FIM Application Data Processing - Felix Nicolas Weber

- ESG Source: https://app.gigasheet.com/spreadsheet/sp-500-esg-risk-ratings/c4866f1c_c239_4114_9d92_bf1d0dcb1b53
- Auch Sektoren, etc. beinhaltet

- Profitmargin Source: https://site.financialmodelingprep.com/developer/docs/stable
- Profit Margins spread over five years

Working document is combined with profit margins and ESG, into "sp500_margins_with_esg"

- merge documents and remove all rows which are missing values in column "Total ESG Risk score"
- left with 2035 value rows.
- calculated regression models with regression_total_esg_profit.py, results saved in esg_margin_results.txt

  ```
  Total ESG Risk score is significantly negatively related to net and gross profit margins,
  but not to operating margins:
  ```

    - Correlations

        - Net: −0.116

        - Gross: −0.161

        - Oper: −0.066

    - OLS regressions (robust SE)

        - Net margin ≈ 0.186 − 0.002 × ESG (p = 0.019)

        - Gross margin ≈ 0.635 − 0.0057 × ESG (p = 0.0007)

        - Operating margin ≈ 0.222 − 0.0013 × ESG (p = 0.17, n.s.)


  ```
  In plain terms: a one-point higher ESG-risk score is associated with about a 0.2 pp drop
  in net margin and a 0.6 pp drop in gross margin, both statistically significant. There's
  no clear relationship with operating margin.
  ```

- all esg correlations calculated in regression_all_esg_metrics.py, results in esg_subscores_correlations.csv
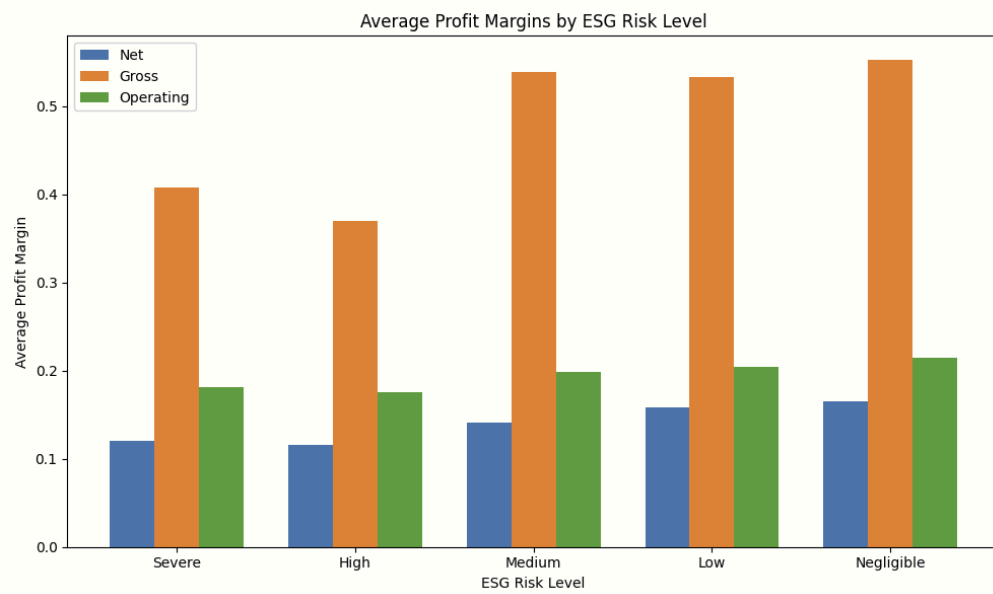
1) What the correlations tell us

ESG Sub-score	Net margin	Gross margin	Oper margin
Total ESG Risk	–0.116	–0.161	–0.066
Environment Risk	–0.131	**–0.402**	–0.078
Social Risk	–0.075	+0.027	–0.053
Governance Risk	+0.065	+0.399	+0.062
Controversy Score	**–0.153**	–0.145	**–0.107**

-
  The **strongest negative** link is between **Environment Risk** and **Gross margin** (r≈–0.40).

- **Controversy Score** also has a moderate negative tie to **Net margin** (r≈–0.15).

- Surprisingly, **Governance Risk** correlates **positively** with Gross (r≈+0.40).

- **Social Risk** shows almost no relationship with any margin.

