

ESG for systematic FX trading

Environmental, Social, and Governance data as a complementary source in a fundamental strategy

Abstract

This article explains how we incorporate ESG data within our systematic FX trading strategies. Our approach uses an in-house data acquisition, cleansing, restructuring, and standardisation pipeline. Our proprietary algorithm dynamically assesses ESG indicators in order to promote the most compatible and demote the least compatible factors depending on recent FX market data. Our 10 years backtest shows incorporating this data as part of a systematic FX strategy can generate uncorrelated signals and be used as a complementary source to other types of economic data.

Introduction

ESG data comprise of a wide variety of factors. Their main emphasis is to measure how much a company, business or country considers, includes, and evaluates its contribution in: (1) incorporating environmental risks (2) social criteria and (3) transparency in governance, within its decision makings, investments and implementation of regulations. Recently, there has been a remarkable raise in the investors' interest to consider the performance of a company or potential investment's ESG criteria.

Could a hedge fund incorporate ESG factors as "alternative data" and use this information to establish a strategy? Our answer to this question is - Yes!

In this paper, we propose our solution to utilising ESG indicators as part of a systematic FX trading strategy, and we

explain how it is possible to use countries' ESG performance to establish a fundamental strategy. Our approach is based on a scalable data preparation stage, which transforms raw data into a standardised clean format that is usable within a relative value (RV) investment strategy. Following this stage, an algorithm dynamically checks the compatibility of the ESG indicators with the incoming market prices and assigns importance weights to them: compatible indicators are promoted, while those less compatible to the current market are demoted.

Our results show that this ESG integration within a systematic FX trading pipeline can generate uncorrelated signals, which can be used as a complementary source next to other types of economic data.

In the next section, our methodology and data preparation are explained, followed by our backtest performance results.



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ESG integration through RV

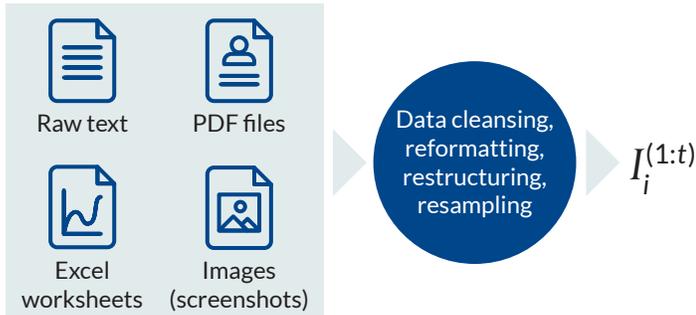
GENERAL OVERVIEW

Data acquisition and preparation

We have developed a systematic approach to include ESG indicators as part of our fundamental models. For this, we have created an in-house data acquisition, cleansing and restructuring pipeline, from various sources including Transparency International, World Bank, World Economic Forum, OECD and the World Energy Council.

Our data acquisition technology is capable of extracting information from different input formats, with minimal human intervention. These range from raw text and tabular Excel to PDF meta-data and even images via optical character recognition (OCR) technology. As shown in Figure 1, we have developed our own data cleansing, quality check, standardisation and normalisation techniques, which empowers us to observe all the analysis performed, from the raw data to the point of generating ESG ranks and scores.

FIGURE 1: DATA ACQUISITION & PREPARATION PROCESS



Our in-house data acquisition pipeline performs data cleansing, reformatting, restructuring and resampling from raw sources, such as irregular textual data, Excel worksheets, PDF files and images via OCR algorithms. The output of this stage will be the historical tabular ESG data up to time t for the i^{th} indicator $I_i^{(1:t)}$.

