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## SPOKE 4

# D4.1.3 – Policy briefs and best practices for SME's access to sustainable finance instruments

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# Sustainability spreads in stock returns: a method to measure it

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## Executive Summary

Sustainability is remunerated as a characteristic with intrinsic value, over and above risk. The value associated with sustainability is typically inferred from the average returns of portfolios tilted toward sustainable assets, with some hedge to make them risk-neutral. Yet, if the sustainability of assets is not proportional to their risk, the common procedures used to construct these portfolios end up altering the portfolio's actual sustainability – an effect that is usually ignored and leads to a mismeasurement of the return spread attributed to sustainability.

This brief presents a method that is robust to this issue, by measuring the spread directly while leveraging the commonalities across stocks to identify risk factors. As shown in Franceschini (2024), the approach unfolds in two steps: (1) identifying common factors to treat as risk factors, and (2) embedding the equilibrium conditions derived from a simple theoretical model directly in the Generalized Method of Moments estimator.

## The target pricing equation

Standard theoretical models (Pastor, et al., 2021; Pedersen, et al., 2021) predict that the returns of financial assets, $R^i$, relate to a measure of sustainability, here exemplified by the ESG score, according to the following equation:

$$E_t\left[R^i_{t+1} - R^f_t\right] = \lambda_t \cdot ESG^i_t + COV_t\left(m_{t+1}, R^i_{t+1}\right),$$

where $\lambda_t$is a negative constant that decreases the expected return required to hold an asset in proportion to its sustainability, and $m_t$is a random variable, the stochastic discount factor (SDF), capturing fluctuations in state variables that affect agents' welfare and are therefore disliked. The covariance between assets' returns and the stochastic discount factor represents the risk component of expected excess returns. The stochastic discount factor is often expressed as a linear combination of risk factors, typically represented by portfolios of traded assets, which implies that these factors have a sustainability score of their own.

In the context of the standard CAPM framework, a portfolio (SOS) that invests in sustainable assets while shorting non-sustainable ones, and that holds positions in the risk factor portfolios opposite to the portfolio's sensitivities in order to isolate the sustainability component, has expected returns given by

$$E_t\left[R_{t+1}^{SOS}\right] = \lambda_t \left[\left(\frac{ESG^{HI}}{ESG^{Mkt}} - \frac{ESG^{lo}}{ESG^{Mkt}}\right) - \left(\beta^{HI} - \beta^{lo}\right)\right].$$

Intuitively, betas affect returns despite the portfolio being market-neutral because the leveraged market holdings that make the overall portfolio insensitive to market fluctuations do not necessarily match the sustainability difference between the sustainable and less sustainable asset pools. In essence, the risk adjustment injects a sustainability component into the portfolio that, if not properly accounted for, can significantly distort the relationship between $\lambda_t$and $R_t^{SOS}$ from what it is expected to be.

## Estimation of the sustainability spread: the procedure

The procedure comprises two sequential steps.

### *Step one*: the factors spanning the stochastic discount factor

It is assumed that financial asset returns are driven by common fundamental factors, collected in the vector $\boldsymbol{f}_t$. Formally, this corresponds to modeling shocks to returns as having a factor structure. Under this assumption, an estimate of $m_{t+1}$ can be recovered from the cross-section of assets under study. Specifically, as the number of assets and observations grows large, the projection of $m_{t+1}$ onto the returns, $m_{t+1}^*$, takes the form

$$m_{t+1}^* = 1 - \boldsymbol{f}_t \cdot \boldsymbol{b}\,,$$

where the factors can be obtained independently by various methods, leaving only the loadings unknown and making recovery feasible. The projection of the SDF formed in this way deviates from the true SDF only by a component orthogonal to the space spanned by returns, which would not contribute to pricing.

Following a standard approach, Principal Component Analysis (PCA) can be used to extract the factors. Let $\Sigma$ be the covariance matrix of returns and let $\boldsymbol{w}^j$denote the $j$-th eigenvector of $\Sigma$, with corresponding eigenvalue $\theta^j$. Each eigenvector $\boldsymbol{w}^j$ represents a direction in the returns space, and the eigenvectors associated with the largest eigenvalues capture the principal directions of variation.