- OLS regression of those results in esg_subscores_regression.py, results in esg_subscores_regression.txt
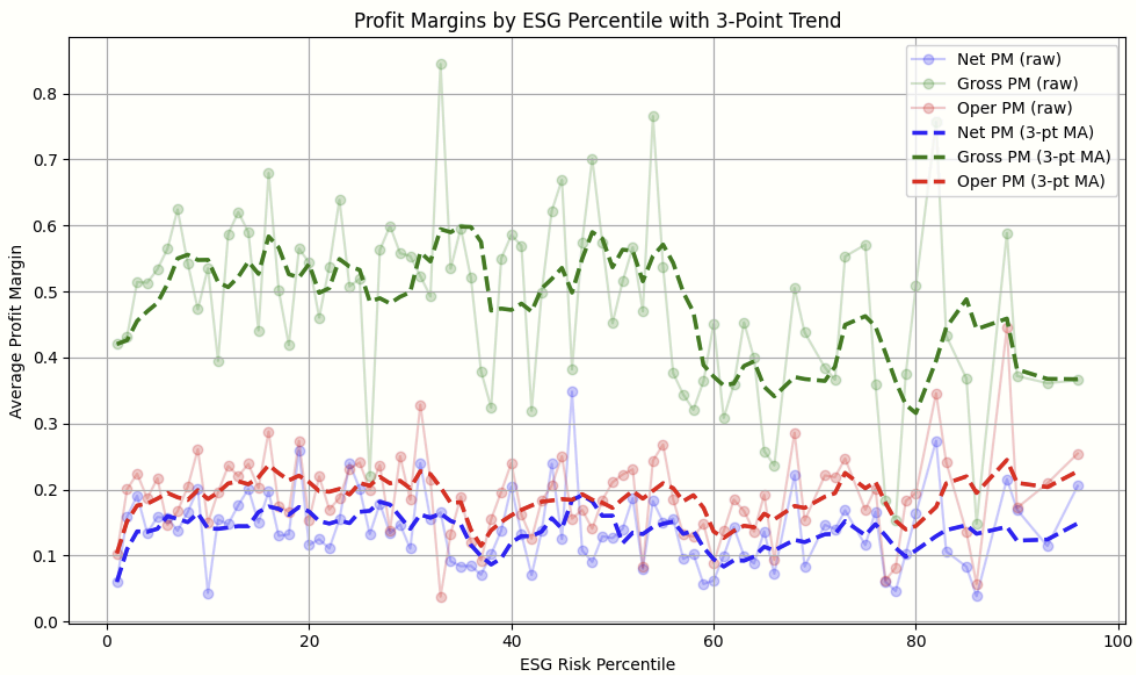
Takeaway:

- Companies with **higher controversy risk** (i.e. more severe negative incidents) tend to have **significantly lower** profit margins, even after accounting for their environmental, social, and governance risk scores. The other ESG dimensions by themselves correlate with profitability, but their effects overlap so much that only controversy stands out in a joint model.

-barplot from plotting_esg_profit.py

Average Profit Margins by ESG Risk Level

- result of percentile_plots.py:

Profit Margins by ESG Percentile with 3-Point Trend

- plot_margins_by_percentile.py

Net Profit Margin vs ESG Risk Percentile
with LOWESS-Smoothed Trend

-
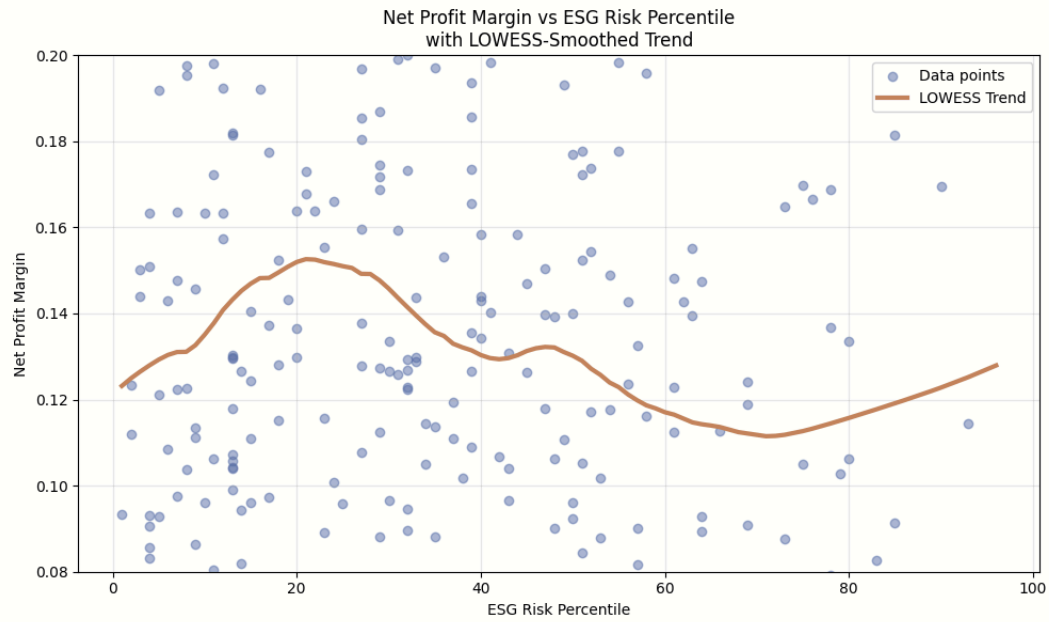
- plot_esgscore_margins.py

Net Profit Margin vs Total ESG Risk Score
with LOWESS-Smoothed Trend
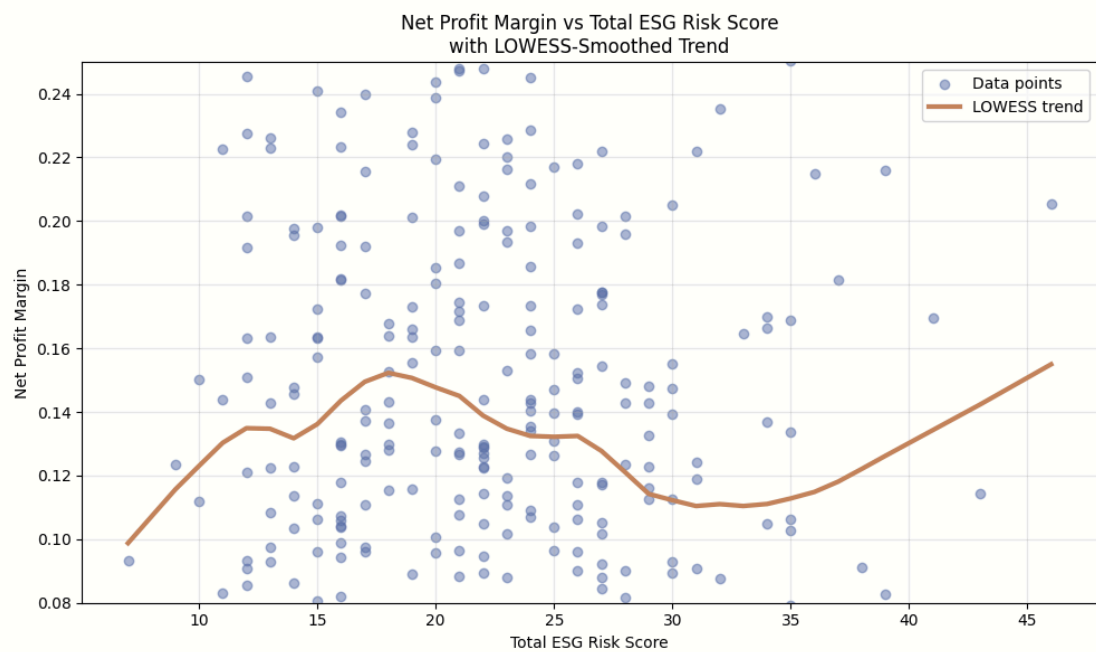
plot_trendline_margins.py:

Combined Profit-Margin Trends by ESG Percentile
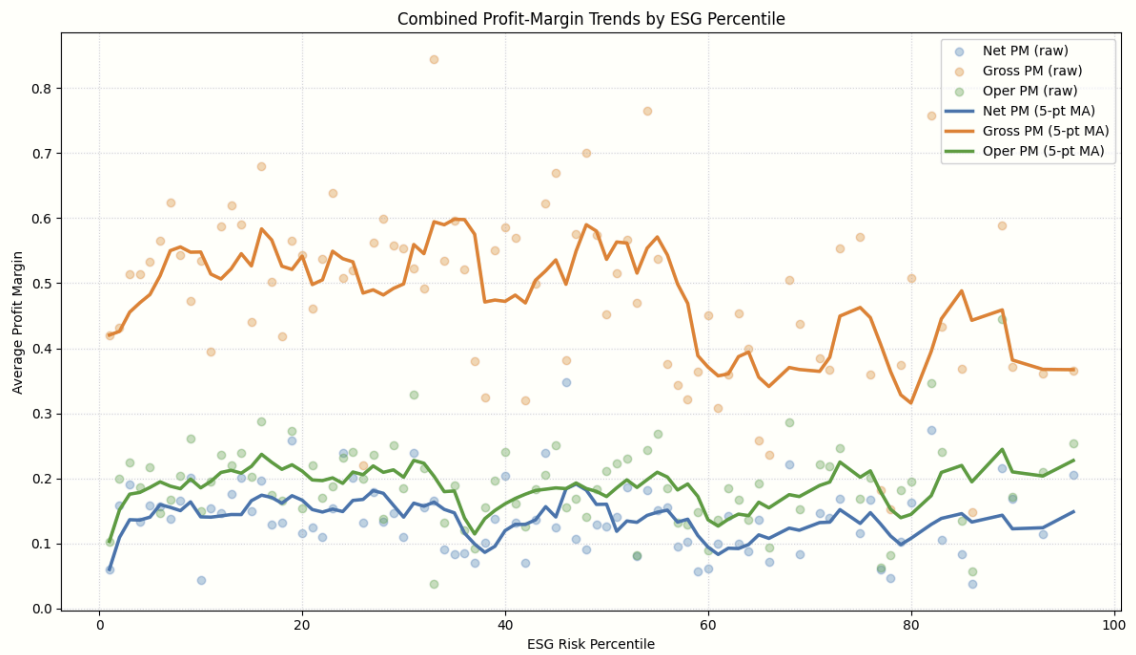
- to remove outliers: plot_binned_profitmargins