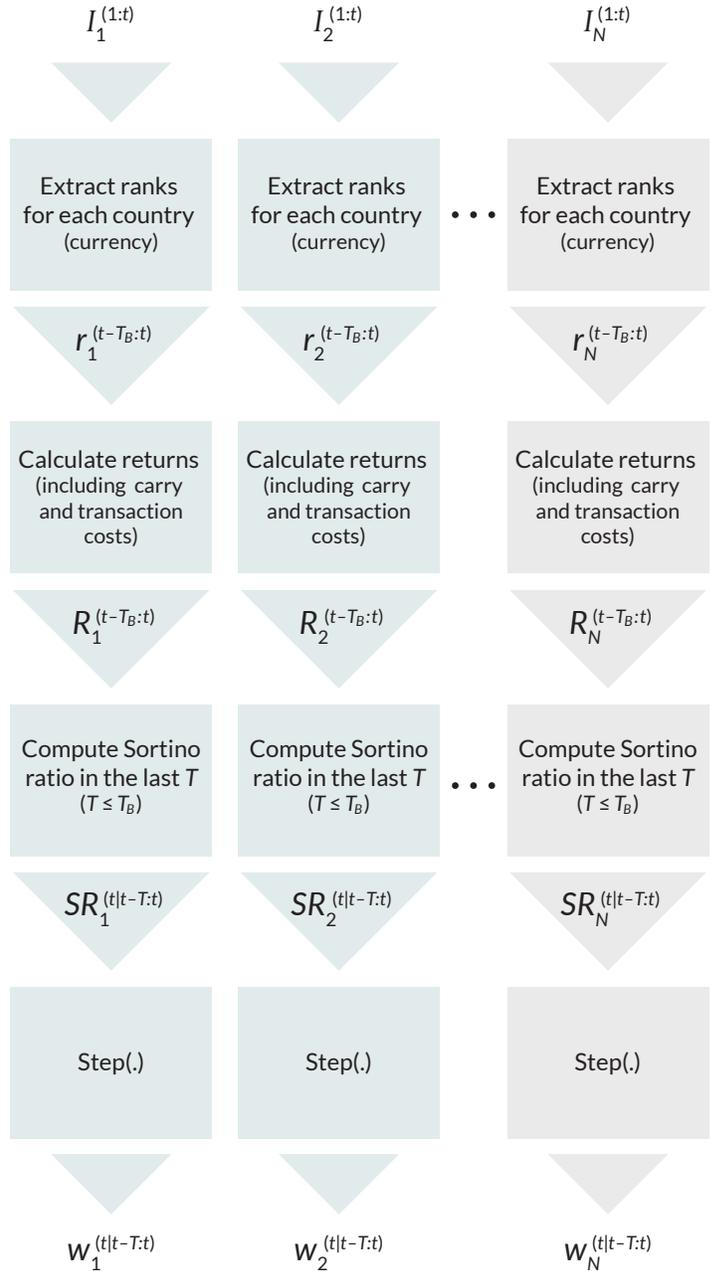
Source: Mesirow

Dynamic indicator selection and fusion

To determine the most robust indicators (in terms of generating high returns with low downsides over the recent currency market), we have developed a dynamic ESG optimisation algorithm. Given the recent FX prices, this approach detects the most effective indicators by optimising an *approximated*¹ Sortino ratio within an RV strategy, which is constructed based on ESG scores. The overall ESG scores from the selected indicators are then fused via a weighted averaging step. While a more detailed explanation of this approach is provided in the next section, Figure 2 summarises it in a block diagram.

1. In our work, we have used an approximated Sortino ratio, in which the average of returns (with no subtraction from risk-free returns, unlike the original Sortino ratio definition) is divided by the standard deviation of downside. Although it does not affect the generalisability of the proposed approach, the main reason for this was to mostly emphasise on maximising returns and minimising downside, while avoiding the use of negative thresholds when constructing the step functions (see Figure 2). To enhance readability of this paper, we drop the ‘approximated’ term and refer to this as the Sortino Ratio.

FIGURE 2: ESG ALLOCATOR ALGORITHM



The procedure of calculating the optimised ESG fusion weights from N indicators as a block diagram. Applied to around 28 currency pairs (from developed to emerging economies), the N indicators are systematically integrated (alongside other economic data) and then used to rank countries within a long/short portfolio.

Source: Mesirow

Optimisation over ESG indicators

Our dynamic ESG ranking, selection and fusion is based on maximising return, while minimising the downside, via calculating the Sortino Ratio.

The first step is to compute the historical returns within the last T_B days. Assuming $I_i^{(1:t)}$ is a matrix containing the standardised historical ESG data, for all C currencies until time t for the i^{th} indicator ($i=\{1,2,\dots,N\}$ for a total of N ESG indicators), we first extract the ESG ranks $r_i^{(t-T_B:t)}$ by simply sorting the ESG scores. Our RV strategy then longs the top and shorts the bottom M currencies. The historical daily returns ($R_i^{(t-T_B:t)}$) for this strategy are then calculated after including carry and transaction costs.

