0.2415	0.5821
Toys & Sporting Goods	4	0.3277	0.1135	0.1890	0.4248	4	0.3425	0.0062	0.2259	0.4357
Utilities & Power Generators	27	0.4493	0.0933	0.2407	0.5575	23	0.4472	0.0494	0.2385	0.5676

Appendix — Description of variables

Variable	Description	Source of input
Std. deviation of returns	Annualised standard deviation of daily returns on a company's stock, computed by financial year	Refinitiv's TR – Datastream
Beta STOXX Europe 600	Market Beta against the STOXX Europe 600 index, computed by financial year from daily returns	Refinitiv's TR – Datastream
Beta MSCI World	Market Beta against the MSCI World index, computed by financial year from daily returns	Refinitiv's TR – Datastream
Circularity Score	Company performance on CE aspects, using a proprietary methodology based on Zara *et al.* (2020)	Refinitiv's TR – Datastream
Total assets, log	Natural logarithm of total assets, average of beginning and end-year figures	Bloomberg
Debt/equity ratio	Ratio between total debt (either long-term or short-term) and total equity (either common or preferred)	Bloomberg
Interest coverage ratio	Ratio between EBITDA and interest expense	Bloomberg
Profit margin	Net income, deflated by total revenue	Bloomberg
Market-to-book ratio	Ratio between market capitalisation and the book value of common equity, average of beginning and end-yea	Bloomberg
Negative M2B, dummy	Dichotomic variable that takes value 1 if the market-to-book ratio is negative, and 0 otherwise	Bloomberg
R&D expenditure	Expenses for research and development, deflated by net sales	Bloomberg
Governance score	Total score of the 'Governance' ESG pillar	Refinitiv's TR – ASSET4
Oil & Gas dummy	Dichotomic variables that takes value 1 if the company belongs to the Oil & Gas industry, and 0 otherwise	Refinitiv's TR – Datastream

Appendix — Regression tables

Pooled OLS

	(1) Std. dev. of returns	(2) Beta against STOXX E. 600	(3) Beta against MSCI World
Circularity Score	**-0.346*** **	**-0.446*** **	**-0.809*** **
	(0.0525)	*(0.160)*	*(0.182)*
Total assets, log	-0.0151***	0.0516***	0.0630***
	(0.00285)	*(0.0087)*	*(0.00989)*
Debt/equity ratio	0.00115***	0,000534	0.00268**
	(0.000322)	*(0.000984)*	*(0.00112)*
Interest coverage ratio	-1,57E-05	5,27E-05	5,67E-05
	(0.0000125)	*(0.0000381)*	*(0.0000433)*
Profit margin	-0.0144***	-0.0278**	-0.0305**
	(0.00386)	*(0.0118)*	*(0.0134)*
Market-to-book ratio *(A)*	-0.00313***	-0,000703	0,00313
	(0.00111)	*(0.00339)*	*(0.00385)*
Negative A, dummy *(B)*	0.118***	0,143	0,147
	(0.0398)	*(0.121)*	*(0.138)*
A∩B, interaction	0.00415***	0,00137	-0,00172
	(0.00124)	*(0.00379)*	*(0.00431)*
R&D expenditure	0.0474**	0,106	0.184**
	(0.0241)	*(0.0737)*	*(0.0838)*
Governance score	0.000398**	0.00123**	0,000928
	(0.00018)	*(0.00055)*	*(0.000625)*
2020 dummy	0.143***	-0.208***	-0.406***
	(0.00687)	*(0.021)*	*(0.0238)*
Constant	0.407***	0.244**	0.290**
	(0.0361)	*(0.110)*	*(0.125)*
Industry dummies	YES	YES	YES
Observations	*1.175*	*1.175*	*1.175*
R-squared	*0,442*	*0,272*	*0,346*

