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ESG Risk:
improving the forecasting power of traditional financial risk measures

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Research aim

- Evaluating an investment, factors related to **environmental, social and governance (ESG) issues** are becoming more and more relevant;
- In order to help investors in the screening and selection of securities, several consulting companies and rating agencies developed **ESG scoring models.**
- Starting from these scores, we propose a rigorous **framework for measuring the ESG risk of a financial portfolio**.
- The research aims to verify how this ESG risk measure is able to **improve the estimation of a portfolio volatility**.

Hypothesis 1

- In order to **test the efficacy of the ESG measure** to capture variables linked to environmental, social and governance conditions of a firm, we define our first hypothesis.

- Hypothesis 1: When managing portfolio composition, **a firm's market value, governance characteristics, and country risk** do explain ESG risk, having a direct effect on its volatility. In more details:
  - Hyp 1a: The higher is firms' market value in a portfolio, the lower is ESG risk associated with that portfolio;
  - Hyp 1b: The larger is board size of firms in a portfolio, the lower is ESG risk associated with that portfolio;
  - Hyp 1c: The lower is country risk, in terms of control of corruption and regulatory quality, associated with firms in a portfolio, the lower is ESG risk associated with that portfolio.

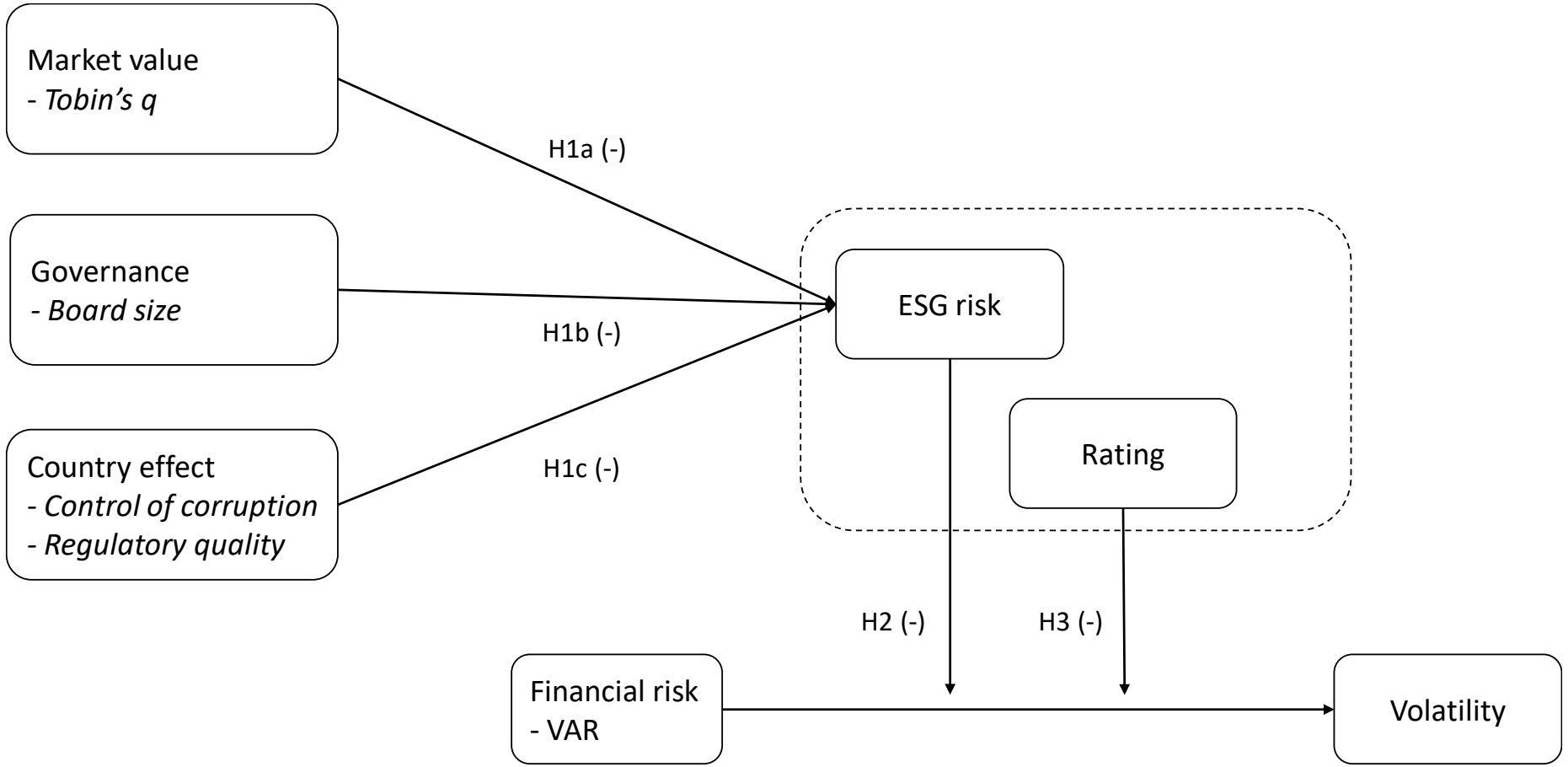
Hypotheses 2 and 3

- Our hypotheses 2 and 3 concern the **opportunity to integrate financial risk measures** (such as VAR) with the ESG risk measure (or, alternatively with financial ratings), to improve their capability to forecast portfolios' volatility.

- Hypothesis 2: **ESG risk improves the performance of volatility forecasting** of a portfolio by negatively moderating the positive relationship between ex ante financial risk and ex post volatility of a portfolio.

- Hypothesis 3: **Financial rating improves the performance of volatility forecasting** of a portfolio by negatively moderating the positive relationship between ex ante financial risk and ex post volatility of a portfolio.

Theoretical framework



Sample

- Our final sample is an unbalanced longitudinal data set comprising **17,996 firm-year observations, referring to 3,332 listed, active firms** with a yearly ESG score in the **period 2007-2015**.