To form the factors, the top $k$ eigenvectors $w^1, \dots, w^k$ are selected and collected into a matrix $W^* = [w^1\ w^2\ \dots\ w^k]$. To guide the choice of $k$, there exist multiple methods proposed in the literature, a recent example of which is Alessi, et al. (2010). The factors are then constructed as weighted combinations of the original returns:

$$\boldsymbol{f}_t = R_t' \cdot W^*,$$

where $R_t$ is the vector of returns at time $t$. Each factor $f_t^j$ is therefore a linear combination of returns, with weights given by the corresponding eigenvector $\boldsymbol{w}^j$, capturing a major source of common variation across assets.

### *Step two*: estimation of the pricing equation

The unconditional version of the main pricing equation has a natural empirical counterpart:

$$\frac{1}{T}\sum_{t=0}^{T-1} R_{t+1}^i - R_t^f = \frac{1}{T}\sum_{t=0}^{T-1}\left\{a\ ESG_t^i + (\boldsymbol{f}_{t+1} \cdot \boldsymbol{b})\left(R_{t+1}^i - \frac{1}{T}\sum_{t=0}^{T-1} R_{t+1}^i\right)\right\},$$

which can be used to estimate $a$ and $\boldsymbol{b}$, where $a$ represents the time-averaged value of $\lambda_t$. Subtracting the right-hand side from both sides gives a moment condition suitable for estimation via the Generalized Method of Moments (GMM). The GMM estimator returns values for $a$ and $\boldsymbol{b}$ that minimize the discrepancy in the equation, along with standard errors to construct confidence intervals and over-identification tests to assess model fit.

## Recommendations

1. **Interpret current findings cautiously:**
    - Most existing analyses ignore the impact of risk-hedging when measuring sustainability spreads, which may lead to biased conclusions.

2. **Support and fund ongoing research in climate finance:**
    - Encourage research that develops robust, scalable methods to measure sustainability premia.
    - Promote studies covering diverse asset classes, geographic regions, and alternative sustainability metrics to deepen understanding of market behavior.

3. **Maintain a monitoring system for updated estimates:**
    - Establish an observatory or dashboard to track market developments and capture evolving sustainability preferences.
    - Regularly update estimates to inform both policy and investment decisions.

## Implementation Considerations

I. **Limited methodological complexity**
    - The statistical methodology is computationally straightforward, enabling frequent updates and flexibility in the sustainability measures tracked.

II. **Extension potential:**
    - The methodology is broadly applicable across different regions, asset classes, and sustainability metrics, making it suitable for diverse implementation contexts.

## Conclusion

Measuring the return spread associated with the sustainability of assets requires careful consideration of risk. A simple two-step procedure illustrates a robust way to measure it while flexibly accounting for systematic risk factors.

1. **Factor extraction:** The first step involves extracting common risk factors from the pool of test assets, which can be accomplished using standard Principal Component Analysis.
2. **Estimation of the sustainability spread:** The second step applies the Generalized Method of Moments, exploiting the equilibrium condition directly to estimate the unconditional value of the sustainability spread.

This approach provides a practical, transparent, and adaptable framework for measuring sustainability premia, supporting both research and policy monitoring in climate finance.

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## References

Alessi, L., Barigozzi, M. & Capasso, M., 2010. Improved penalization for determining the number of factors in approximate factor models. Statistics and Probability Letters, Volume 80, p. 1806–1813.

Franceschini, F., 2024. Are You Betting On Sustainability?.

Pastor, L., Stambaugh, R. F. & Taylor, L. A., 2021. Sustainable investing in equilibrium. Journal of Financial Economics, 142(2), pp. 550-571.

Pedersen, L. H., Fitzgibbons, S. & Pomorski, L., 2021. Responsible investing: The ESG-efficient frontier. Journal of Financial Economics, 142(2), pp. 572-597.