At the next step, given the returns within the period of $[t-T, t]$ (where $T \leq T_B$), the Sortino Ratio is computed (as $SR_i^{(t|t-T:t)}$) and then given to a Step function to find the weight for the i^{th} indicator at time t , i.e. $w_i^{(t|t-T:t)} = \text{step}(SR_i^{(t|t-T:t)})$: if the Sortino ratio is positive, $w_i^{(t|t-T:t)}$ will be 1, otherwise it will be zero. After calculating $w_i^{(t|t-T:t)}$ for all N indicators, the fused ESG ranks used in the next T_F days will be computed as follows,

$$S_f^{(t+1|t-T:t)} = - \frac{\sum_{i=1}^N w_i^{(t|t-T:t)} r_i^{(t)}}{\sum_{i=1}^N w_i^{(t|t-T:t)}} ,$$

where $s_f^{(t+1|t-T:t)}$ is a $1 \times C$ vector, containing the fused ESG scores for all C currencies, given the weights calculated from the previous T days, which will be used within the next $[t+1, t+1+T_F]$ period. $r_i^{(t)}$ represents the ESG ranks for the i^{th} indicator at time t .

The reason for multiplying -1 with the weighted average is to transform ranks into scores. Performing the weighted averaging over ranks (instead of scores) lifts the necessity of applying normalisation as a preprocessing step. This technique amplifies the importance of those indicators with higher performance during the last T days and attenuates those with weaker performance.

Incorporated ESG data

In this section we explain the data we used to construct our ESG-based RV strategy. We have taken extra care to avoid information leakage² from potential future data, and a causal (backward looking) linear interpolation is used to replace missing data. To further emphasise on always using causal sub-systems, we always utilise the previous year's ESG data to construct the current year's data. In other words, the ESG ranks/scores for year $x-1$ are used as inputs at time x . As most of our data points are in annual intervals and because our RV model assumes the inputs to be in monthly format, we up-sample the last year's annual data to map onto monthly granularity.

The data is obtained from various online sources. For some of the indicators, the raw data is not in textual format but are, instead, collected as images. As we are interested in indicators for numerous countries over the last decades, manually entering these data points could be a time-consuming and an error-prone process. To avoid this, we use OCR technology, which uses computer vision algorithms to automatically extracts texts from images.

Rigorous data cleansing is then performed; if Taiwan's ESG data is unavailable up to a given year, the data belonging to South Korea is used instead. If a country's ESG data is unavailable until year x , we completely discard that country from the RV model even if we have its data after year x . This is, again, to ensure there is no information leakage from the future data.

The incorporated indicators and sources used are as follows (descriptions obtained from information provided on the given indicator's website source—access time 24 July 2021):

ENERGY TRILEMMA INDEX (ETI)³

The countries' capability in providing sustainable energy is ranked by this factor. Provided by the World Energy Council (in partnership with Oliver Wyman), a comparative ranking of 130 countries is released annually from 2010 (in autumn months - September or October). This ranking quantifies each country's performance in three dimensions: energy security, energy equity (accessibility and affordability), and environmental sustainability.

GLOBAL COMPETITIVENESS INDEX (GCI)⁴

This index rates countries based on 98 variables, which can be roughly categorised into 12 clusters, some of which are: infrastructure, ICT adoption, macroeconomic stability, health, skills, product market, labour market, financial system, market size, business dynamism, and innovation capability.

CORRUPTION PERCEPTIONS INDEX (CPI) AND EASE OF DOING BUSINESS⁵

Gathered from 2012, this index rates around 180 countries based on their corruption level in public sector and ease of doing business, via 10 topics. High scores correspond to more transparent regulatory environment to establish a business.

BETTER LIFE INDEX (BLI)⁶

This indicator quantifies within 11 topics how citizens are well-informed to engage in policy-making processes.

WORLDWIDE GOVERNANCE INDICATORS⁷

These indicators incorporate six different factors from 1996 to the current time:

- Control of corruption
- Government stability & effectiveness
- Rule of law
- Regulatory quality
- Lack of violence
- Voice & accountability

ECONOMIC COMPLEXITY (ECI)⁸

Covering around 40 years of data, ECI measures the relative knowledge intensity of an economy or product by considering the knowledge intensity of the products it exports.

THE GINI COEFFICIENT OF INCOME INEQUALITY⁹

With its data going back to 1976, using five indicators, income inequality is rated by comparing cumulative proportions of the population against cumulative proportions of income they receive. It ranges between 0, in the case of perfect equality, and 1, in the case of perfect inequality.

