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The Recent Performance of ESG Investing, the Covid-19 Catalyst and the Biden Effect

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The Recent Performance of ESG Investing, the Covid-19 Catalyst and the Biden Effect

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Abstract

The purpose of this paper is to appraise recent ESG trends in global equity markets. It contributes to a broader research project started at Amundi in 2014 on the relevance of ESG. Since the latest update in 2019, we have lived through a global pandemic that profoundly reshaped the global economy and society, and an eventful change of leadership in the United States. The aim of this paper is to analyze the changes in ESG trends since our latest update in June 2019. We work on the North American and EMU universes and, for the first time in our research series, also shed the light on Emerging Asia market. We identify that a presumed "Biden effect", assumed to be supportive for ESG performance in North America, was actually anticipated earlier by investors and rooted in the fertile ground of rising ESG awareness. This being said, Joe Biden's election may have fueled some momentum for the Emissions & Energy component of the Environmental pillar on both sides of the Atlantic at the end of 2020. In addition, we previously showed that the Social pillar in North America had already caught ESG investors' attention following the market stress caused by the Covid-19 outbreak. Our results also demonstrate the Social pillar's strong performance in North America since the end of 2020. Additionally, we show that companies with better Governance have been the most resilient in terms of performance during the pandemic's troublesome market environment, independently of the region considered. In North America, employing credit market data, we demonstrate that these firms also benefited from a lower corporate cost of debt. In Emerging Asia, we have witnessed strong ESG performance since the end of 2020. Finally, employing a predictive non-linear framework, our results support ESG as a serious candidate risk factor not only in the EMU, but also in North America since 2019.

Keywords: ESG, environmental, social, governance, asset pricing, active management, factor investing, covid-19, feature extraction, machine learning.
JEL classification: G10, M14, C38.

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Contents

1 Introduction

Responsible investing has been expanding continuously since our latest discussion on ESG asset pricing with Drei *et al.* (2019). The number of signatories to the Principles for Responsible Investment, which increased 63% between 2019 and 2021, corroborates the higher consideration of ESG by financial markets (UNPRI, 2020, 2021)). However, higher interest has also fueled some debate. To illustrate, the dispersion of ESG ratings from ESG data providers has been in the spotlight (Berg *et al.*, 2020; Billio *et al.*, 2021). Still, on the credit ratings front, it appears that longer established credit rating agencies tend to reduce dispersion. Thus, in the future we might see separate developments between "matter-of-fact - value" oriented ESG providers and "values" oriented ESG providers. The "value vs. values" situation is highlighted by Eccles and Stroehle (2018). Besides, progress and innovation in the ESG field have been flourishing. For instance, with a risk orientation, Sahin *et al.* (2021) proposed accounting for missing ESG information with a *Missing pillar*. Pedersen *et al.* (2020) formulated ESG in an efficient frontier framework. On our side, we showcased the value added by incorporating news related to companies' stakeholders into the ESG assessment (Taleb *et al.*, 2020). We identified that ESG data's influence on prices is in fact dependent on information volume, which contradicts the pure Efficient Market Hypothesis (Fama, 1965). We understand that ESG information is treated differently between an *ESG sensitive species* and an *ESG non-sensitive species*, which makes its price integration closer to the Adaptive Market Hypothesis (Lo, 2004). The Natural Language Processing route has also been explored by researchers. For instance, Sokolov *et al.* (2021) incorporated ESG criteria extracted from news data into a systematic portfolio construction.

In this piece of research, we propose refreshing ESG's asset pricing from the point where we left it in June 2019 (Drei *et al.*, 2019). This exercise is particularly compelling in the sense that recent years have been characterized by unprecedented events, that have shaken financial markets and reshaped our economies. At first, Covid-19 was perhaps perceived as a local and one-off event, but its outbreak in March 2020 not only shattered the markets worldwide, but also population and trade movements. It turned out to also be a latent market driver that is still causing significant headwinds on today's markets. Covid-19 also fostered significant business model disruptions and accelerated changes in collective attitudes towards numerous ESG themes. At the same time, the US political scene also set the stage for promises of potential U-turns on some of these aspects. Nevertheless, uncertainty remained over the outcome of the presidential race and the leeway to effectively implement promised ESG-focused policies.

