LA QUESTION DE L'(IN)EFFICIENCE DES MARCHÉS FINANCIERS FACE À LA TRANSITION ÉCOLOGIQUE

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Chaire Énergie et Prospérité

Backtesting ESG Ratings

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Agenda

1. Introduction: motivation, methodology and results
2. Overview of ESG research
3. Contribution to existing research on ESG
4. Methodology
5. Empirical application
6. Conclusion

1. Introduction

1.1 Motivation

ESG, main driver in the financial industry.

- ESG assets are on track to exceed $53 trillion by 2025, representing more than a third of the $140.5 trillion in projected total assets under management.
- Fast evolving environment - multiple labels with different (and sometime non-transparent) methodologies leading to difficult implementation of ESG criteria for financial institutions.
- Improving but still low and confusing regulation (SFDR, Paris agreement,…).
- ESG preferences become as important as risk/reward for asset allocation.

ESG ratings, essential but reliable?

- No standard framework for disclosure of ESG elements at the firm level (Sustainability Accounting Standards Board, the Global Reporting,…)
- Oligopolistic organization of ESG rating agencies (Asset4, Sustainalytics and MSCI) but different methodologies and scope lead to biased and divergent ratings (see Berg, 2022 and PRI working groups).
- Revision of ratings, systematic and related to past performance (Berg et al., 2021).

➢ One criterion to check and compare ESG ratings? ESG incidents or controversies?

1. Introduction

1.1 Motivation

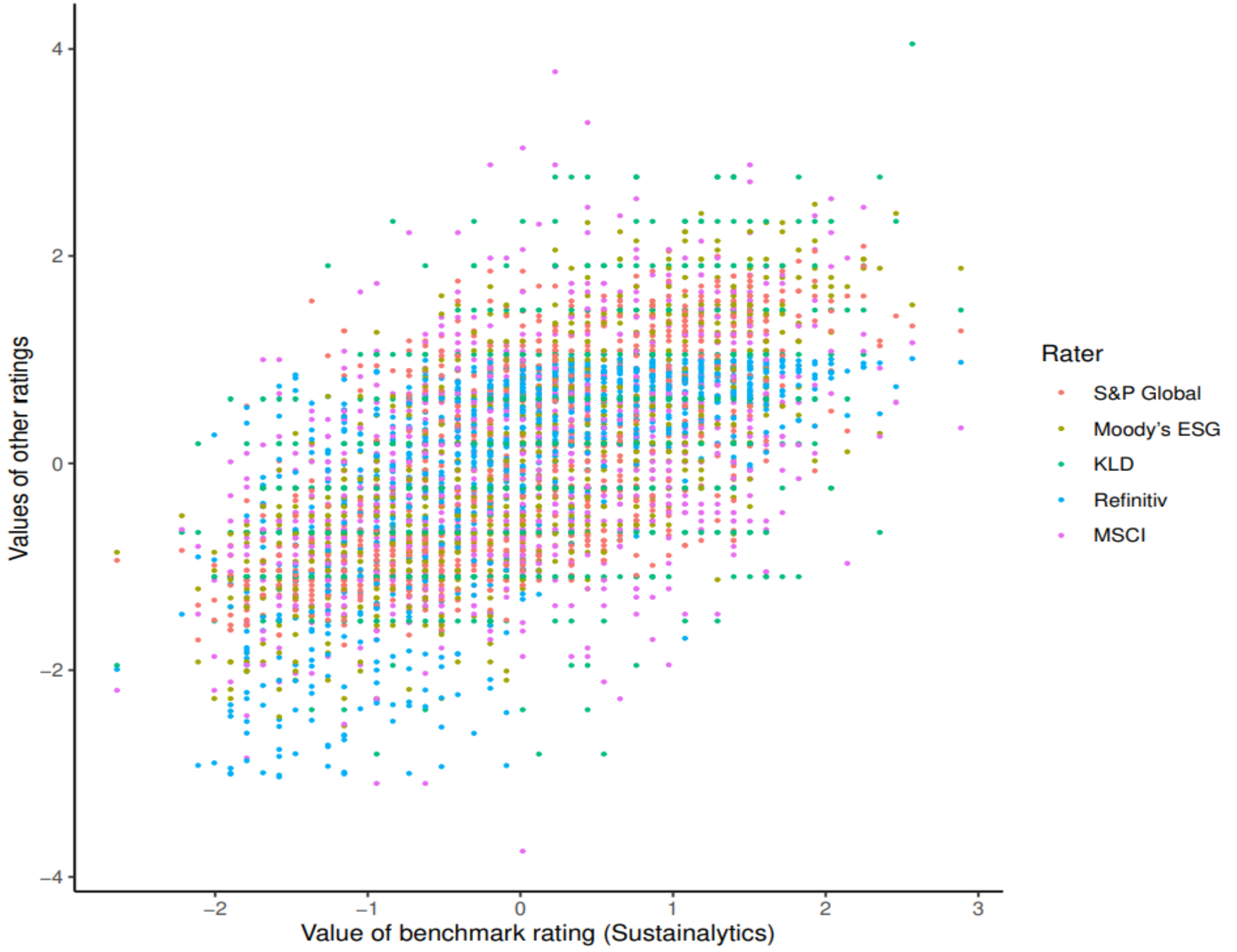


Figure 1: *(Berg et al., 2020. Sustainalytics ESG ratings vs five other ESG providers. Values are normalized.)*

1. Introduction

1.2 Problematic and methodology

Research questions

- Is there any informational content in the various existing ESG rating systems?
- Is this informational content related to the degrees of exposure to ESG risk?
- Is there an ESG ratings system more accurate than the other?

Methodology

- Measuring how well ESG ratings (Sustainalytics and Asset4) help in predicting ESG risk materialization as given by an increase in idiosyncratic realized volatility.
- Extending the conditional predictive ability test of Giacomini and White (2006) to a panel data setting (firms and times.

<u>The procedure tests for the difference between two loss functions, one resulting from a predictive model of idiosyncratic volatility using only financial variables and the other resulting from the same predictive model enhanced with ESG ratings.</u>

- If the null hypothesis holds (no difference between the two loss functions), including ESG ratings does not help for forecasting idiosyncratic volatility.
- If the null hypothesis is rejected, considering ESG ratings in forecasting idiosyncratic volatility overall gives real benefit across all firms and times.

Disparities between A4 and Sust. regardings Controversy ratings

- The boxplot highlights the consistency between Asset 4 and Sustainalytics for companies with a good controversy rating.
- On the other hand, for companies rated highly controversial by Sustainalytics (4 or 5), the distribution of Asset 4 ratings is much wider.
- For companies rated 5 by Sustainalytics , A4 ratings average around 50, representing moderate controversy.