2. Information leakage from the future data, during which the algorithm (usually unintentionally) utilises the future samples for the current time, is a common issue when analysing financial time series. This can potentially result in designing non-causal strategies and generate biased conclusions from the data. | 3. <https://trilemma.worldenergy.org/> | 4. <https://www.weforum.org/reports/how-to-end-a-decade-of-lost-productivity-growth> | 5. <https://www.transparency.org/en/cpi/2020/index/nzl> and <https://www.doingbusiness.org/en/data/doing-business-score> | 6. <https://stats.oecd.org/Index.aspx?DataSetCode=BLI> | 7. <https://databank.worldbank.org/source/worldwide-governance-indicators> | 8. <https://oec.world/en/rankings/country/eci/> | 9. <https://data.oecd.org/chart/6m0o>

GLOBAL PEACE INDEX (GPI)¹⁰

Using 23 indicators, this index ranks about 162 countries according to their peacefulness level.

ENVIRONMENTAL PERFORMANCE REVIEWS (EPR)¹¹

An OECD program to support countries' progress towards their environmental and sustainable development goals.

HUMAN CAPITAL INDEX (HCI)¹²

This index quantifies a country's ability to have the best utilisation of its workforce, by considering the degree of health and education level.

WORLD PRESS FREEDOM RANKINGS¹³

Pluralism, media independence, media environment and self-censorship, legislative framework, transparency, and the quality of the infrastructure that supports the production of news and information are evaluated for about 180 countries by pooling responses of experts to a questionnaire devised by Reporters Without Borders.

AQUEDUCT WATER CRISIS ATLAS¹⁴

Starting from October 2013, this index utilises "peer reviewed methodology" and the "best-available data" to generate maps indicating globally emerging water risks.

ND-GAIN¹⁵

Summarises a country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience.

FRAGILE STATES INDEX (FSI)¹⁶

FSI measures trends in "pressures" within each individual state, by making political risk assessment and early warning of conflict. This data is published annually and 178 countries are analysed.

SUSTAINABLE DEVELOPMENT GOALS (SDG) INDEX¹⁷

This index evaluates each country's position with regards to achieving its development goals. This index is available, not only for emerging and developing countries, but also for developed and industrialised economies.

ENVIRONMENTAL PERFORMANCE INDEX (EPI)¹⁸

Released biannually, EPI ranks countries on 24 performance indicators across 10 issue categories, covering environmental health and ecosystem vitality.

CLIMATE CHANGE PERFORMANCE INDEX (CCPI)¹⁹

CCPI rates 57 countries and the European Union on their climate protection performance. It evaluates four categories, with 14 indicators: Greenhouse Gas Emissions (40% of the overall score), Renewable Energy (20%), Energy Use (20%), and Climate Policy (20%). The CCPI's unique climate policy section evaluates countries' progress in implementing policies working towards achieving the Paris Agreement goals.

FREEDOM IN THE WORLD (FIW) INDEX²⁰

FIW analyses the electoral process, political pluralism and participation, the functioning of the government, freedom of expression and of belief, association and organisation rights, the rule of law, and personal autonomy and individual rights. It started in 1972 and is an annual report based on political rights and civil liberties for around 210 countries.

WOMEN, BUSINESS, AND THE LAW (WBL)²¹

WBL measures legal differences between men's and women's access to economic opportunities in 190 economies.

HUMAN DEVELOPMENT INDEX (HDI)²²

HDI is a summary measure of average achievements in key dimensions of human development: a long and healthy life, being knowledgeable and have a decent standard of living. With its data annually released from 1990 to 2020, HDI was created to emphasise that "people and their capabilities should be the ultimate criteria for assessing the development of a country, not economic growth alone".

SOCIAL PROGRESS INDEX²³

This indicator provides a comprehensive analysis of a country's social and environmental performance, independent from its economic factors, and potentially capable of complementing other measures, such as GDP. The index captures outcomes related to 17 Sustainable Development Goals.