This paper is structured as follows. Section 2 will cover the acceleration of ESG in North America[1] since June 2019 and answer the frequently asked question: *"is there a Biden effect for ESG in North America?"*. Section 3 will provide an update on ESG in the EMU while section 4 will be our first analysis of ESG in the Emerging Markets, with a focus on Asia. Section 5 will be devoted to ESG in a factor context with a predictive non-linear framework, while Section 6 will conclude.

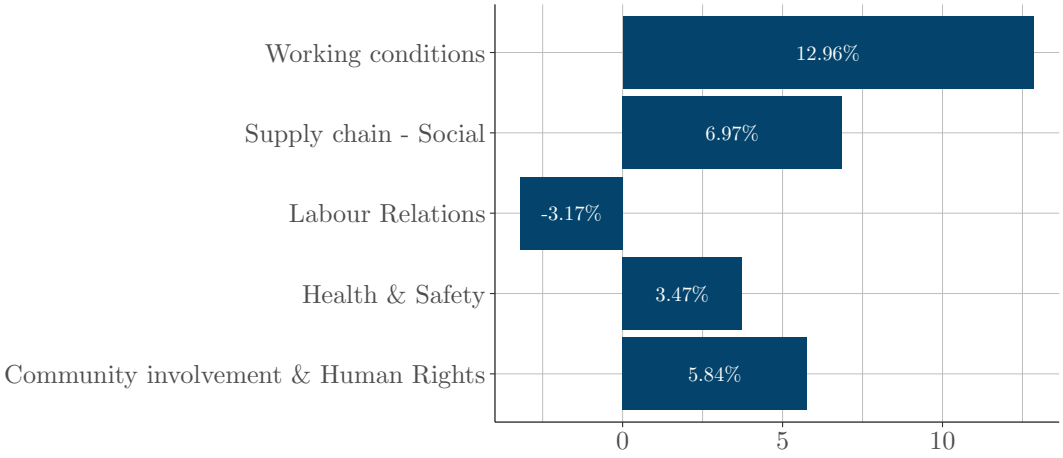
[1]We confirmed the transatlantic divide (Drei *et al.*, 2019), already identified in our previous studies, between North America and EMU in the equity markets. We also showed that this result holds in the investment grade credit market (Ben Slimane *et al.*, 2019). It supports our choice of regional segmentation that we thus maintain in this paper when analyzing the performance of ESG.

2 The acceleration of ESG in North America

2.1 Working conditions: the lion's share of Social issues

In a recent study (Lepetit & Sekine, 2020), we already highlighted that during the first quarter of 2020, the Social pillar largely outperformed other ESG metrics in North America[2]. We also demonstrated in a cointegrating framework that the Social pillar in North America seemed to have reacted to the Covid-19's financial market stress, which materialized by the all-time high spike of the VIX on March 16^{th}. In Figure 1, based on stock's exposure to the different social sub-pillars, we are able to appraise their respective performance for the MSCI North America universe between June 2019 and June 2021. We observe that during this period, *Working conditions* have been particularly valued by investors, who rewarded companies scoring well on that social aspect. As a matter of fact, we believe that this phenomenon is not incidental. The Covid-19 crisis triggered deep uncertainty in North American labor markets, traditionally perceived as fairly flexible, raising fears of unemployment for millions of workers. In this context, companies taking a stance on that matter, such as announcing no lay-offs, sent a positive signal to stock holders. This result echoes the lower sovereign bond's yield faced by countries with sound labor standards (Semet *et al.*, 2021). *Working conditions* are thus an integral part of Social concerns. Still, the *Supply Chain - Social* and *Community Involvement & Human Rights* sub-pillars also performed well since 2019, which hints that the well-being of employees, but also of other stakeholders, is at the forefront of investors' mind. The positive return associated to the *Health & Safety* authenticates this idea. On another topic, *Labour relations* lagged other sub-pillars, which might be explained by the low collective bargaining coverage in the US[3]. We thus believe that from investors' point of view, this theme may remain in the background when assessing a company's social performance in the region.