-
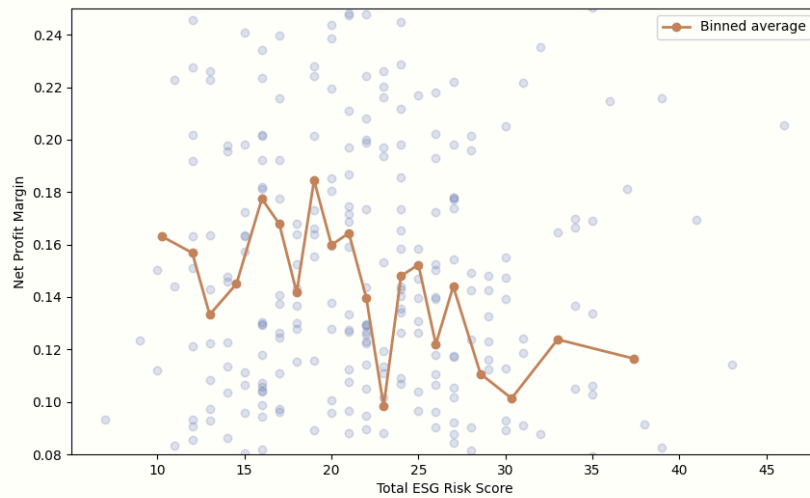
Scraping S&P500 Stock

- using **4_scrape_sp500_stock.py** to scrape s&p500 stock over the last 5 years, roughly 1255 entries per stock.

How to continue:

- normalize stock prices to start day (5/26/2020) = 1 using normalize_stock.py, saved in sp500_prices_5y_normalized.csv
- merge with previous file, which will give us normalized stock prices + esg score. remove any rows with missing values
- 510,785 rows left.

  merged using merge_norm_stock_esg.py, saved in sp500_prices_with_esg.csv.

- plotted development of stock values over time, grouped by ESG risk level group in plot_stock_development_riskgroups.py
-
- analyze correlation and causation between factors, relationship between esg risk score group and stock price development.

Average Stock Price Development by ESG Risk Level
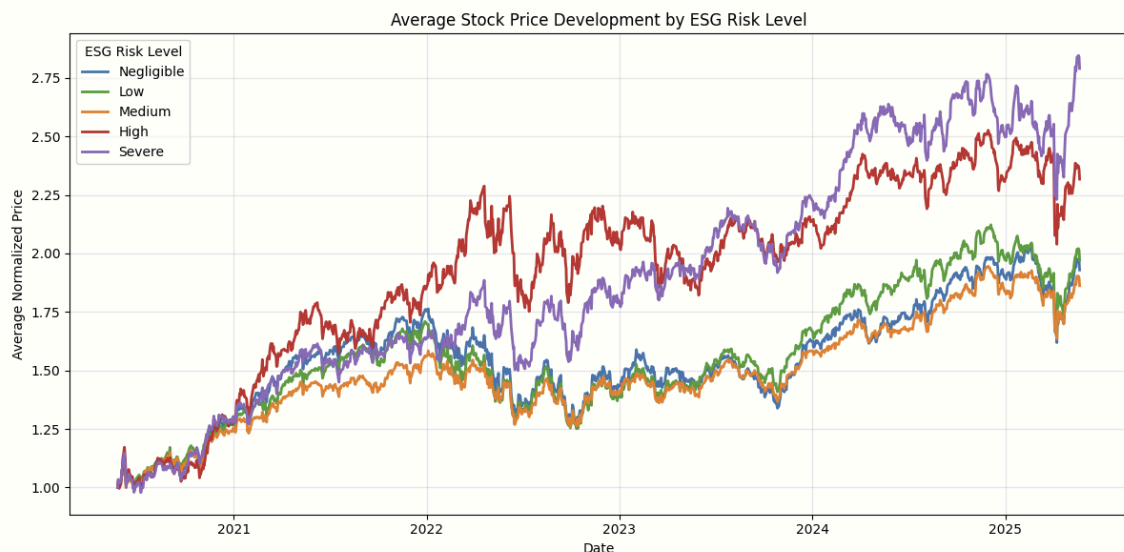
- same for low, medium, high risk levels. plot_stock_development_risk_lowmedhigh.py