10. https://visionofhumanity.org/wp-content/uploads/2020/10/GPI_2020_web.pdf | 11. <https://www.oecd.org/env/country-reviews/> | 12. <https://www.worldbank.org/en/publication/human-capital> | 13. <https://rsf.org/en/world-press-freedom-index> | 14. <https://www.wri.org/data/aqueduct-water-risk-atlas-0> | 15. <https://gain.nd.edu/our-work/country-index/> | 16. <https://fragilestatesindex.org/> | 17. <https://www.sdgindex.org/> | 18. <https://epi.yale.edu/> | 19. <https://ccpi.org/> | 20. <https://freedomhouse.org/countries/freedom-world/scores> | 21. <https://wbl.worldbank.org/en/wbl> | 22. <http://hdr.undp.org/en/content/human-development-index-hdi> | 23. <https://www.socialprogress.org/>

Experimental results: analysis of historical performance

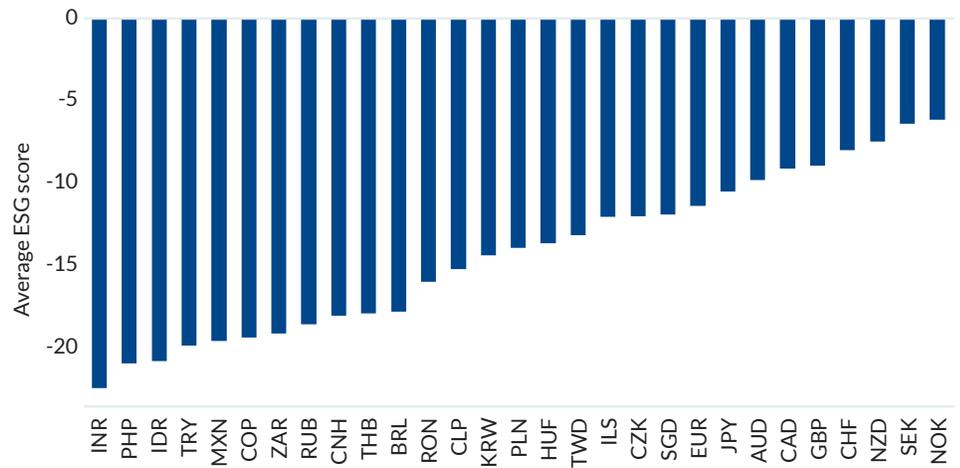
The proposed ESG integration algorithm has been back tested over the last 10 years (March 2011 to May 2021) and incorporates prices for around 28 currency pairs. The main hyper-parameters used in the algorithm are T (the look-back window size used to calculate the Sortino Ratio) and T_F (the look-forward window size to maintain the calculated ESG fusion weights). In our following results, we use $T=T_F=80$ (days).

Figure 3 shows the averaged ESG scores calculated over this backtest period. As expected, developed economies (such as Norway (NOK), Sweden (SEK), New Zealand (NZD), Switzerland (CHF) and the United Kingdom (GBP)) had the highest scores, while emerging economies (such as India (INR), the Republic of the Philippines (PHP), Indonesia (IDR), Turkey (TRY), and Mexico (MXN)) generated the lowest ESG scores.

Figure 4 indicates which ESG indicators output the highest averaged Sortino Ratios (please visit the Appendix in this paper to map any abbreviated indicator name onto its full version).

Interestingly, those factors that quantify peace and stability in a country (such as GPI or WwGIPSNV), those representing fairness in employability status (such as BLIUR, BLILFPR and WDILF), and those covering freedom of speech and high regulations quality (WPFI and WwGIRQ) are amongst the top ranks.

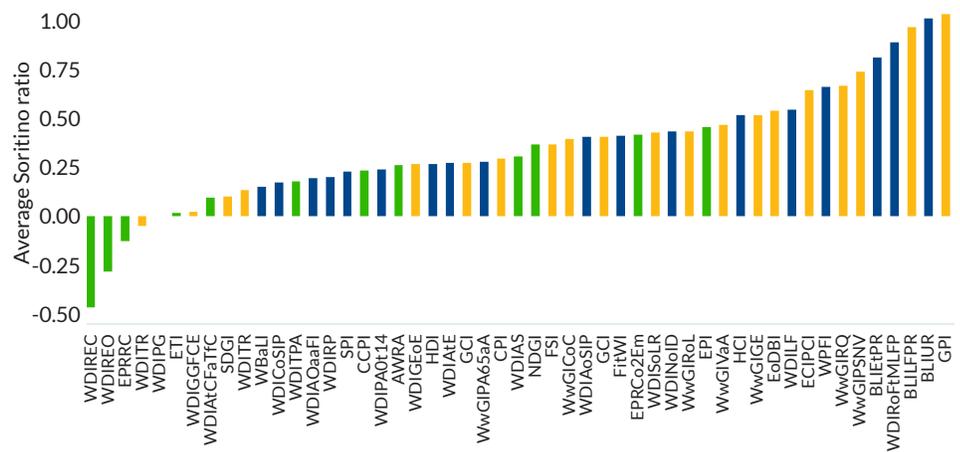
FIGURE 3: AVERAGE ESG SCORE



Average ESG scores (March 2011 - May 2021) for each currency (country).