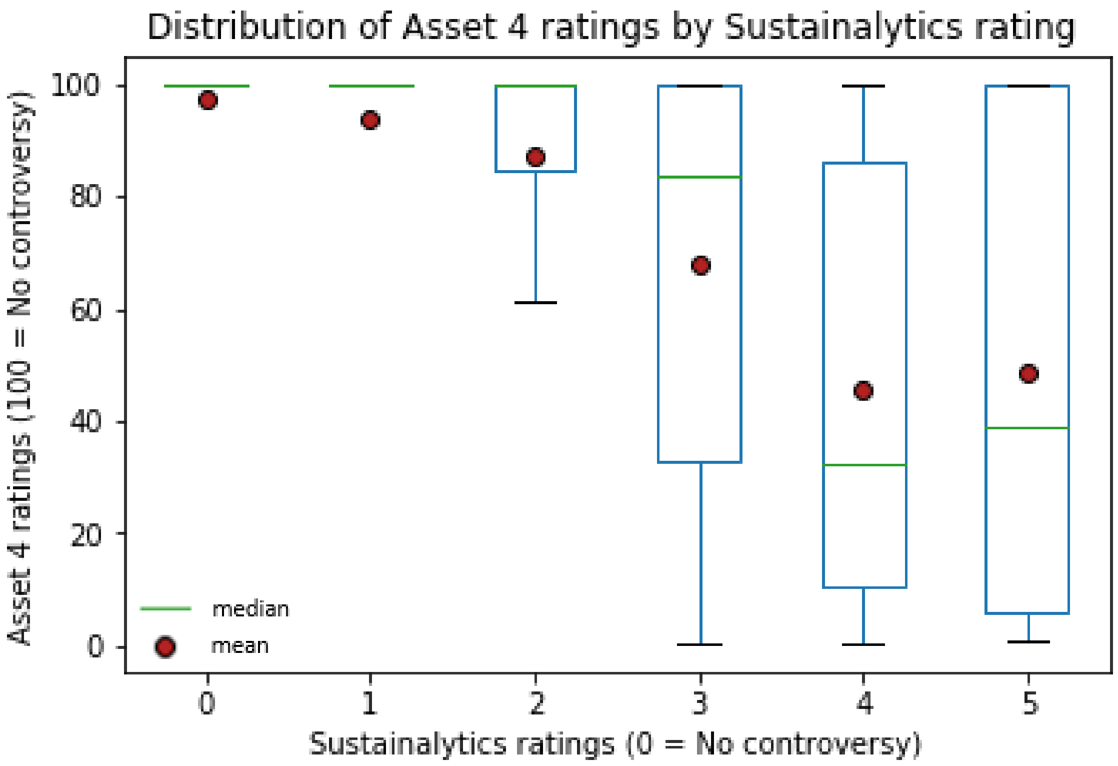
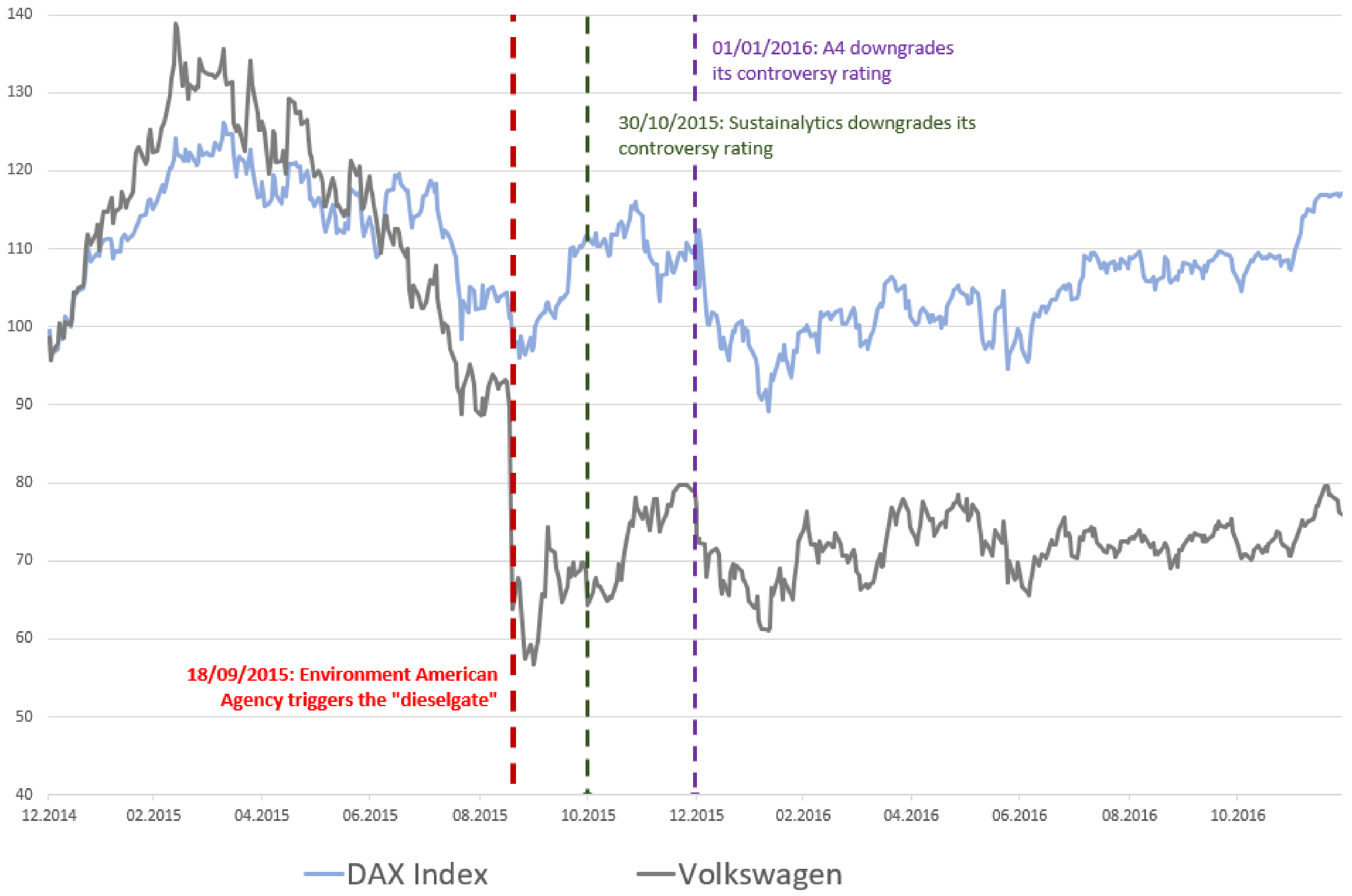


Figure 6: Boxplot of A4 and Sustainalytics rating

Source: Monthly data from 01/31/2012 to 12/31/2020 for 1201 stocks, Asset 4 and Sustainalytics

ESG incidents: events vs records



1. Introduction

1.3 Main results

- The null hypothesis of lacking informational content of ESG ratings is rejected in Europe and in a lesser extent North America, where there is less disagreement between the two ratings (Asset4 and Sustainalytics).

- Results are mixed for the Asia-Pacific region, where there is more disagreement.

- **Applying the test only to firms with convergent ESG ratings leads to the null hypothesis being rejected for all three regions.**

➢ Results confirm Serafeim and Yoon (2021), who found that consensus about the ESG rating predicts ESG risks, but the predictive ability diminishes for firms about which there is large disagreement among rating agencies.

2. Overview of ESG research

- **Positive impact on asset prices and cost of capital** (Mozaar et al., 2016; Amel-Zadeh and Serafeim, 2018; Hartzmark and Sussman, 2019). **Engagement by investors has a positive impact on ESG performance** and ultimately on financial returns (Dyck et al., 2019).

- **Investors' preferences for ESG affect expected returns** - investors are willing to accept lower expected returns and higher management fees for holding companies with strong ESG performance (Pastor et al., 2020; Pedersen et al., 2020; Lioui et al., 2021).

- **Correlations between the ratings of the various available providers are weak** (Chatterji et al., 2009; Semenova and Hassel, 2015; Chatterji et al., 2016; Berg et al., 2020) - ESG ratings of providers are on average 61% for a set of five different ESG providers.

- **Heterogeneity in ESG ratings can lead to completely opposite opinions on the same company** and disperses the ESG preferences of investors (Billio et al., 2019).

2. Overview of ESG research

- **ESG ratings should have significant power in predicting ESG events** - strong extra financial performance in the form of good environmental externalities, and good social impact are less likely to face ESG events which then poorly reflect on financial performances (Champagne et al., 2019, Serafeim and Yoon, 2021).

- Champagne et al. (2019) observe that **an increase of one unit in a firm's rating reduces its probability of facing adverse events during the following year by 8%**, and this result holds even after controlling for the impact of financial performance variables.

- Serafeim and Yoon (2021), use a firm-day panel dataset to show that **the latest outstanding consensus ESG rating is associated with future ESG news.**

Issues

1. Use of proprietary tools to identify ESG risks.
2. In-sample approach.
3. Existence of the link between ESG ratings and ESG risks depends deeply on the correct specification of the econometric models.

3. Contribution to existing research on ESG

Issue 1 - Use of proprietary tools to identify ESG risks

- Objective measure that is not subject to data revisions and divergence across providers: the idiosyncratic realized volatility.
- ESG ratings correctly measures ESG risks in our approach if high (low) values are associated with low (high) levels of idiosyncratic volatility, once the effects of traditional financial variables are taken into account.

Issue 2 - In-sample approach

- Out-of-sample and dynamic forward looking approach that fits with the practice of institutions.

Issue 3 - Existence of the link between ESG ratings and ESG risks depends deeply on the correct specification of the econometric models

- Robustness of our approach that allows for possible misspecifation of the model.

4. Methodology

4.1 Definition of the null hypothesis

- $\boldsymbol{y_{i,t}}$, ESG incident or a market variable highly correlated with ESG incidents (e.g. idiosyncratic volatility).
- $\boldsymbol{x_{i,t}}$, vector of $\boldsymbol{p}$ financial variables.

Let $\boldsymbol{m^{(0)}_{i,t+\tau} = E(y_{i,t}|x_{i,t})}$ be the unknown expected value of $\boldsymbol{y_{i,t}}$ for firm $\boldsymbol{i}$ at time $\boldsymbol{t+\tau}$.

The forecast (obtained from a given predictive model) is noted $\boldsymbol{\widehat{m}^{(0)}_{i,t+\tau}(\widehat{\beta}^{(0)}_{t,b_t})}$ and based on $\boldsymbol{\mathcal{F}^{(0)}_t = \{x_{i,s}, s = t - b_t + 1, \dots, t, i = 1, \dots, n\}}$ where $\boldsymbol{b_t}$ refers to the size of the estimation sample and $\boldsymbol{\widehat{\beta}^{(0)}_{t,b_t}}$ collects all the estimated parameters.