Average Stock Price Development by ESG Risk Level (Low/Med/High)
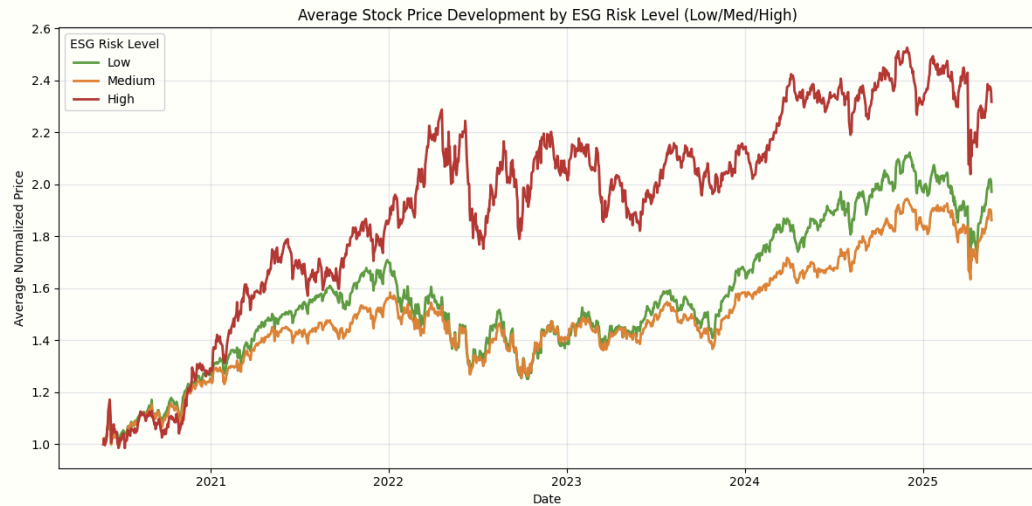
stock_volatility.py to show volatility by risk group

Average 30-Day Rolling Volatility by ESG Risk Level (Low/Medium/High)
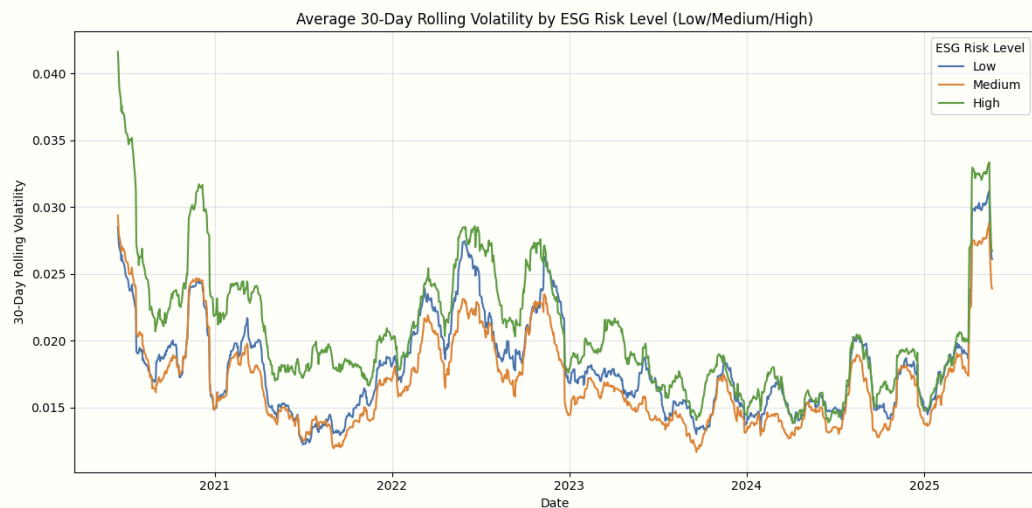
- calculate statistical tests with calculate_relationship_stock_esg.py:

   results in relationship_stock_esg.txt

The results show **no meaningful relationship** between a company's Total ESG Risk score and its **current** normalized stock price:

● **Pearson r = 0.069**: a very weak positive correlation.

● **p ≈ 0.27**: far above the usual 0.05 threshold, so we cannot reject the null of zero correlation.

- **R² ≈ 0.5 %** in the OLS regression: ESG score explains essentially none of the cross‑sectional variation in normalized price.

- **Slope ≈ +0.013** (p ≈ 0.27): each one‑point higher ESG risk is associated with a 1.3 % higher normalized price, but this estimate is not statistically significant.
-