Source: Mesirow

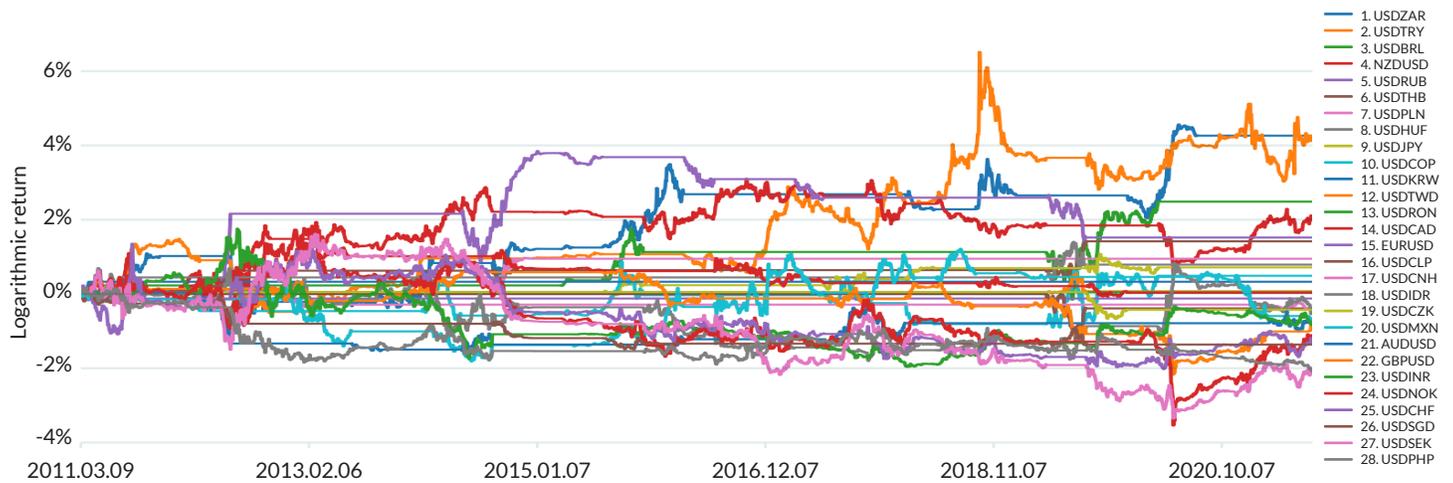
FIGURE 4: AVERAGE SORTINO SCORE



Average Sortino ratio over the backtest period for each ESG indicator. E, S, and G factors are shown in green, blue, and yellow, respectively.

Source: Mesirow

FIGURE 5 | LOGARITHMIC RETURNS PER CURRENCY PAIR



Source: Mesirow

Surprisingly, although EPI (one of the environmental indicators) is amongst the top factors, some similar factors (WDIREC and WDIREO which both quantify the rate of renewable energy source consumption), are amongst the least effective indicators when used within our RV strategy.