- Our sample includes securities from **55 countries and 10 industries**, based on Bloomberg industry classification.
- Data and information from worldwide active public companies with an ESG score have been collected from **ECPI Global Ethical Equity index** (companies had to be ranked in the same ESG index for at least two subsequent years).
- We collected other data for the analysis from **Thomson Datastream database**, **World Bank World Governance Indicators**, and **Bloomberg**.

Methodology

- We ran **population-averaged regression models** and used **generalized list squares (GLS) to control for firm heterogeneity**.
- In order to account for a potential simultaneity bias, we paid significant attention to **appropriate lags between our independent and dependent variables**. This analysis allowed us also to investigate the short- and medium-term impact of our predictors on the dependent variables.
- Then, we checked for **potential multicollinearity** in our independent variables. Multicollinearity had little impact in our analyses.
- Finally, we used a **hierarchical regression approach** to test our hypotheses.

FIRST STAGE OF THE ANALYSIS

Dependent variable – ESG Risk

- We developed a measure of risk focused on **large and medium cap**, due to the standard breakdown of mutual fund portfolios, i.e. for so-called liquid asset allocation.
- To compute our measure of ESG risk, we started from **ESG scores** of firms in our sample, then considering **their securities frequency distribution in 8 ranges or classes**, where scores goes from >0 to 10, labelled from A (i.e., lower class) to H (higher class).
- Ranges are built as follows: [8;10), [7;8), [6;7), [5;6), [4;5), [3;4), [1;3), [>0;1]. Then, we use the **concept of entropy**, such as studied by Shannon (1948). Entropy represents the **disorder** due to the different portfolio's configurations in these 8 classes.

$$S_{ESG} = -\sum_{i=1}^{8} p_i \log(p_i)$$

Dependent variable – ESG Risk

- In order to have an effective measure of ESG risk, we would like that risk increases if a fund invests primarily in classes with low scores and, vice versa, it decreases when higher ranges are more populated. Therefore, we introduce a **corrective factor, i.e. the minimum *j* of each range:**

$$R_{ESG} = -\sum_{i=1}^{8}\left(p_i \log\left(p_i\right) \cdot \frac{1}{\min_{j \in i}\left(p_j\right)_i} \right)$$

- In order to have a firm specific ESG risk score, we calculate the **weighted average ESG risk associated to each country and industry** in our sample for each year from 2007 to 2015.