Heatmap to find correlations: heatmap_plot.py
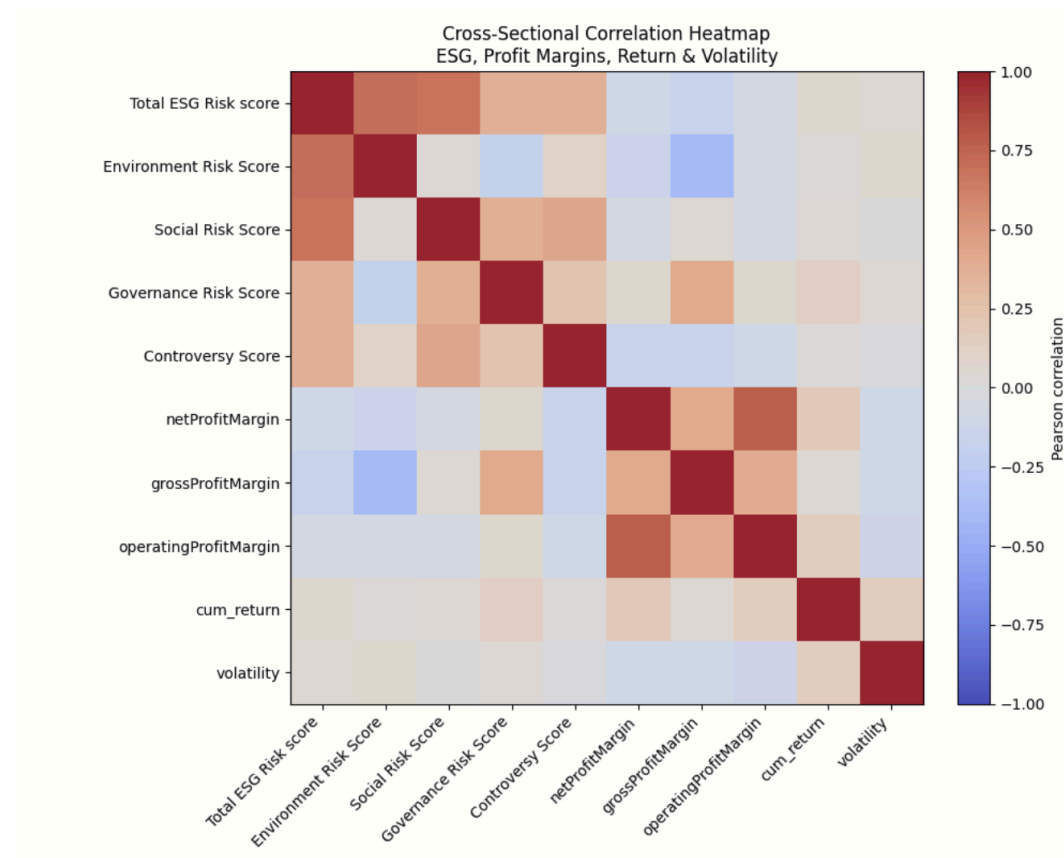
ESG sub-scores are highly collinear.

- Total ESG Risk is almost perfectly correlated with Environment (≈0.75) and Social (≈0.69), and strongly with Controversy (≈0.37).

- Governance stands a bit apart, correlating negatively with Environment (≈–0.18) but positively with Social (≈0.38).

Profit-margin metrics cluster tightly.

- Net, Gross and Operating margins all inter-correlate above 0.40, and each also correlates positively with cumulative return (≈0.5 for net & gross).

- Operating margin and net margin both have a moderate positive link with ESG risk (≈0.2–0.3), but note that once you control for controversy earlier these effects disappeared.

Returns vs. Volatility.

- Cumulative return shows a small positive relationship with ESG risk (≈0.1), but virtually zero with Governance risk.

- Volatility is mildly higher for higher-risk firms (≈0.15 with ESG total, ≈0.1 with controversy).

Small heatmap: small_heatmap_plot.py

ESG Scores vs Profit & Stock Metrics Correlation
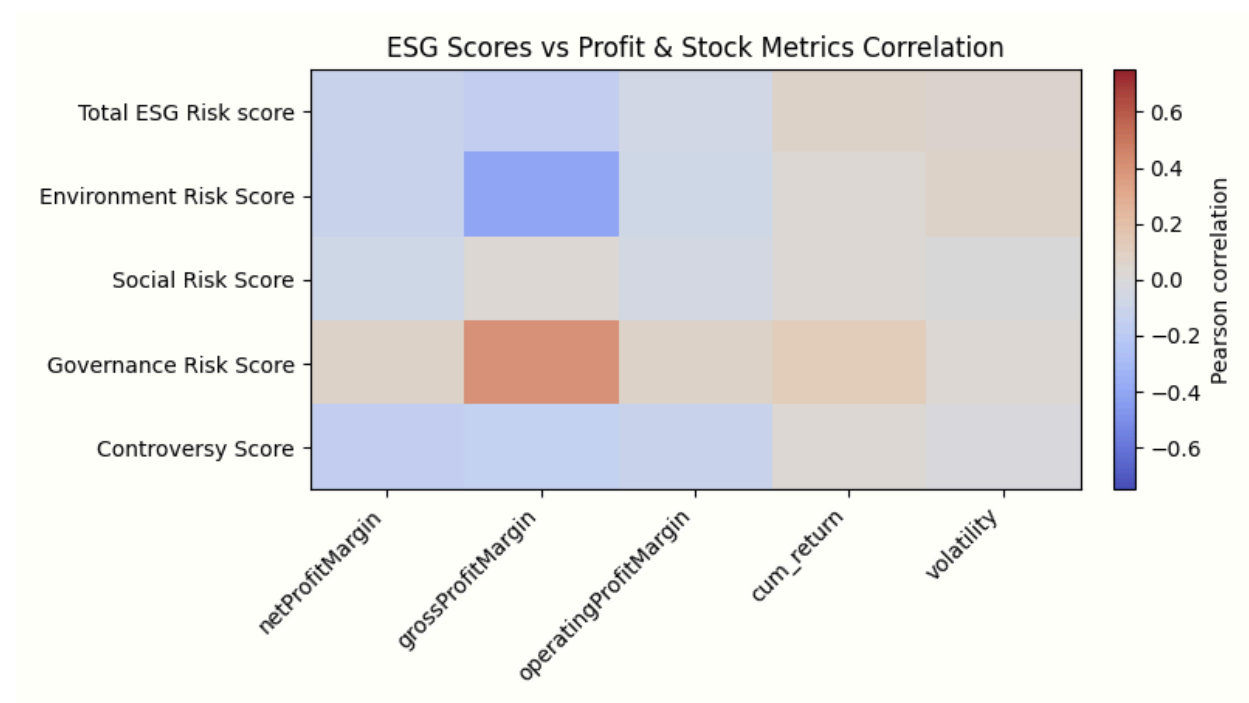
That "ESG vs Profit & Stock" heatmap tells the story cleanly:

- **Governance Risk Score** is **positively** correlated with **gross profit margin** (~ +0.45).

- **Environment Risk Score** shows a **negative** link to gross margin (~ –0.40).

- All ESG dimensions have small **positive** ties to **cumulative return** (~ +0.1–+0.2).

- **Controversy Score** is mildly **negatively** correlated with **net margin** (~ –0.15).

- Higher ESG Risk tends to go with slightly higher **volatility** (~ +0.15).

File to compute cummulative returns and volatility: compute_returns_volatility.py, saved in sp500_prices_with_esg_plus_returns.csv

Then plotted esg correlations by industry; plot_esg_by_industry.py
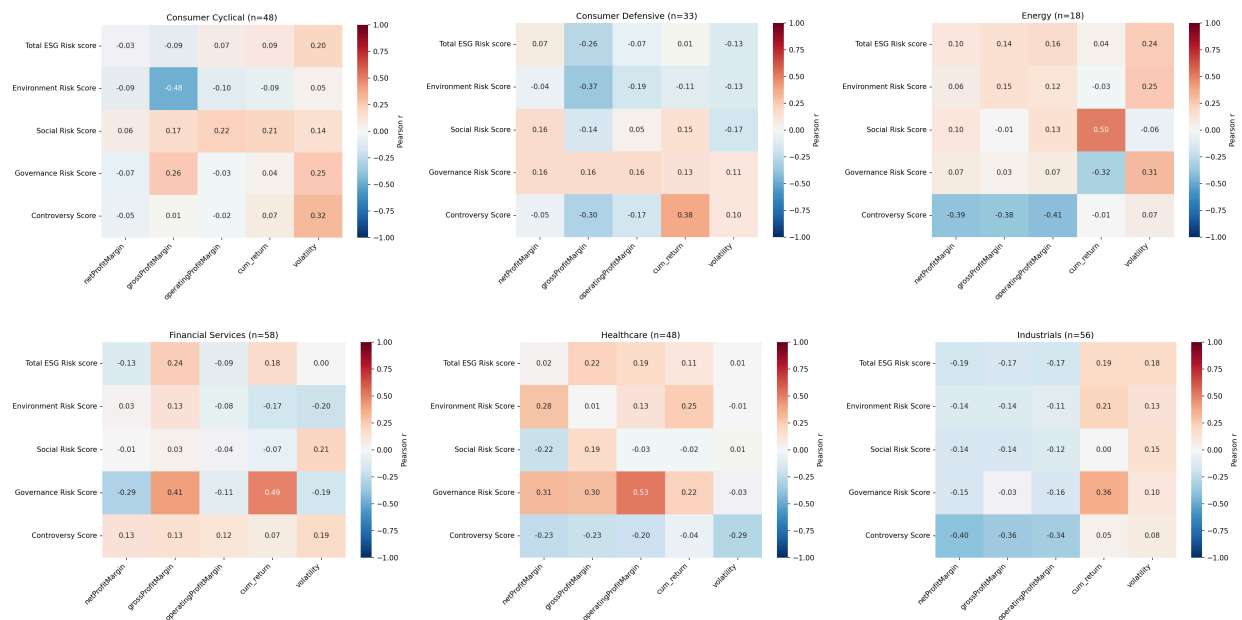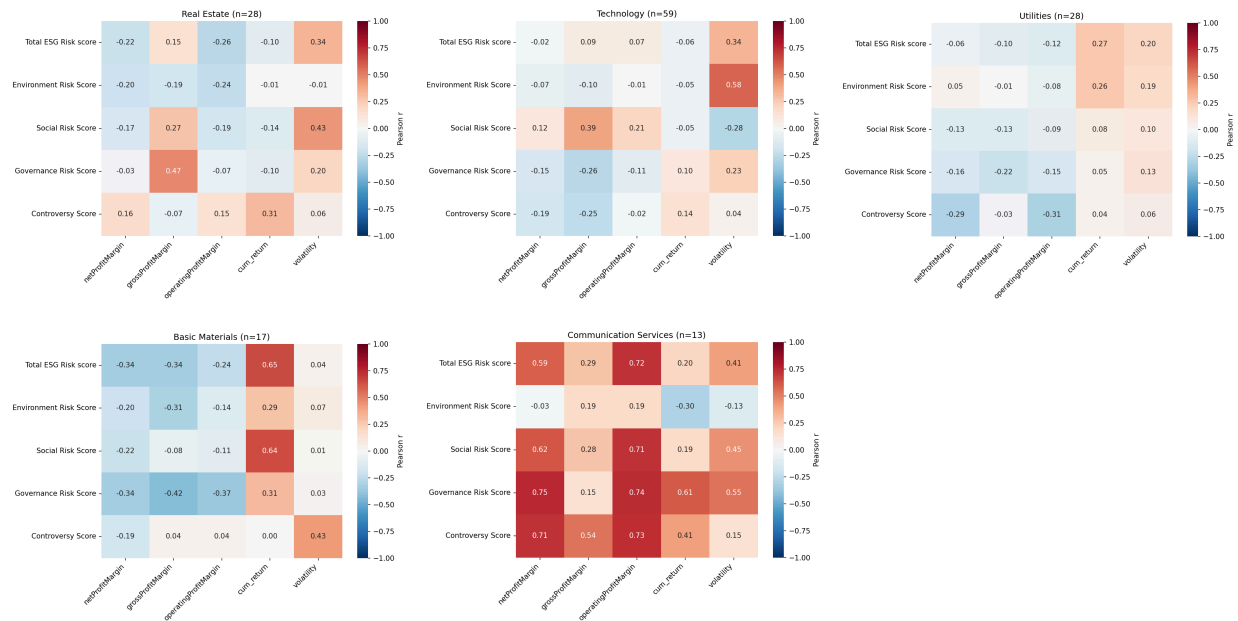
- calculate correlations and statistical significance with significance_esg_stock_by_sector.py
- results saved in sector_esg_stock_significance.csv