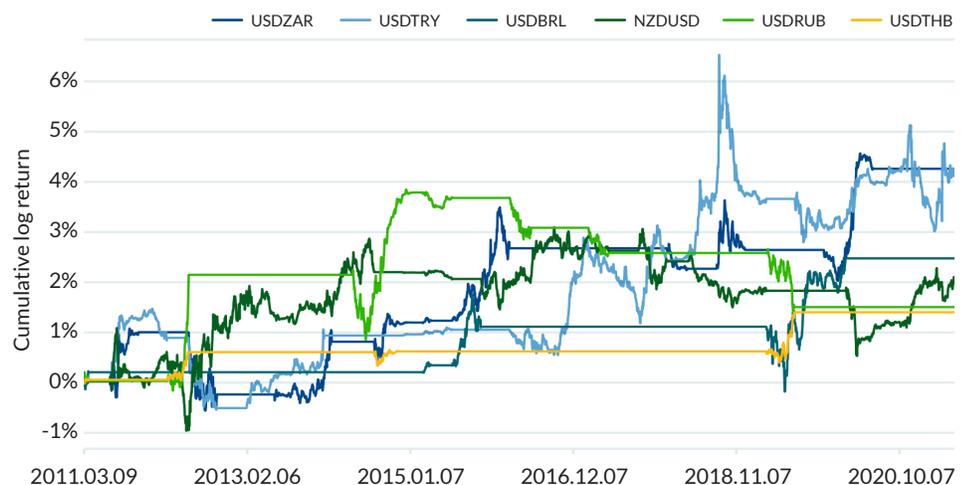
Figures 5 and 6 show the accumulated logarithmic returns (per currency pair and for the overall portfolio, respectively), during the backtest period. As illustrated in Figure 6, there is a relatively steady overtime increase in the accumulated total returns, showing the effectiveness of this strategy. USDTRY, USDZAR, USDINR, USDIDR, USDRUB and USDBRL are the top currency pairs (Figure 7), with $\approx 1.02\%$, 0.58% , 0.40% , 0.36% , 0.30% and 0.26% total returns, respectively. On the other hand, Figure 8 shows six currency pairs in our portfolio, whose total returns are the lowest.

FIGURE 6: LOGARITHMIC AND CUMULATIVE SUM OF RETURNS FOR ENTIRE PORTFOLIO



Source: Mesirow

FIGURE 7: TOP RETURNS PER CURRENCY PAIR



Source: Mesirow

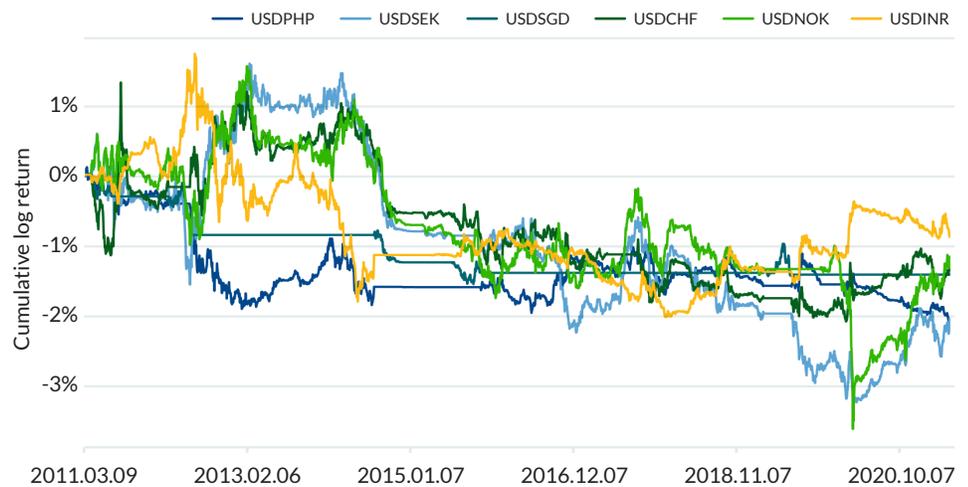
Finally, Table 1 summarises the performance of the proposed approach over a more recent period (the last 5 years).

TABLE 1: PERFORMANCE
(May 2016 – May 2021)

	Returns (%)	Information Ratio
6 months	0.99 ± 3.70	0.27
1 year	2.03 ± 2.92	0.70
2 years	1.74 ± 3.64	0.48
3 years	0.99 ± 3.60	0.28
5 years	0.55 ± 3.30	0.17

Source: Mesirow

FIGURE 8: BOTTOM RETURNS PER CURRENCY PAIR



Source: Mesirow

Conclusions

This paper explained our approach to incorporating ESG indicators within a systematic FX strategy. We explained our in-house data preparation pipeline, which is capable of transforming data from raw and irregular formats (such as textual, PDF, Excel or even images) into tabular forms, suitable to use within an RV strategy. Then, we detailed our algorithm to dynamically allocate higher weights to ESG indicators that are more compatible to the current FX market state, while assigning lower weights to less compatible ones. Our 10 years backtest shows incorporating ESG data as part of a systematic FX strategy can generate uncorrelated signals, which can be used as a complementary source next to other types of economic data.

The ESG integration has been part of our Fundamental Strategy since 01 Jun 2021, for the Extended and Emerging programmes. While we currently use around 51 indicators, the proposed approach is completely scalable, and upon availability, more factors can also be easily added.