Figure 1: North America: Social Sub-Pillars (Long-Short Return % between 28/06/2019 and 30/06/2021)



Source: Amundi

[2]As described in Bennani *et al.* (2018) and Drei *et al.* (2019), we implement the Fama and French (1992) method of sorted portfolios. The stocks are ranked within each sector along the ESG Score, or E, S, G pillars or sub-pillars depending on our analysis. From each sector, we keep the top 20% and the bottom 20% to build the top quintile portfolio (Q_1) and the bottom quintile portfolio (Q_5). We rebalance the portfolios on a quarterly basis. At the rebalancing date, stocks are equally weighted within each sector and the Q_1-Q_5 long-short portfolio is sector neutral.

[3]https://www.oecd.org/employment/collective-bargaining.htm

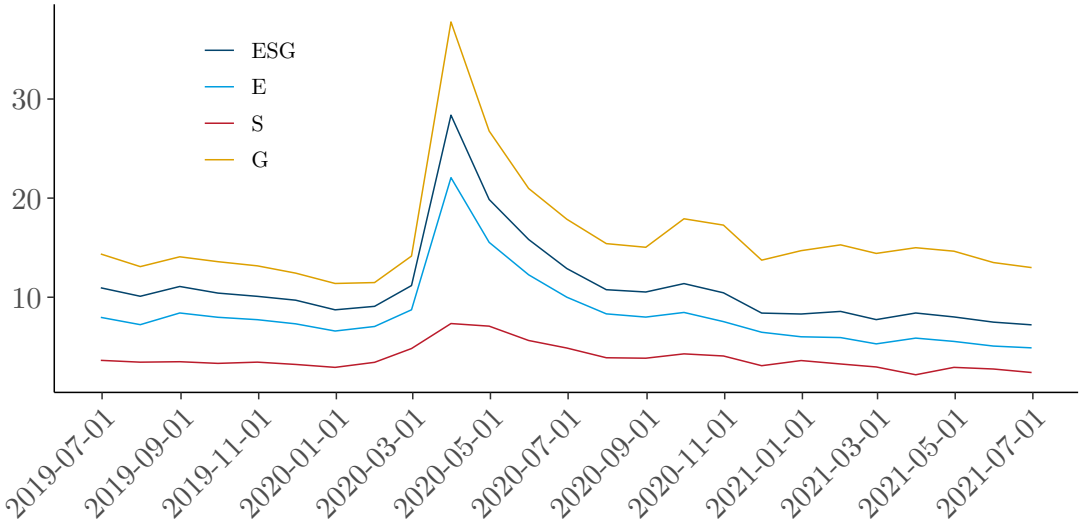
2.2 Better Governance supports financing

Although the market stress related to Covid-19 receded after the first Federal Reserve Quantitative Easing announcement (Rebucci *et al.*, 2020), corporates were left with requirement for external capital. Halling *et al.* (2020) indicate that capital raised during Covid-19 via equity issues represented only 5% of capital raised via bond issues in the US. We therefore turn our attention to the credit side of issuers. We extend the calculation of cost of capital that we introduced in Ben Slimane *et al.* (2019) to the 2014-2021 period. We emphasize that we work on corporate bond issuers that belong to MSCI North America, an equity universe[4]. More specifically, we model the cost of capital differentials between the weakest and the strongest issuer on the chosen metric for each sector/rating combination for a maturity close to 7 years, as follows in Equation (1):