Let $\boldsymbol{m^{(1)}_{i,t+\tau} = E(y_{i,t}|x_{i,t}, \omega_{i,t})}$ be defined as $\boldsymbol{m^{(0)}_{i,t+\tau}}$ but $\boldsymbol{\mathcal{F} \equiv \mathcal{F}^{(1)}_t}$ is extended to include the ESG rating as given by $\boldsymbol{\omega_{i,t}}$.

$\boldsymbol{T_0}$ out-of-sample forecasts of both expected values $\boldsymbol{m^{(0)}_{i,t+\tau}}$ and $\boldsymbol{m^{(1)}_{i,t+\tau}}$ for each firm are produced and we denote $\boldsymbol{\mathcal{L}(.)}$ the loss function.

The predictive performance of each model is evaluated by generating two panels of losses:

$$\boldsymbol{\mathcal{L}^{(0)}_{i,t+\tau} \equiv \mathcal{L}^{(0)}_{i,t+\tau}(y_{i,t+\tau}, \widehat{m}^{(0)}_{i,t+\tau}(\widehat{\beta}^{(0)}_{t,b_t}))} \text{ and } \boldsymbol{\mathcal{L}^{(1)}_{i,t+\tau} \equiv \mathcal{L}^{(1)}_{i,t+\tau}(y_{i,t+\tau}, \widehat{m}^{(1)}_{i,t+\tau}(\widehat{\beta}^{(1)}_{t,b_t}))}$$

4. Methodology

4.1 Definition of the null hypothesis

Let $\boldsymbol{\Delta\mathcal{L}_{i,t+\tau}} = \boldsymbol{\mathcal{L}_{i,t+\tau}^{(1)}} - \boldsymbol{\mathcal{L}_{i,t+\tau}^{(0)}}$ be the panel of loss differentials and $\boldsymbol{\mu_i(\widehat{\beta}_{t,b_t}^{(0)}, \widehat{\beta}_{t,b_t}^{(1)})}$ the expected value of loss differentials for firm $\boldsymbol{i}$.

Hence, the null hypothesis of overall equal predictive ability of two forecasting models can be stated as:

$$\boldsymbol{H_0}\colon \boldsymbol{\overline{\mu}\left(\widehat{\beta}_{t,b_t}^{(0)}, \widehat{\beta}_{t,b_t}^{(1)}\right) = 0}$$

with the alternative hypothesis being:

$$\boldsymbol{H_1}\colon \boldsymbol{\overline{\mu}\left(\widehat{\beta}_{t,b_t}^{(0)}, \widehat{\beta}_{t,b_t}^{(1)}\right) < 0}$$

and,

$$\boldsymbol{\overline{\mu}\left(\widehat{\beta}_{t,b_t}^{(0)}, \widehat{\beta}_{t,b_t}^{(1)}\right) = \frac{1}{n}\sum_{i=1}^{n} \mu_i\left(\widehat{\beta}_{t,b_t}^{(0)}, \widehat{\beta}_{t,b_t}^{(1)}\right)}$$

with $\boldsymbol{n}$ the number of firms.

4. Methodology

4.2 Simulations under misspecifications

Simulation setup

Simulation of vector $\boldsymbol{x}_{i,t}$ of length $\boldsymbol{p} = \mathbf{10}$ with $\boldsymbol{t} = \mathbf{1}, \dots \boldsymbol{T}$ and $\boldsymbol{T} \in \{\mathbf{120}, \mathbf{180}, \mathbf{240}\}$. These $\boldsymbol{p}$ variables are generated from a multivariate Gaussian distribution with mean vector $\overline{\boldsymbol{x}}$ and covariance matrix $\boldsymbol{\Omega}$ calibrated using real data.

We generate the log value of $\boldsymbol{y}_{i,t}$ for firm $\boldsymbol{i}$ as:

$$\log(\boldsymbol{y}_{i,t+1}) = \boldsymbol{c}_i^* + \boldsymbol{x}'_{i,t}\boldsymbol{\beta}_i^* + \boldsymbol{\gamma}\boldsymbol{\omega}_{i,t} + \boldsymbol{u}_{i,t+1}$$

With $\boldsymbol{\gamma} \in \mathbb{R}^-$ a parameter. The null hypothesis holds for $\boldsymbol{\gamma} = \mathbf{0}$.

For each Mote Carlo replication, with $\boldsymbol{n}$ and $\boldsymbol{T}$ fixed, the above simulation design is run for the $\boldsymbol{n}$ firms, with $\boldsymbol{n} \in \{\mathbf{100}, \mathbf{250}, \mathbf{500}\}$.

4. Methodology

4.2 Simulations under misspecifications

Medium level of misspecification

- Forecasts are obtained using pooled OLS regression models.

- Generating process uses a linear form for the logarithm of $y_{i,t}$ whereas pooled OLS regressions are fitted for the raw values of the same variable.

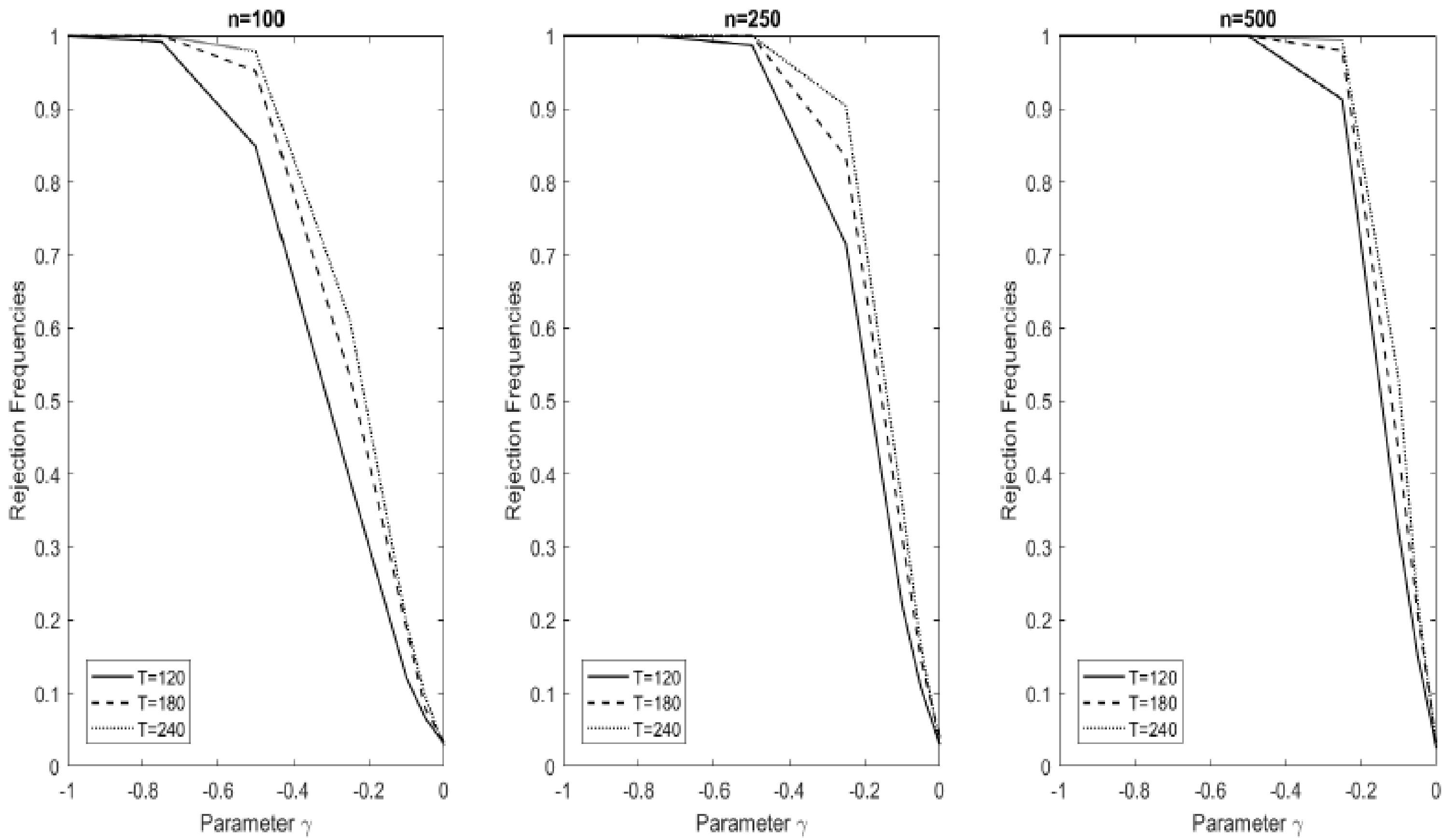


***Figure 2**: Rejection frequencies under a medium level of misspecification with the squared error loss function*

4. Methodology
4.2 Simulations under misspecifications

High level of misspecification

- Only p/2 financial variables are randomly retained.
- Forecasts are obtained using pooled OLS regression models.
- Generating process uses a linear form for the logarithm of $y_{i,t}$ whereas pooled OLS regressions are fitted for the raw values of the same variable.