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Appendix

1. 'World Development Indicators: Terrestrial Protected Areas (% of total land area)': 'WDITPA',
2. 'Social Progress Index': 'SPI',
3. 'World Development Indicators: Strength of Legal Rights Index': 'WDISoLR',
4. 'Worldwide Governance Indicators: Political Stability No Violence': 'WwGIPSNV',
5. 'Energy Performance Review: Renewable Consumption': 'EPRRC',
6. 'World Development Indicators: Rural Population (% of total population)': 'WDIRP',
7. 'Better Life Index: Labour Force Participation Rate': 'BLILFPR',
8. 'Corruption Perceptions Index': 'CPI',
9. 'Energy Performance Review: CO2 Emission': 'EPRCo2Em',
10. 'Gini Coefficient (Income) Index': 'GCI',
11. 'World Development Indicators: Ratio of Female to Male Labour Force Participation Rate': 'WDIRoFtMLFP',
12. 'World Development Indicators: Tax Revenue (% of GDP)': 'WDITR',
13. 'Worldwide Governance Indicators: Rule of Law': 'WwGIRoL',
14. 'Better Life Index: Unemployment Rate': 'BLIUR',
15. 'Fragile States Index': 'FSI',
16. 'World Development Indicators: Access to Clean Fuels and Technologies for Cooking (% of population)': 'WDIAtCFaTfC',
17. 'World Development Indicators: Adequacy of Social Insurance Programs (% of total welfare of beneficiary households)': 'WDIAoSIP',
18. 'ECI and PCI Index': 'ECIPCI',
19. 'World Development Indicators: Access to Electricity (% of population)': 'WDIAtE',
20. 'Worldwide Governance Indicators: Government Effectiveness': 'WwGIGE',
21. 'Environmental Performance Index': 'EPI',
22. 'Freedom in the World Index': 'FitWI',
23. 'Energy Trilemma Index': 'ETI',
24. 'World Development Indicators: Renewable Electricity Output (% of total electricity output)': 'WDIREO',
25. 'World Development Indicators: Coverage of Social Insurance Programs (% of population)': 'WDICoSIP',
26. 'Ease of Doing Biz Index': 'EoDBI',
27. 'World Development Indicators: Government Expenditure on Education, Total (% of GDP)': 'WDIGEoE',
28. 'World Development Indicators: Account Ownership at a Financial Institution or with a Mobile-Money-Service Provider (% of population ages 15+)': 'WDIAOaaFI',
29. 'World Development Indicators: Tariff Rate, Applied, Simple Mean, all Products (%)': 'WDITR',
30. 'World Development Indicators: Adjusted Savings: Carbon Dioxide Damage (% of GNI)': 'WDIAS',
31. 'World Development Indicators Labour Force, Female': 'WDILF',
32. 'Worldwide Governance Indicators: Regulatory Quality': 'WwGIRQ',
33. 'Worldwide Governance Indicators: Voice and Accountability': 'WwGIVaA',
34. 'Climate Change Performance Index': 'CCPI',
35. 'Human Capital Index': 'HCI',
36. 'SDG Index': 'SDGI',
37. 'Women Business & Law (WBL) Index': 'WBaLI',
38. 'World Development Indicators: Number of Infant Deaths': 'WDINoID',
39. 'Worldwide Governance Indicators: Control of Corruption': 'WwGICoC',
40. 'World Development Indicators: Population Growth (annual %)': 'WDIPG',
41. 'ND-GAIN Index': 'NDGI',
42. 'Better Life Index: Employment to Population Ratio': 'BLIEtPR',
43. 'World Development Indicators: Renewable Energy Consumption (% of Total Final Energy Consumption)': 'WDIREC',
44. 'Human Development Index': 'HDI',
45. 'World Press Freedom Index': 'WPF',
46. 'World Development Indicators: Population Ages 0-14 (% of total population)': 'WDIPA0t14',
47. 'Aqueduct Water Risk Atlas': 'AWRA',
48. 'Global Peace Index': 'GPI',
49. 'Global Competitiveness Index': 'GCI',
50. 'World Development Indicators: Population ages 65 and above (% of total population)': 'WwGIPA65aA',
51. 'World Development Indicators: General Government Final Consumption Expenditure (% of GDP)': 'WDIGGFCE'

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