$$\ln \mathrm{OAS}_i \approx \hat{\alpha} + \hat{\beta}_{ESG\,pillar} \cdot \mathcal{S}_i + \hat{\beta}_{md} \cdot \mathrm{MD} + \hat{\beta}_{\mathcal{S}ector}(j) + \hat{\beta}_{\mathcal{R}ating}(k) \tag{1}$$

where OAS_i stands for the option adjusted spread of Bond i, S_i is the ESG pillar of interest, MD_i is the modified duration, $Sector(j)$ is a dummy variable for the j^{th} sector, while $Rating(k)$ is a dummy variable for the k^{th} rating. Then we aggregate sector/rating data using equal weights, for each pillar at each date. The cost of debt differentials is presented in Figure 2. For the issuers from the MSCI North America universe, Governance was the most differentiating element among ESG itself -as a whole- and the Environmental and Social pillars before February 2020. This phenomenon was magnified during the Covid-19 outbreak when the cost of debt spiked, before Central banks' response. Governance has actually downplayed other ESG themes as the most differentiating pillar for the cost of debt since March 2020. Over our period of analysis, companies with poor (good) governance have been more sanctioned (rewarded) by market participants that examine this pillar closely.

Figure 2: Cost of Debt Differentials by Pillars (bps)



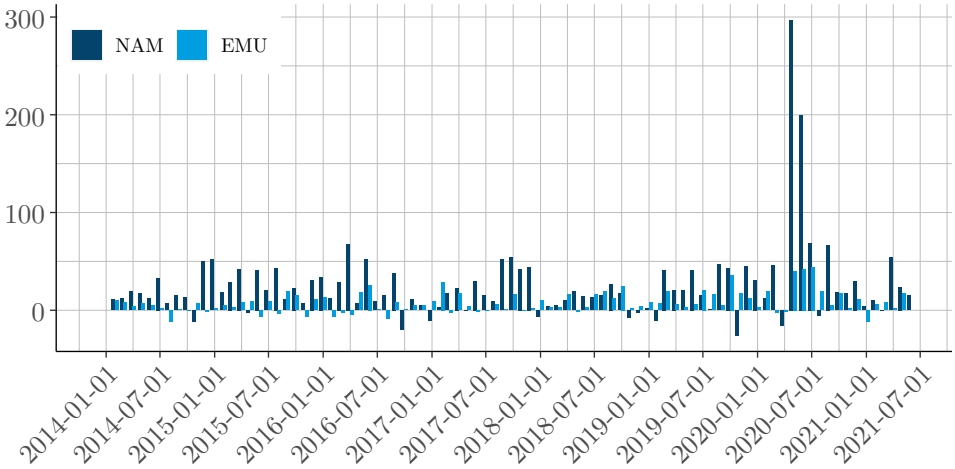
Source: ICE, MSCI, author's calculations

Figure 3 indicates that financing requirements (assessed by the number of net new emissions) for the issuers from the MSCI North America universe were exceptionally high in the months following March

[4]We manage to retrieve credit metrics for 96% of the issuers of the MSCI North America.

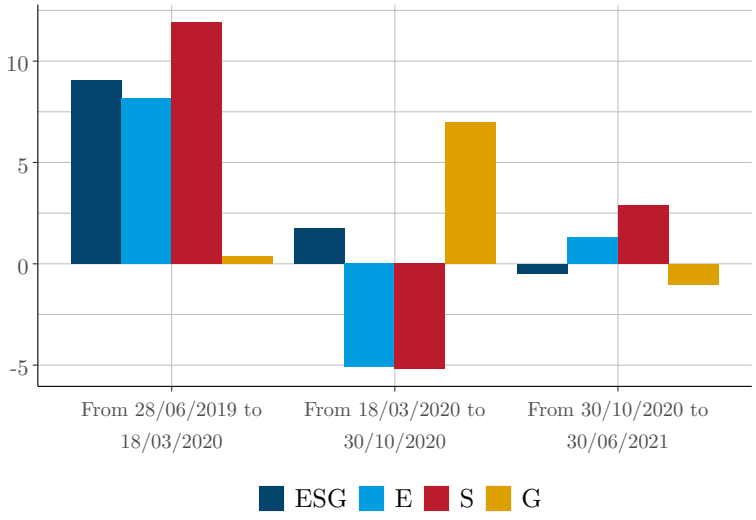
2020. While there were also soaring for issuers from the MSCI EMU universe, they still remained within the *business as usual* range. Indeed, the number of monthly net emissions from MSCI North America's corporates between April 2020 and October 2020 financing frenzy period peaked at 436% of the maximum monthly net amount issued for the period between January 2014 and March 2020. This ratio stands at 122% for the MSCI EMU. In this context, better Governance, associated with a lower cost of debt - the main source of financing - has become a very powerful discriminant feature since March 2020.