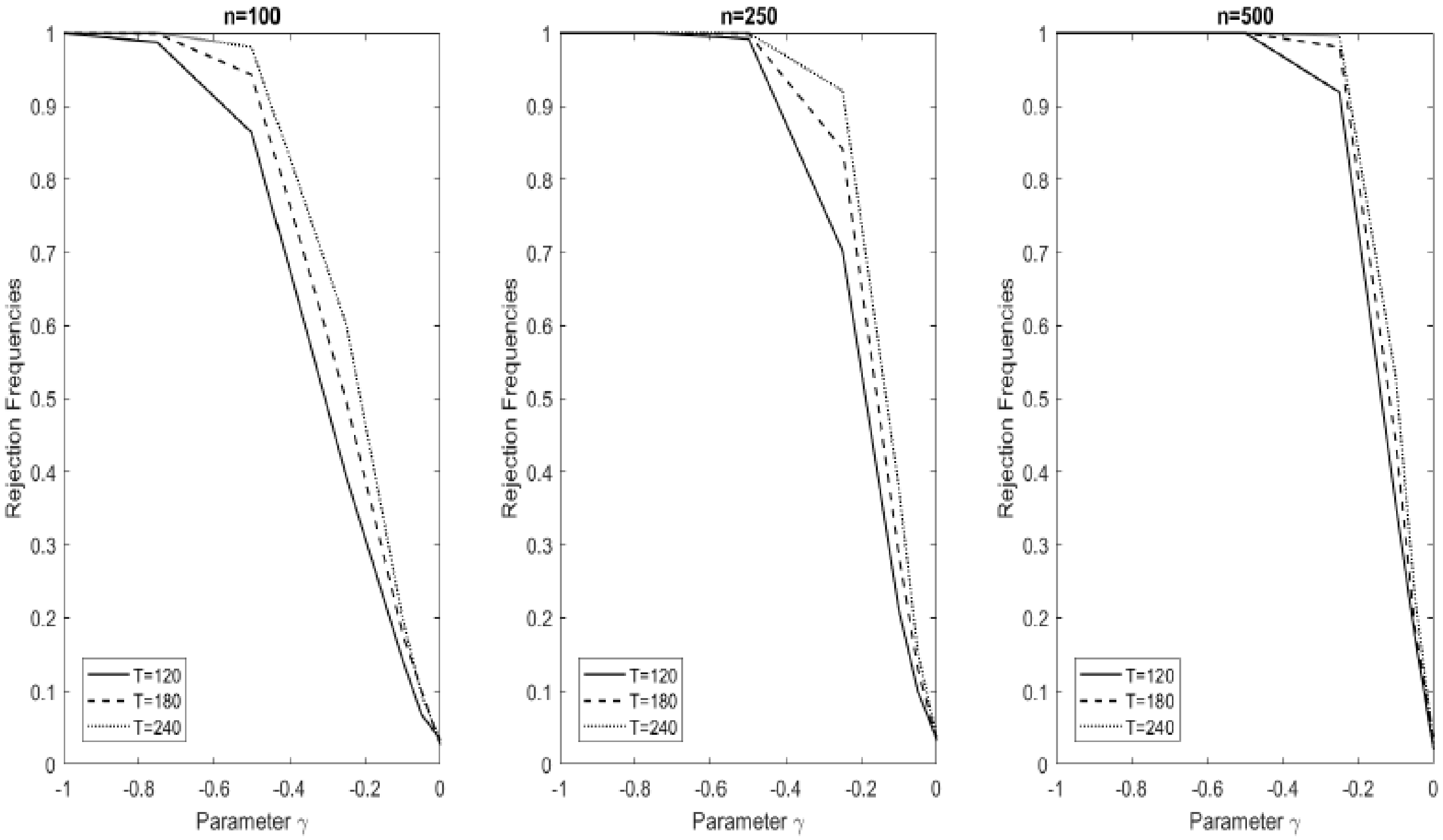


Figure 3: *Rejection frequencies under a high level of misspecification with the squared error loss function*

4. Methodology

4.3 Idiosyncratic volatility as target variable

- Divergence of ESG incident measures across providers. Rank correlations of ESG incident metrics are weak (around 40% in our dataset).

- Materialisation of an ESG risk generates market stress which is always accompanied by an increase in idiosyncratic volatility (e.g. Volkswagen, Wirecard, Steinhoff…). ESG incident variables are lagging the event.

- Academic research reported a link between ESG risks and idiosyncratic volatility. E.g. Jo and Na (2012) note that companies with lower leverage and high ESG ratings are best at capturing the benefits of ESG performance to reduce idiosyncratic risk.

- Our inferential procedure controls for the effects of idiosyncratic factors (here innovation in financial variables).

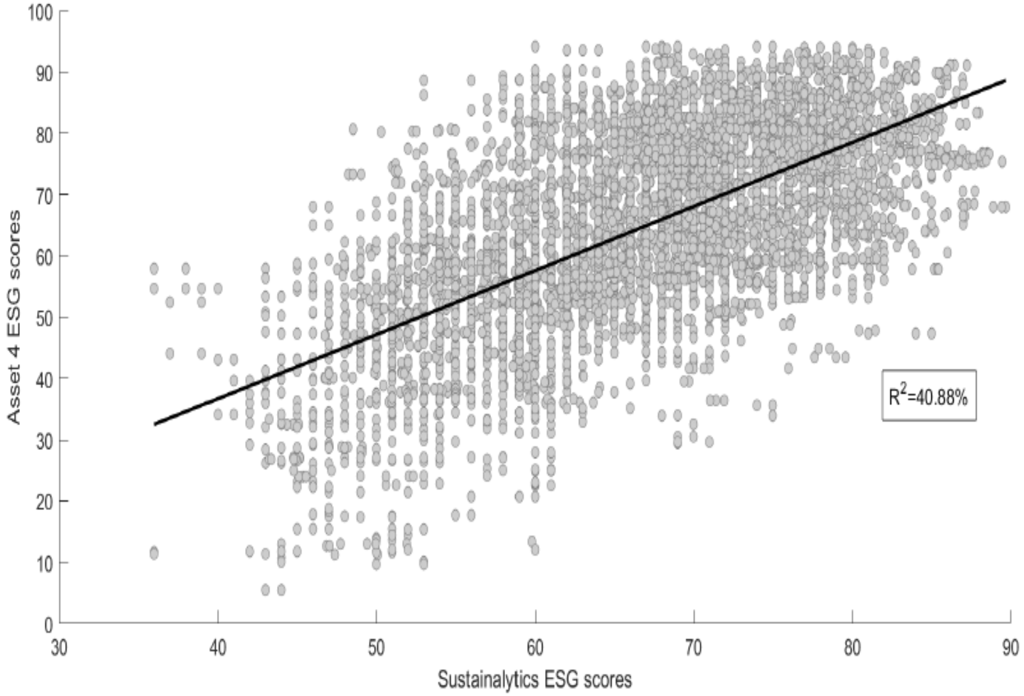


Figure 4: *Relation between Sustainalytics and Asset4 ESG ratings (Europe).*

5. Empirical application

5.1 Framework

- The methodology is applied to two popular providers of ESG materials, Sustainalytics and Asset4, over three universes, North America, Europe and Asia-Pacific.

- Dataset contains information (financial variables, ESG ratings, market returns) for $\boldsymbol{n = 781}$ firms at a monthly frequency over a period ranging from January 2010 to October 2018 ($\boldsymbol{T = 106}$ months).

- Pooled OLS regression for the two models needed to run our testing procedure.

Several specifications for robustness check:

i. Two forecasting schemes: a fixed scheme where 75% of $\boldsymbol{T}$ is used to estimate both models and forecasts computed on last 25%; a rolling-window scheme with forecasts computed by moving sample by one more month, giving different estimation samples with the same fixed size $\boldsymbol{b_t = b = [0.75T]}$.

ii. Two different loss functions: mean squared error; mean absolute error.

iii. Two factor models to compute the idiosyncratic volatility: CAPM; multifactor (extension of Fama-French model).

5. Empirical application

5.2 Results

- For Europe, the introduction of ESG information significantly increases the model predictive power in all configurations. Results appear to be mixed for other universes.
- We obtain similar results using either Sustainalytics or Asset 4 ESG ratings.