Standard OLS, 2020 full-year

	(4) Std. dev. of returns	(5) Beta against STOXX E. 600	(6) Beta against MSCI World
Circularity Score	**-0.439*** **	**-0.513*** **	**-0.719*** **
	(0.0851)	*(0.157)*	*(0.142)*
Total assets, log	-0.0159***	0.0387***	0.0411***
	(0.00475)	*(0.00873)*	*(0.0079)*
Debt/equity ratio	0.0191***	-0,00742	0,00152
	(0.00548)	*(0.0101)*	*(0.00912)*
Interest coverage ratio	-4,26E-05	-4,16E-05	-6,20E-05
	(0.0000301)	*(0.0000555)*	*(0.0000502)*
Profit margin	-0,0113	-0.0228*	-0,0162
	(0.00725)	*(0.0133)*	*(0.0121)*
Market-to-book ratio *(A)*	-0.00480**	-0.00675*	-0,00207
	(0.00194)	*(0.00358)*	*(0.00324)*
Negative M2B, dummy *(B)*	0.283***	0,317	0.478***
	(0.109)	*(0.200)*	*(0.181)*
A∩B, interaction	0.0485***	0,0302	0.0553*
	(0.017)	*(0.0312)*	*(0.0282)*
R&D expenditure	0.0620*	0,0833	0.136**
	(0.0318)	*(0.0585)*	*(0.0529)*
Governance score	0.000647**	0.00130**	0,000783
	(0.000301)	*(0.000553)*	*(0.0005)*
Constant	0.662***	0.533***	0.518***
	(0.0759)	*(0.140)*	*(0.126)*
Industry dummies	YES	YES	YES
Observations	*575*	*575*	*575*
R-squared	*0,36*	*0,336*	*0,301*

Appendix — Regression tables

Standard OLS, pre-shock

	(7) Std. dev. of returns	(8) Beta against STOXX E. 600	(9) Beta against MSCI World
Circularity Score	**-0.182*** **	0,0317	-0,651
	(0.0692)	*(0.361)*	*(0.472)*
Total assets, log	-0.0211***	0,0296	0.0793***
	(0.00386)	*(0.0201)*	*(0.0263)*
Debt/equity ratio	0.0272***	0,0273	-0,0387
	(0.00446)	*(0.0232)*	*(0.0304)*
Interest coverage ratio	-1,13E-05	6,00E-05	-1,05E-04
	(0.0000245)	*(0.000128)*	*(0.000167)*
Profit margin	-0.0120**	-0,0085	0,0147
	(0.0059)	*(0.0308)*	*(0.0402)*
Market-to-book ratio *(A)*	-0.00323**	-0,000695	0,00284
	(0.00158)	*(0.00825)*	*(0.0108)*
Negative A, dummy *(B)*	0.277***	-0,328	1.028*
	(0.0883)	*(0.461)*	*(0.602)*
A∩B, interaction	0.0533***	-0,0328	0,0822
	(0.0138)	*(0.072)*	*(0.0941)*
R&D expenditure	0.119***	0.253*	0,204
	(0.0258)	*(0.135)*	*(0.176)*
Governance score	-0,000168	0,000729	0,000992
	(0.000245)	*(0.00128)*	*(0.00167)*
Constant	0.498***	0,356	0,288
	(0.0618)	*(0.322)*	*(0.421)*
Industry dummies	YES	YES	YES
Observations	*575*	*575*	*575*
R-squared	*0.364*	*0.132*	*0.125*

Standard OLS, shock

	(10) Std. dev. of returns	(11) Beta against STOXX E. 600	(12) Beta against MSCI World
Circularity Score	**-0.688*** **	-0,223	**-0.445*** **
	(0.132)	*(0.163)*	*(0.153)*
Total assets, log	-0,00577	0,00307	0.0200**
	(0.00737)	*(0.00909)*	*(0.00853)*
Debt/equity ratio	0.0382***	0.0210**	0.0283***
	(0.0085)	*(0.0105)*	*(0.00985)*
Interest coverage ratio	-5,74E-05	6,05E-06	-7,44E-06
	(0.0000468)	*(0.0000578)*	*(0.0000542)*
Profit margin	-0,00818	-0.0248*	-0,0167
	(0.0113)	*(0.0139)*	*(0.013)*
Market-to-book ratio *(A)*	-0.00550*	-0,00204	-0,000834
	(0.00302)	*(0.00372)*	*(0.00349)*
Negative A, dummy *(B)*	0,0958	0,129	0,262
	(0.169)	*(0.208)*	*(0.195)*
A∩B, interaction	0,0361	0,0216	0,0483
	(0.0263)	*(0.0325)*	*(0.0305)*
R&D expenditure	0.136***	0.184***	0.219***
	(0.0493)	*(0.0609)*	*(0.0571)*
Governance score	0.000862*	0.00119**	0,000672
	(0.000467)	*(0.000576)*	*(0.00054)*
Constant	0.883***	0.564***	0.393***
	(0.118)	*(0.145)*	*(0.136)*
Industry dummies	YES	YES	YES
Observations	*575*	*575*	*575*
R-squared	*0,254*	*0,172*	*0,173*