Predictors – ESG Risk

- *Market value.* We expect **the higher is the value that the market attributes to the firm, the lower is the ESG risk for that asset**. Therefore, we measure market value based on Tobin's *q;*

- *Governance characteristics*. We test **the impact of board size on the ESG risk of the firm**, whereas board size has been negatively associated to credit risk;

- *Country effect*. Country-specific factors can have a direct impact on the risk level associated to securities in a portfolio. We used **two different measures of country effect, that is *control of corruption* and *regulatory quality.***

Results – ESG Risk

- According to hypothesis 1, specific factors associated to market value of the firm, its governance structure, and country effects **do represent the determinants of the firm specific ESG risk.**

- The regression results provide **strong statistical support for our hypothesis 1 both in the short- and medium-term.**

SECOND STAGE OF THE ANALYSIS

Dependent variable – volatility

- In the second stage of the analysis, the **direct relationship between financial risk *ex* ante** associated to a portfolio of investment **and the ex post volatility** of the same portfolio has been investigated.

- *Volatility*: to measure volatility we rely on the **historical volatility** of securities in our sample.
- We collected annual data of volatility from Bloomberg, where volatility is calculated by determining the average deviation from the average return of a financial instrument in the given time period.

Predictor – volatility

- We examine the forecasting performance by means of economic criteria in terms of risk analysis. **Value-at-Risk (VaR)** has been adopted by practitioners and regulators as the standard mechanism to measure **market risk of financial assets**. It estimates how much a set of investments might lose (with a given probability), given normal market conditions, in a set time period.

- We aim at testing **factors able to help VaR to get a better forecasting capability.**

Moderators – volatility

- ***ESG risk* and *financial ratings*** have been considered as two alternative moderators of the relationship between ex ante financial risk and ex post volatility of a portfolio.

- We do expect **higher values of ESG risk reflect a higher ex post volatility of the portfolio**. Same but opposite consideration do apply to traditional financial ratings, whereas **higher ratings reflect more reliable and secure asset, which are supposed to be characterized by lower level of volatility**.

Control variables – volatility

- We introduced several **controls that might influence volatility** of a portfolio, according to the literature.

- We controlled for:
  - the financial *solvency ratio* as a firm's long-term debt-equity ratio;
  - the overall performance ratio as the firm *Return on Equity*;
  - a dummy variable, coded one for *holding* companies, and zero if the firm is an operating company;
  - *industry dummy variables,* considering the Bloomberg industry classification for 10 industry categories;
  - *country dummy variables,* according to the geographical location of each firm in the sample;
  - *year dummy variables*.

Results – volatility

- Introducing the moderating effect of ESG risk, **results statistically support hypothesis 2 in the medium-term**, having the interaction term between VaR and ESG risk a negative and statistically significant impact on ex post volatility ($r = -0.02$; $p < .05$);

- **Hypothesis 2 is not supported in the short term**.

- Shifting to the moderating effect of financial ratings, **hypothesis 3 does not find support in the short-term, neither in the medium-term.**

Discussion and conclusion

- The measure of **ESG risk can contribute to the improvement of the financial volatility's estimation, especially in the medium-run**.
- The forecasting capability of VaR can be improved adding the ESG risk measure.

- Based on the assumption that traditional financial metrics do not necessarily fill the gap between expected (ex ante) and final recorded ex post volatility, **ESG risk metrics are able to mitigate the unexpected volatility of a portfolio in the medium-run**, therefore **maximizing the likelihood to arrange the best diversification grade within the portfolio**.