Sustainalytics		ESG	E	S	G
Rolling Window	EU	**−3.124%*****	**−4.107%*****	**−2.035%*****	**−0.528%*****
	NA	−0.009%	**−0.779%*****	0.438%	0.345%
	AP	**−0.171%****	**−0.591%*****	−0.029%	0.038%
Fixed Window	EU	**−4.249%*****	**−4.938%*****	**−2.763%*****	**−1.146%*****
	NA	0.393%	**−1.001%****	1.094%	0.769%
	AP	**−0.525%****	**−0.667%****	−0.166%	**−0.241%***
Asset 4		**ESG**	**E**	**S**	**G**
Rolling Window	EU	**−3.694%*****	**−3.4%*****	**−4.063%*****	**−0.192%***
	NA	−0.324%	**−0.51%*****	**−0.362%***	0.32%
	AP	−0.015%	**−0.123%*****	**−0.336%*****	−0.048%
Fixed Window	EU	**−4.815%*****	**−3.556%*****	**−5.055%*****	**−0.755%****
	NA	**−1.351%****	**−0.94%****	**−1.274%****	0.266%
	AP	**−0.144%*****	**−0.281%*****	**−0.451%*****	0.075%

Table 1: *Backtest of ESG ratings: results for squared error loss and idiosyncratic volatility from CAPM. *,*,*** indicate rejection of the null hypothesis at the 10%, 5% and 1% nominal risk levels respectively.*

5. Empirical application

5.2 Results

- Results appear to be robust to the choice of the loss function.
- Results obtained in Table 1 and Table 2 suggest that the informativeness of ESG ratings about ESG risk depends on the universe and the dimension of the rating.
- Environmental (E) and social (S) dimensions of the ratings appear to carry more information. It is consistent with Berg et al (2020) who reported higher noise for governance dimension (G).

Sustainalytics					
		ESG	E	S	G
Rolling Window	EU	**−1.677%***	**−2.261%***	**−1%***	**−0.382%***
	NA	−0.129%	**−0.563%***	0.125%	0.147%
	AP	**−0.088%***	**−0.346%***	−0.008%	0.013%
Fixed Window	EU	**−2.397%***	**−2.845%***	**−1.441%***	**−0.76%***
	NA	−0.093%	**−0.832%***	0.388%	0.3%
	AP	**−0.326%****	**−0.398%****	−0.115%	**−0.143%***
Asset 4					
		ESG	E	S	G
Rolling Window	EU	**−2.307%***	**−1.807%***	**−2.553%***	**−0.262%***
	NA	**−0.451%***	**−0.385%***	**−0.505%***	0.058%
	AP	0.008%	**−0.062%***	**−0.146%***	**−0.062%****
Fixed Window	EU	**−2.901%***	**−1.913%***	**−3.094%***	**−0.585%***
	NA	**−1.247%***	**−0.747%***	**−1.135%***	−0.045%
	AP	**−0.067%****	**−0.162%***	**−0.22%***	0.058%

Table 2: *Backtest of ESG ratings: results for absolute error loss and idiosyncratic volatility from CAPM. *,*,*** indicate rejection of the null hypothesis at the 10%, 5% and 1% nominal risk levels respectively.*

5. Empirical application
5.2 Results

- Results appear to be robust to the choice of the factor model.

		ESG	E	S	G
Sustainalytics					
Rolling Window	EU	−3.434%***	−4.489%***	−2.238%***	−0.637%***
	NA	−0.212%	−0.91%***	0.314%	0.265%
	AP	−0.112%*	−0.648%***	−0.013%	−0.004%
Fixed Window	EU	−4.606%***	−5.344%***	−3.005%***	−1.335%***
	NA	0.143%	−1.021%**	0.923%	0.538%
	AP	−0.414%*	−0.698%**	−0.082%	−0.092%
Asset 4		ESG	E	S	G
Rolling Window	EU	−3.997%***	−3.729%***	−4.149%***	−0.2%*
	NA	−0.642%**	−0.721%***	−0.489%*	0.313%
	AP	0.158%	−0.045%***	−0.079%***	−0.205%**
Fixed Window	EU	−5.189%***	−3.816%***	−5.189%***	−0.874%***
	NA	−1.805%***	−1.262%**	−1.382%**	0.115%
	AP	0.168%	−0.152%***	−0.003%***	−0.098%**

Table 3: *Backtest of ESG ratings: results for squared error loss and idiosyncratic volatility from multifactorial model. *,*,*** indicate rejection of the null hypothesis at the 10%, 5% and 1% nominal risk levels respectively.*

5. Empirical application
5.3 Extension

- We partitioned each panel into consensus and disagreement groups based on the firm level correlation between the ratings of the two providers.
- Results show important differences in terms of the rejection of the null hypothesis between the two groups. Overall, predictive accuracy gains resulting from the inclusion of ESG information are considerably greater for firms belonging to the consensus group.

Sustainalytics		ESG	E	S	G
Consensus	EU	**−9.675%*****	**−9.1%*****	**−6.555%*****	**−4.772%*****
	NA	**−1.968%*****	**−3.309%*****	**−1.091%****	0.774%
	AP	**−1.841%*****	**−3.017%*****	**−0.33%*****	**−0.571%***
Disagreement	EU	**−3.448%*****	**−2.794%*****	**−3.121%*****	−0.145%
	NA	**−0.789%***	**−1.15%****	−0.339%	−0.013%
	AP	**−1.445%*****	0.358%	**−1.24%***	**−1.721%*****

Asset 4		ESG	E	S	G
Consensus	EU	**−6.45%*****	**−7.659%*****	**−7.111%*****	−0.027%
	NA	**−2.223%*****	**−4.997%*****	**−2.043%*****	0.732%
	AP	**−2.718%*****	**−3.159%*****	**−1.064%*****	**−0.354%*****
Disagreement	EU	**−1.921%*****	**−4.02%*****	**−2.574%*****	0.49%
	NA	−0.043%	−0.221%	−0.193%	0.387%
	AP	−0.265%	**−0.893%****	0.234%	**−0.224%***

Table 4: *Consensus (top 25% correlations) vs disagreement (bottom 25% correlations) between providers using a rolling window forecasting scheme (MSE) and idiosyncratic volatility from multifactorial model. *,*,*** indicate rejection of the null hypothesis at the 10%, 5% and 1% nominal risk levels respectively.*

6. Conclusion

- The null hypothesis of a lack of informational content about ESG risks in the ESG ratings is strongly rejected for Europe and to a lesser extent for the North-America and Asia-Pacific Region

- Applying the test only to firms over which there is a high degree of consensus leads to higher predictive accuracy gains for all three universes.

- For investors, this procedure provides a useful and practical framework for considering ESG ratings before integrating them into the investment process.

- Future application for investors could be to compare the ratings of competing ESG rating agencies, since our inferential procedure can be easily adapted to compare the informational content about ESG risks in the ESG ratings.

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Maison des sciences économiques, Paris, 23 juin 2023

Chaire Énergie et Prospérité

Alpha and betas of ESG funds: Fifty shades of Green

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Patrick Kouontchou, Université de Lorraine- CEREFIGE

Main Questions

- ESG Funds Identification: Why is it so important ?

  - *Could be really difficult for investors to identify ESG funds.*
  - *Information asymmetry between asset managers and investors.*
  - *Various criteria used to identify an ESG fund. Consistency?*
  - *Need for regulation (reducing information asymmetry)*

- Are ESG funds really outperforming “conventional” funds ?

  - *Yes, according to literature (Mozaffar et al., 2016; Amel-Zadeh and Serafeim, 2018)*
  - *Depending on the different way of identification, is there real proof of excess returns for ESG funds ?*
  - *What about the regional, sectoral and styles bias of ESG funds ?*
  - *Overlap between extra-financial and financial characteristics*
  - *Controlling for risk factors (linked to characteristics): no alpha or ESG premium*

1. Funds Identification

1.1 Framework

➢ We define 8 criteria to identify an ESG fund:

Objective Criteria

- *Fund names*: specific words referring to ESG in the fund name (matching procedure)
- *ESG Label*: all label funds (ISR ECO Label, FNG-Siegel, Towards Sustainability and LuxFLAG ESG)
- *PRI Signatory*: all Proponent of Responsible Investment signatory funds

Declarative Criteria

- *Controversy*: ESG funds with a low risk of controversy (percentile: 32.5)
- *Sust. Ratings*: fund rated "high" and "above average" according to Sustainalytics methodology.
- *Carbon risk*: portfolio with a low carbon footprint (see Hale, 2018) (percentile 32.5)

Market Criteria

- *SRI multi-factor beta*: portfolio sensitivities to the MSCI SRI index*.
- *Climate beta*: portfolio sensitivities to the climate factor*.