Appendix — Regression tables

Standard OLS, post-shock

	(13) Std. dev. of returns	(14) Beta against STOXX E. 600	(15) Beta against MSCI World
Circularity Score	**-0.591*** **	**-0.734*** **	**-0.921*** **
	(0.120)	*(0.247)*	*(0.221)*
Total assets, log	-0,00936	0.0588***	0.0621***
	(0.00669)	*(0.0138)*	*(0.0123)*
Debt/equity ratio	0.0180**	-0.0341**	-0,0211
	(0.00772)	*(0.0159)*	*-0,0143*
Interest coverage ratio	-4,81E-05	-5,31E-05	-6,34E-05
	(0.0000425)	*(0.0000876)*	*(0.0000785)*
Profit margin	-0,0168	-0,0186	-0,0177
	(0.0102)	*(0.0211)*	*(0.0189)*
Market-to-book ratio *(A)*	-0,00373	-0,000309	0,00602
	(0.00274)	*(0.00565)*	*(0.00506)*
Negative A, dummy *(B)*	0,235	0,427	0.483*
	(0.153)	*(0.316)*	*(0.283)*
A∩B, interaction	0,0335	-0,00434	0,0109
	(0.0239)	*(0.0493)*	*(0.0441)*
R&D expenditure	0,0241	0,0846	0.138*
	(0.0448)	*(0.0923)*	*(0.0827)*
Governance score	0.000891**	0,00132	0,000985
	(0.000424)	*(0.000874)*	*(0.000782)*
Constant	0.836***	0.446**	0.444**
	(0.107)	*(0.221)*	*(0.198)*
Industry dummies	YES	YES	YES
Observations	*575*	*575*	*575*
R-squared	*0.331*	*0.221*	*0.190*

Oil & Gas focus, Standard OLS, 2020 full-year

	(16) Std. dev. of returns	(17) Beta against STOXX E. 600	(18) Beta against MSCI World
Circularity Score	**-0.331*** **	**-0.361** **	**-0.562*** **
	(0.0838)	*(0.154)*	*(0.138)*
CS ∩ Oil&Gas dummy, int.	**-1.404*** **	**-1.354** **	**-1.736*** **
	(0.292)	*(0.537)*	*(0.482)*
Total assets, log	-0.0136***	0.0418***	0.0398***
	(0.0045)	*(0.00827)*	*(0.00743)*
Debt/equity ratio	0.0145***	-1,34E-02	-4,93E-03
	(0.00549)	*(0.0101)*	*(0.00906)*
Interest coverage ratio	-6.34e-05**	-0,0000622	-8.22e-05*
	(0.0000299)	*(0.000055)*	*(0.0000494)*
Profit margin	-0.0148**	-0.0281**	-0.0222*
	(0.00718)	*(0.0132)*	*(0.0119)*
Market-to-book ratio *(A)*	0,000288	-0,00281	-0,000682
	(0.00164)	*(0.00302)*	*(0.00271)*
Negative A, dummy *(B)*	0.284***	0,316	0.478***
	(0.108)	*(0.199)*	*(0.179)*
A∩B, interaction term	0.0295*	0,0103	0,0366
	(0.017)	*(0.0312)*	*(0.028)*
Constant	0.512***	0.262**	0.194*
	(0.0603)	*(0.111)*	*(0.0995)*
Industry dummies	YES	YES	YES
Observations	*584*	*584*	*584*
R-squared	*0,368*	*0,338*	*0,308*