using heatmap_esg_profit_by_sector.py, we see correlation between esg factors and profit margins by industrial sector.

Healthcare (n=240)
(masked if p ≥ 0.05)

	netProfitMargin	grossProfitMargin	operatingProfitMargin
Total ESG Risk score		0.33	0.16
Environment Risk Score			
Social Risk Score		0.29	
Governance Risk Score	0.23	0.33	0.41
Controversy Score	-0.20	-0.21	-0.25

Industrials (n=280)
(masked if p ≥ 0.05)

	netProfitMargin	grossProfitMargin	operatingProfitMargin
Total ESG Risk score	-0.19	-0.21	-0.19
Environment Risk Score	-0.17	-0.21	-0.18
Social Risk Score		-0.13	
Governance Risk Score	-0.13		-0.19
Controversy Score	-0.25	-0.32	-0.25

Real Estate (n=140)
(masked if p ≥ 0.05)

	netProfitMargin	grossProfitMargin	operatingProfitMargin
Total ESG Risk score			
Environment Risk Score			
Social Risk Score	-0.18	0.22	
Governance Risk Score		0.40	
Controversy Score			

Technology (n=295)
(masked if p ≥ 0.05)

	netProfitMargin	grossProfitMargin	operatingProfitMargin
Total ESG Risk score		0.13	0.17
Environment Risk Score	0.12		0.14
Social Risk Score		0.41	0.14
Governance Risk Score		-0.23	
Controversy Score		-0.22	

Utilities (n=140)
(masked if p ≥ 0.05)

	netProfitMargin	grossProfitMargin	operatingProfitMargin
Total ESG Risk score	-0.19		
Environment Risk Score			
Social Risk Score	-0.27		-0.17
Governance Risk Score			
Controversy Score	-0.32		-0.27

Basic Materials (n=85)
(masked if p ≥ 0.05)

	netProfitMargin	grossProfitMargin	operatingProfitMargin
Total ESG Risk score			
Environment Risk Score		-0.25	
Social Risk Score			
Governance Risk Score		-0.30	-0.22
Controversy Score			

Communication Services (n=65)
(masked if p ≥ 0.05)

	netProfitMargin	grossProfitMargin	operatingProfitMargin
Total ESG Risk score	0.45	0.46	0.57
Environment Risk Score		0.29	
Social Risk Score	0.48	0.46	0.57
Governance Risk Score	0.58		0.58
Controversy Score	0.56	0.65	0.56