** See appendix*

1. Funds Identification

1.2 Data

- Wide disparity of information contained in the criteria.
- PRI Signatory represents 48% of the global universe whereas ESG Label represent 3% of the Universe.
- This large difference could be explained by the strict condition set up by countries for obtaining a label.

Table 1: Number of funds selected for the different criteria and universes

Critères ESG	Europe (881)		US (585)		Global (2920)	
	Nombre	% univers	Nombre	% univers	Nombre	% univers
Nom du fonds	127	14,42%	57	9,74%	335	11,47%
ESG Label	103	11,69%	24	4,10%	97	3,32%
Signataires PRI	523	59,36%	344	58,80%	1390	47,60%
Controverses	171	19,41%	122	20,85%	449	15,38%
Sust. Rating	164	18,62%	148	25,30%	518	17,74%
Risque Carbone	175	19,86%	122	20,85%	446	15,27%
Beta multi-facteur ISR	325	36,89%	141	24,10%	1126	38,56%
Beta climat	255	28,94%	28	4,79%	183	6,27%

Sources: Morningstar data for the different universes (Europe, USA and Global) as at 28/03/2022 for the criteria (ESG Rating, Controversies, Carbon Risk, Fund Name, SRI Label and PRI signatories) and weekly fund returns in Euro (for Europe and Global) and USD (for US) from 09/01/2016 to 19/03/2022.

1. Funds Identification

1.3 Matching Table

- The "PRI signatory" criterion, based on voluntary participation, is logically the least demanding.
- “Sust. Rating” , “Controversies” and “Carbon Risk” criteria describe the same information.
- The criteria may be homogeneous in some cases and heterogeneous in others.

Table 2: Proportion of funds matching various criteria (all funds in the universe) - Europe universe

	Total	Nom du fonds	ESG Label	Signataires PRI	Controverses	Sust. Rating	Risque Carbone	Beta multi-facteur ISR	Beta climat
Nom du fonds	127	100,00%	40,16%	63,78%	44,09%	43,31%	44,09%	59,84%	15,75%
ESG Label	103	49,51%	100,00%	76,70%	43,69%	50,49%	44,66%	65,05%	20,39%
Signataires PRI	523	15,49%	15,11%	100,00%	19,89%	19,50%	21,99%	37,67%	28,87%
Controverses	171	32,75%	26,32%	60,82%	100,00%	56,73%	54,39%	52,63%	25,15%
Sust. Rating	164	33,54%	31,71%	62,20%	59,15%	100,00%	69,51%	60,98%	23,78%
Risque Carbone	175	32,00%	26,29%	65,71%	53,14%	65,14%	100,00%	57,71%	20,57%
Beta multi-facteur ISR	325	23,38%	20,62%	60,62%	27,69%	30,77%	31,08%	100,00%	32,31%
Beta climat	255	7,84%	8,24%	59,22%	16,86%	15,29%	14,12%	41,18%	100,00%

Sources: Morningstar data for the different universes (Europe, USA and Global) as at 28/03/2022 for the criteria (ESG Rating, Controversies, Carbon Risk, Fund Name, SRI Label and PRI signatories) and weekly fund returns in Euro (for Europe and Global) and USD (for US) from 09/01/2016 to 19/03/2022.

1 . Funds Identification

1.4 *A priori* classification

- We break down the criteria into three meta-categories: "objective criteria", "declarative criteria" and "market criteria".
- Meta-category funds: "objective criteria" describe a homogeneous group
- "ESG label" and "Nom ESG" criteria appear homogeneously, which is reassuring regarding the risk of green washing, as it means that funds with an ESG name are also labelled.

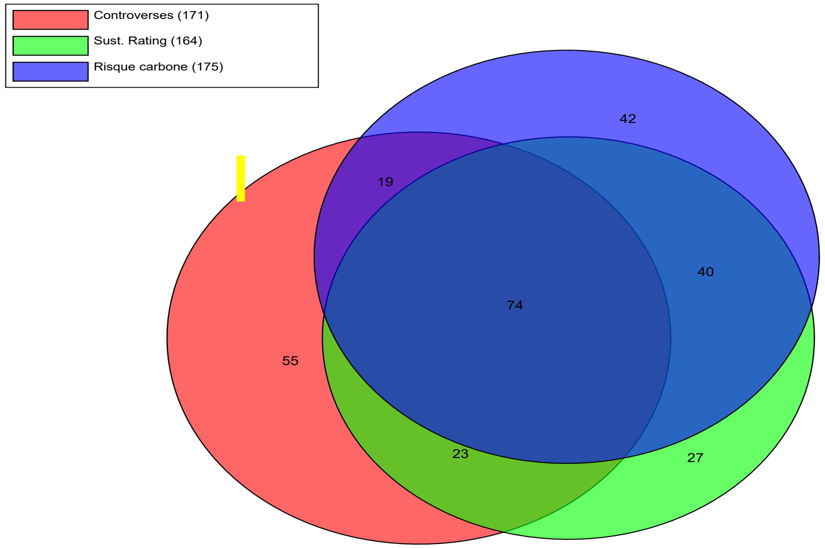

Figure 1: Number of funds in the "objective criteria" meta-category - Europe universe

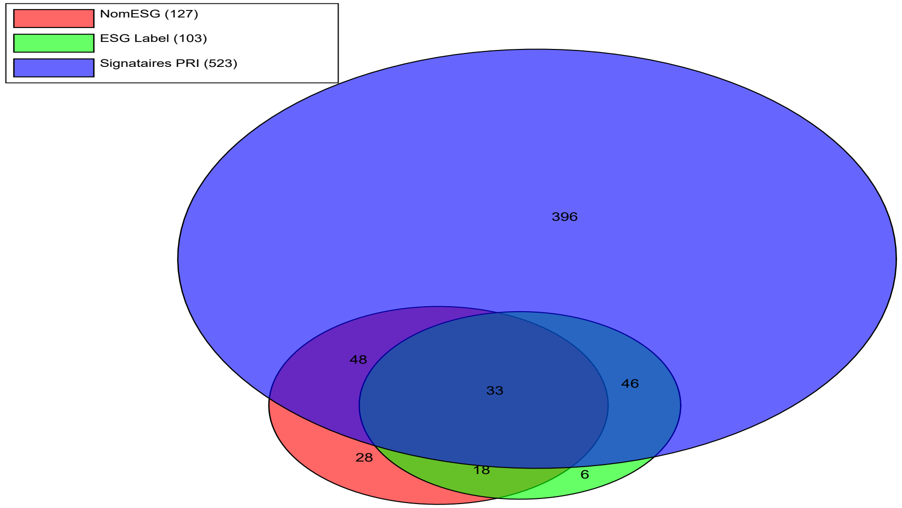

Figure 2: Number of funds in the "declarative criteria" meta-category - Europe universe

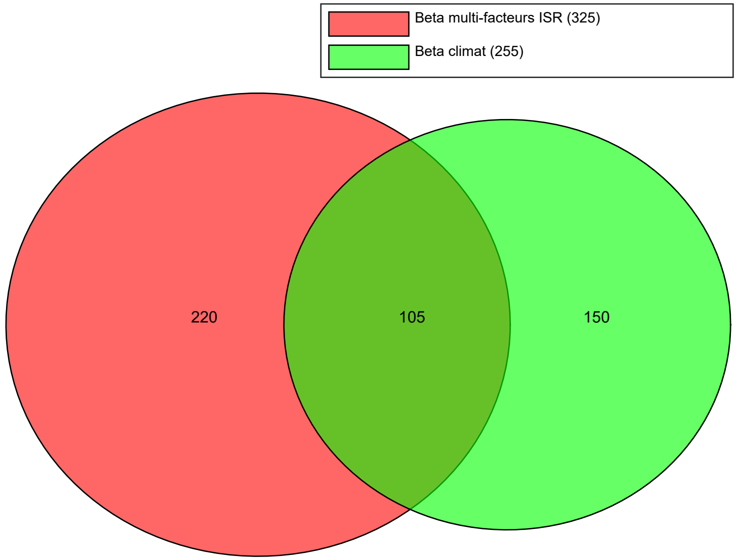

Figure 3: Number of funds in the "market criteria" meta-category - Europe universe

Source: Morningstar data for the Europe universe at 28/03/2022. Authors' calculations.

1. Funds Identification

1.5 Factorial Analysis

- We perform a principal component analysis on the various criteria The two main components represent 68% of the overall inertia.
- By considering the two principal axes, three distinct groups can be defined for the universe. Group 1 is made up of the criteria: "Fund name", "ESG Label", and "PRI signatories"; group 2 is made up of "Sust. Rating", "SRI Multi-Factor Beta", "Carbon Risk" and "Controversies", and Group 3 is made up solely of "Climate Beta".