Appendix — Regression tables

Oil & Gas focus, Standard OLS, pre-shock

	(19) Std. dev. of returns	(20) Beta against STOXX E. 600	(21) Beta against MSCI World
Circularity Score	**-0.122***	0.184	-0.31
	(0.0695)	*(0.356)*	*(0.464)*
CS ∩ Oil&Gas dummy, int.	**-1.273*****	-1.338	**-3.289****
	(0.242)	*(1.241)*	*(1.617)*
Total assets, log	-0.0214***	0.0248	0.0722***
	-0.00373	*-0.0191*	*-0.0249*
Debt/equity ratio	0.0231***	2.19E-02	-4.81E-02
	(0.00455)	*(0.0233)*	*(0.0304)*
Interest coverage ratio	-0.000037	0.0000677	-0.0000839
	(0.0000248)	*(0.000127)*	*(0.000166)*
Profit margin	-0.0160***	-0.019	0.00417
	(0.00595)	*(0.0305)*	*(0.0398)*
Market-to-book ratio *(A)*	0.00178	-0.0141**	-0.0156*
	(0.00136)	*(0.00698)*	*(0.0091)*
Negative A, dummy *(B)*	0.288***	-0.367	0.959
	(0.0898)	*(0.461)*	*(0.601)*
A∩B, interaction term	0.0362**	-0.0376	0.0691
	(0.0141)	*(0.0721)*	*(0.094)*
Constant	0.401***	0.365	0.225
	(0.0499)	*(0.256)*	*(0.334)*
Industry dummies	YES	YES	YES
Observations	*584*	*584*	*584*
R-squared	*0.362*	*0.13*	*0.129*

Oil & Gas focus, Standard OLS, shock

	(22) Std. dev. of returns	(23) Beta against STOXX E. 600	(24) Beta against MSCI World
Circularity Score	**-0.518*****	-0.081	**-0.295***
	(0.13)	*(0.161)*	*(0.151)*
CS ∩ Oil&Gas dummy, int.	**-2.105*****	**-1.425****	**-1.624*****
	(0.454)	*(0.562)*	*(0.527)*
Total assets, log	-0.00386	0.00427	0.0165**
	(0.007)	*(0.00866)*	*(0.00812)*
Debt/equity ratio	0.0306***	0.0129	0.0207**
	(0.00853)	*(0.0106)*	*(0.0099)*
Interest coverage ratio	-9.19e-05**	-0.0000188	-0.0000318
	(0.0000465)	*(0.0000575)*	*(0.0000539)*
Profit margin	-0.0144	-0.0331**	-0.0250*
	(0.0112)	*(0.0138)*	*(0.0129)*
Market-to-book ratio *(A)*	0.00157	-0.000109	-0.000915
	(0.00255)	*(0.00316)*	*(0.00296)*
Negative A, dummy *(B)*	0.106	0.141	0.273
	(0.169)	*(0.209)*	*(0.196)*
A∩B, interaction term	0.00862	0.00333	0.0317
	(0.0264)	*(0.0327)*	*(0.0306)*
Constant	0.651***	0.396***	0.157
	-0.0937	*-0.116*	*-0.109*
Industry dummies	YES	YES	YES
Observations	*584*	*584*	*584*
R-squared	*0.263*	*0.168*	*0.165*

Appendix — Regression tables

Oil & Gas focus, Standard OLS, post-shock

	(25) Std. dev. of returns	(26) Beta against STOXX E. 600	(27) Beta against MSCI World
Circularity Score	**-0.475*** **	**-0.694*** **	**-0.857*** **
	-0.119	*-0.243*	*-0.218*
CS ∩ Oil&Gas dummy, int.	**-1.308*** **	0.784	0.297
	-0.415	*-0.847*	*-0.76*
Total assets, log	-0.00523	0.0609***	0.0606***
	-0.00639	*-0.0131*	*-0.0117*
Debt/equity ratio	0.0135*	-0.0349**	-0.0233
	-0.0078	*-0.0159*	*-0.0143*
Interest coverage ratio	-7.02e-05*	-0.0000561	-0.0000706
	-0.0000425	*-0.0000868*	*-0.0000778*
Profit margin	-0.0194*	-0.0227	-0.0231
	-0.0102	*-0.0208*	*-0.0187*
Market-to-book ratio *(A)*	0.00333	-0.00251	0.00305
	-0.00233	*-0.00477*	*-0.00428*
Negative A, dummy *(B)*	0.239	0.419	0.480*
	-0.154	*-0.315*	*-0.282*
A∩B, interaction term	0.013	-0.00368	0.00913
	-0.0241	*-0.0493*	*-0.0442*
Constant	0.606***	0.247	0.206
	-0.0857	*-0.175*	*-0.157*
Industry dummies	YES	YES	YES
Observations	*584*	*584*	*584*
R-squared	*0.336*	*0.217*	*0.179*