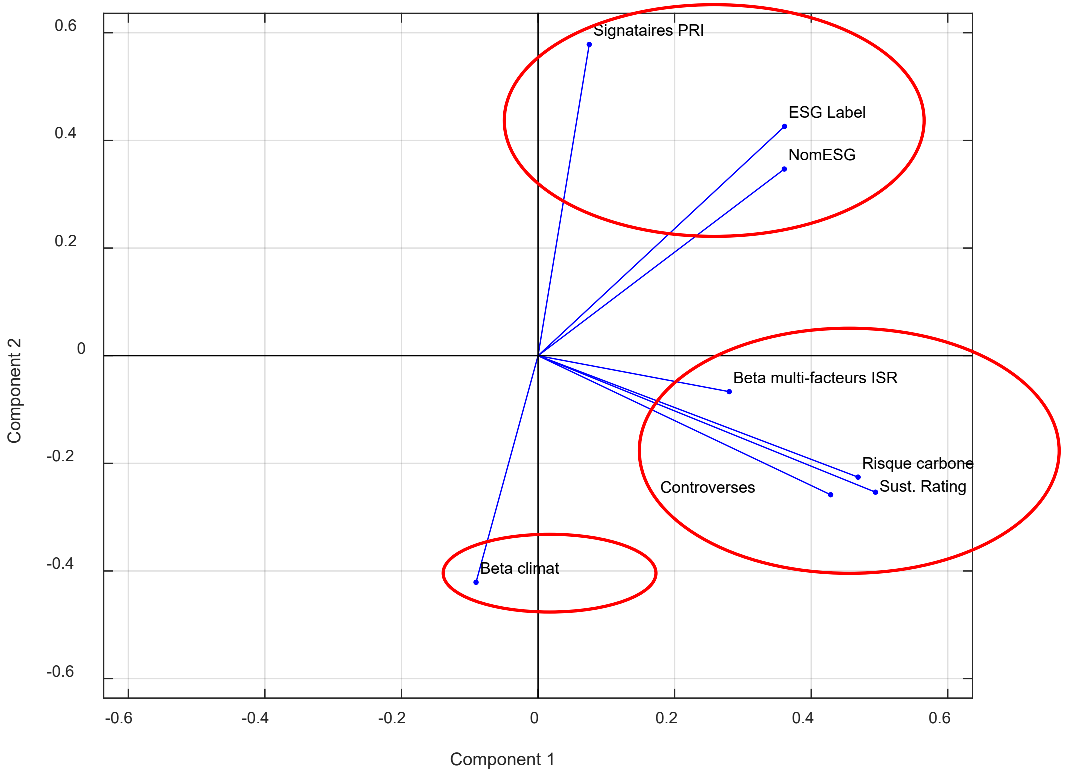

Figure 4: Projection of criteria on the two main PCA axes for the Europe universe

Sources: Morningstar data for the different universes (Europe, USA and Global) as at 28/03/2022 for the criteria (ESG Rating, Controversies, Carbon Risk, Fund Name, SRI Label and PRI signatories) and weekly fund returns in Euro (for Europe and Global) and USD (for US) from 09/01/2016 to 19/03/2022.

Style bias in ESG strategies

- ESG strategies have many style biases: large-cap, growth, quality and low-volume.
- ESG portfolios are therefore exposed to a significant rotation risk.

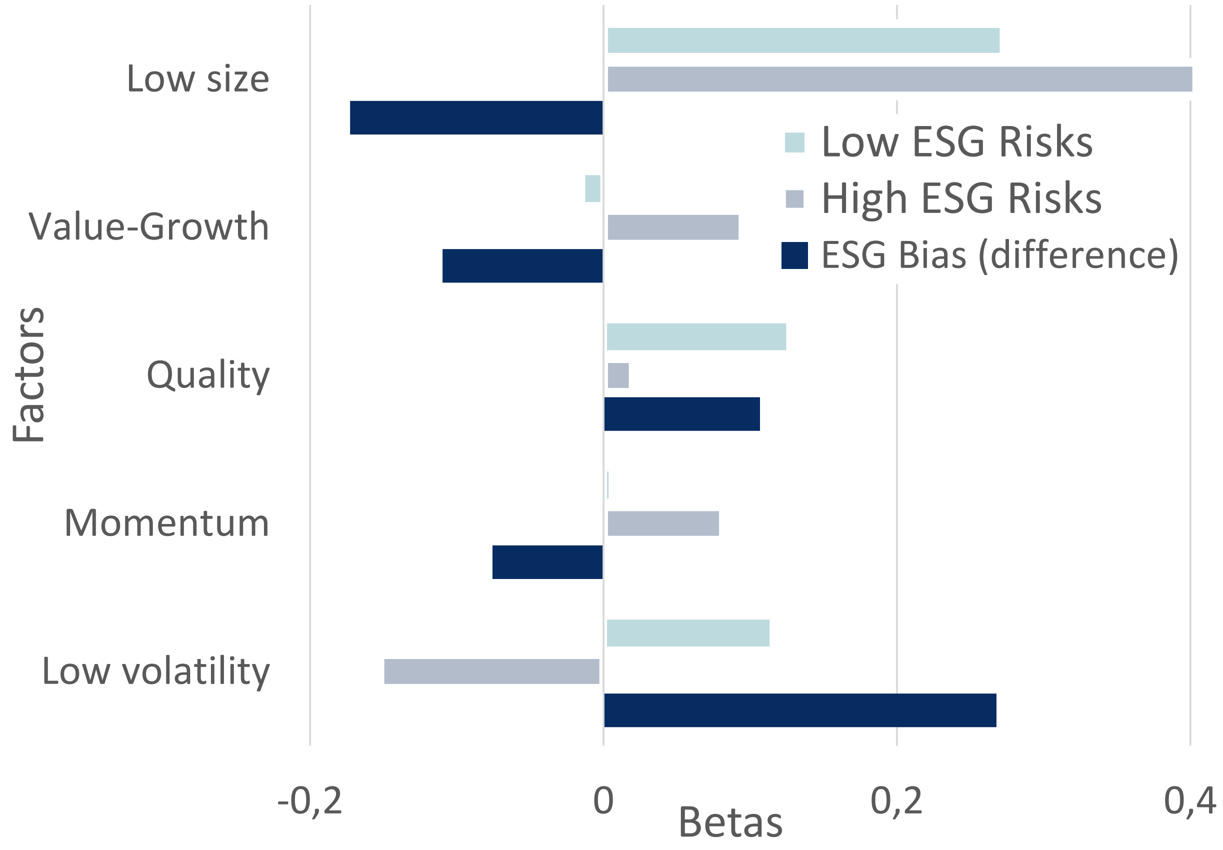

Figure 6: Alternative Beta of ESG strategies for US equities

Source: Morningtsar, Eikon, 5-year data, ESG risks of different strategies measured by Morningstar globes (High and Low risks), average betas estimated by regressions on MSCI factorial indices.

2. ESG Funds Performance

2.1 Framework

- We calculated risk and performance measures over the 1, 3 and 5-year periods for the different criteria and for the different universes (USA, Global, Europe).

- For the calculation of the "CAPM alpha" we used the following formula :

$$R_{pt} - r_f = \alpha + \beta_m(R_{mt} - r_f) + \varepsilon_t$$

- For the calculation of the "Factor model Alpha" we used the following formula :

$$R_{pt} - r_f = \alpha + \beta_m(R_{mt} - r_f) + \beta_{vg}(R_{vt} - R_{gt}) + \beta_{sl}(R_{st} - R_{lt}) + \beta_q(R_{qt} - R_{mt}) + \beta_{mom}(R_{momt} - R_{mt}) + \beta_{vol}\ (R_{volt} - R_{mt}) + \varepsilon_t$$

- With :
  - r_f *the return on the risk-free asset*
  - R_{mt} *the market return at date t.*
  - R_{vt} *the market return of the Value style at date t.*
  - R_{gt} *the market return of the "Growth" style at date t.*
  - R_{st} *the market return of the "Small Cap" style at date t.*
  - R_{lt} *the market return of the "Large Cap" style at date t.*
  - R_{qt} *the market return of the "Quality" factor at date t.*
  - R_{momt} *the market return of the "Momentum" factor at date t.*
  - R_{volt} *the market return on the "volatility" factor at date t.*
  - β_k *the sensitivity to factor k*
  - ε_t *the model residual at date t.*

2. ESG Funds Performance
2.2 “Nom du fonds” criteria

- For the "Fund name" criterion, ESG funds appear to outperform conventional funds over the 1 and 5-year horizons, in terms of absolute returns and Sharpe ratio.
- However, over 2 years, ESG funds underperformed, which can be explained by the Covid-19 effect, which impacted investment behavior on management style.

Table 4: Performance and risk measures by median for the Europe universe – "Fund name" ESG criteria

	Ensemble des fonds			**Fonds ESG**			**Fonds non-ESG**		
	1 an	**2 ans**	**3 ans**	**1 an**	**2 ans**	**3 ans**	**1 an**	**2 ans**	**3 ans**
Rendement absolu	6,93%	57,43%	24,23%	7,69%	57,20%	27,70%	6,84%	57,51%	23,94%
Nombre de fonds	539	484	453	92	76	69	447	408	384
Rendement annualisé	6,93%	25,47%	7,50%	7,69%	25,38%	8,49%	6,84%	25,50%	7,42%
Volatilité	13,58%	17,35%	20,19%	13,64%	17,37%	20,17%	13,57%	17,35%	20,20%
Sharpe Ratio	0,51	1,47	0,37	0,56	1,46	0,42	0,50	1,47	0,37
Skewness	-0,79	0,11	-2,10	-0,72	0,08	-2,15	-0,80	0,12	-2,10
Kurtosis	6,09	4,67	15,72	6,25	4,54	16,13	6,07	4,70	15,57
Max. Drawdown	-14,48%	-14,41%	-31,19%	-15,17%	-15,03%	-30,52%	-14,35%	-14,30%	-31,31%
VaR 95%	-2,81%	-3,45%	-3,50%	-2,89%	-3,44%	-3,48%	-2,80%	-3,45%	-3,51%
Alpha-CAPM	-2,59%	-0,03%	-0,73%	-2,24%	-0,48%	-0,12%	-2,67%	0,06%	-0,78%
Alpha-modèle à Facteurs	-2,02%	-0,26%	-0,89%	-1,95%	-0,55%	-0,58%	-2,02%	-0,15%	-1,04%

Sources: Morningstar data for the Europe universe as at 28/03/2022 for the "Fund name" criterion and weekly returns for Euro funds from 09/01/2016 to 19/03/2022. Authors' calculations.

2. ESG Funds Performance

2.3 “Sust ratings” criteria

- For the "least subjective" criterion, “sust ratings”, the results are more mixed.
- Once again, this underlines the fact that it's difficult to talk about the performance/risk of ESG funds without properly defining what is behind "ESG funds".

Table 5: Performance and risk measures by median for the Europe universe – ESG "Sust. Rating" ESG criterion

	Ensemble des fonds			**Fonds ESG**			**Fonds non-ESG**		
	1 an	**2 ans**	**3 ans**	**1 an**	**2 ans**	**3 ans**	**1 an**	**2 ans**	**3 ans**
Rendement absolu	6,93%	57,43%	24,23%	6,80%	55,35%	24,40%	7,03%	58,18%	24,13%
Nombre de fonds	539	484	453	146	118	109	393	366	344
Rendement annualisé	6,93%	25,47%	7,50%	6,80%	24,64%	7,55%	7,03%	25,77%	7,47%
Volatilité	13,58%	17,35%	20,19%	13,60%	17,19%	19,70%	13,50%	17,37%	20,30%
Sharpe Ratio	0,51	1,47	0,37	0,50	1,43	0,38	0,52	1,48	0,37
Skewness	-0,79	0,11	-2,10	-0,61	0,12	-2,06	-0,85	0,11	-2,12
Kurtosis	6,09	4,67	15,72	5,67	4,51	14,82	6,38	4,71	15,89
Max. Drawdown	-14,48%	-14,41%	-31,19%	-16,10%	-16,15%	-30,03%	-14,00%	-13,95%	-31,60%
VaR 95%	-2,81%	-3,45%	-3,50%	-3,06%	-3,43%	-3,47%	-2,70%	-3,45%	-3,51%
Alpha-CAPM	-2,59%	-0,03%	-0,73%	-2,71%	-0,44%	-0,37%	-2,58%	0,06%	-0,77%
Alpha-modèle à Facteurs	-2,02%	-0,26%	-0,89%	-2,37%	-0,81%	-1,33%	-1,84%	0,10%	-0,75%

Sources: Morningstar data for the Europe universe as at 28/03/2022 for the « Sust Ratings" criterion and weekly returns for Euro funds from 09/01/2016 to 19/03/2022. Authors' calculations.

2. ESG Funds Performance

2.4 Criteria intersections

- In order to achieve a "finer" criterion, we look at the various intersections between the criteria.
- We note that the differences between minimum and maximum performance are very high, whatever the performance indicator considered. There is therefore a clear risk of underperformance according to the criteria selected for portfolio construction.

Table 6: Median performance measures for the Europe universe of combined strategies by Intersection

Mesure de performance	Stratégie	Annualized Return	Sharpe Ratio	Alpha-CAPM	Alpha-Fa[c]
Absolute Perf.-Min	C1&C2&C4&C8	3,42%	0,14	-5,46%	-2,14%
Absolute Perf.-Median	C1&C7&C8	7,53%	0,36	-0,95%	-0,93%
Absolute Perf.-Max	C1&C2&C3&C4&C5&C6&C7	11,36%	0,56	3,03%	0,40%
Sharpe Ratio-Min	C1&C2&C4&C8	3,42%	0,14	-5,46%	-2,14%
Sharpe Ratio-Median	C1&C6&C8	7,54%	0,38	-0,47%	-1,78%
Sharpe Ratio-Max	C1&C3&C4&C6&C7	11,36%	0,56	3,03%	0,40%
Alpha-CAPM-Min	C1&C2&C4&C8	3,42%	0,14	-5,46%	-2,14%
Alpha-CAPM-Median	C1&C3&C5&C8	7,24%	0,34	-0,51%	-1,20%
Alpha-CAPM-Max	C1&C2&C3&C4&C5&C6&C7	11,36%	0,56	3,03%	0,40%
Alpha-Factor-Min	C2&C3&C6&C8	5,18%	0,26	-2,46%	-4,49%
Alpha-Factor-Median	C1&C2&C5	6,95%	0,36	-0,22%	-1,36%
Alpha-Factor-Max	C1&C2&C3&C4&C5&C6&C7	11,36%	0,56	3,03%	0,40%
	Ensemble des fonds	7,50%	0,37	-0,73%	-0,89%

Sources: Morningstar data for the Europe universe as at 28/03/2022 and weekly returns for Euro funds from 09/01/2016 to 19/03/2022. Authors' calculations. C1 represents the "ESG Name" criterion, C2 is the "ESG Label", C3 the "PRI Signatories", C4 the "Controversies", C5 the "Sust. Rating", C6 "Carbon Risk", C7 "SRI Multi-Factor Beta", and C8 "Climate Beta".

Concludings Remarks

- The main criteria used by investors to select ESG funds do not provide the same information. While some criteria are more selective (SRI label, climate sensitivity), others are less demanding (signatories, sensitivities to ESG or SRI market indices).

- Robust statistical analysis using principal component analysis enables us to group the criteria more effectively. We thus find that the criteria can be classified into three distinct groups for the three universes studied (Europe, US and Global).

- The study of fund performance and risk indicators shows that ESG-identified funds perform better and are less risky than "Non-ESG" funds over certain periods and for certain criteria. However, there is no significant impact of ESG differentiation on returns.

- In this “zoo of ESG criteria”, the regulator's work to increase transparency is absolutely essential.

- Especially as there could be major disparities within the same criteria. (see next slide)

Appendix

Precision on criteria

➢ The ***SRI multi-factor beta*** is calculated as follow :

$$R_{pt} - r_f = \alpha + \beta_m(R_{mt} - r_f) + \beta_{vg}(R_{vt} - R_{gt}) + \beta_{sl}(R_{st} - R_{lt}) + +\beta_q(R_{qt} - R_{mt}) + \beta_{mom}(R_{momt} - R_{mt}) + \beta_{vol}(R_{volt} - R_{mt}) + \beta_{ESG}(R_{ESGt} - R_{mt}) + \varepsilon_t,$$

With :

- r_f *the return on the risk-free asset*
- R_{mt} *the market return at date t.*
- R_{vt} *the market return of the Value style at date t.*
- R_{gt} *the market return of the "Growth" style at date t.*
- R_{st} *the market return of the "Small Cap" style at date t.*
- R_{lt} *the market return of the "Large Cap" style at date t.*

– R_{qt} *the market return of the "Quality" factor at date t.*
– R_{momt} *the market return of the "Momentum" factor at date t.*
– R_{volt} *the market return of the "volatility" factor at date t.*
– R_{ESG} *the market return of the “ESG" factor at date t.*
– β_k *the sensitivity to factor k*
– ε_t *the model residual at date t.*

➢ ***Climate beta*** is calculated as follow :

$$R_{pt} - r_f = \alpha + \beta_c(F_{ct} - r_f) + \varepsilon_t$$

With :

– F_{ct} *the market return of the climatic factor at date t.*
– β_c *the sensitivity to climatic factor*