Figure 3: Net Financing Requirements by Issuers in MSCI EMU and MSCI North America (Net Number of Issues)



Source: ICE, MSCI, author's calculations

Figure 4: North America: ESG and E, S and G Pillars (Long-Short Return %)



Source: Amundi

2.3 The Biden effect for ESG?

In Bennani *et al.* (2018), we showed that ESG investing has become relevant and thus rewarded in equity markets since 2014. Awareness concerning environmental, social and governance challenges has steadily increased, augmenting the profitability focal point, at the heart of financial markets. As a matter of fact, we argue that the Friedman and Freeman debate has been at play over recent years and has tilted towards the stakeholder theory of Freeman, with firm's ESG value creation benefiting to all stakeholders, not only shareholders (Freeman, 2008). However, from collective agreement on theoretical ESG's benefits to practice, it has not been an easy ride. For instance, there has been much debate in academia concerning potential "greenwashing" that can hinder companies' credibility in the eyes of investors and consumers (Delmas & Burbano, 2011). More recently, a turnaround occurred in the public debate, that shifted from greenwashing to "woke washing", the companies' appropriation of societal injustices (Vredenburg *et al.*, 2020). Environmental topics have not been spared. For instance, we confirmed that in aggregate, corporates have not delivered in the objective to curb their emission intensity trajectories (Le Guenedal *et al.*, 2020). However, it must be stressed that corporate's ESG advances and their materiality on financial markets may be at different stages across world regions, a phenomenon notably illustrated by the transatlantic divide (Drei *et al.*, 2019). Investors probably assumed that deeper integration of ESG in North America would be triggered by the Biden administration, which has highlighted climate and racial equity ahead of the economy in their priorities[5].

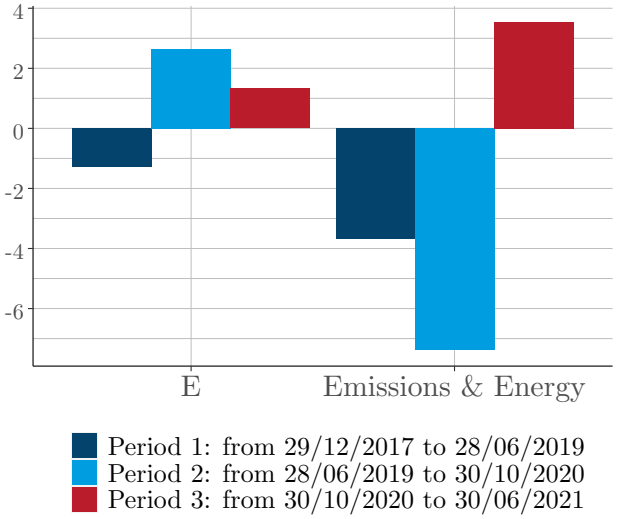
But did the Biden election indeed lead to an outperformance of the ESG pillars in the North American equity market? We illustrated in a previous subsection that the *Working conditions* have been a matter of prime importance on the social front since June 2019. The Covid-19 crisis also shed the light on the growing role of Governance, notably through firms' impressive financing needs in North America once the markets were appeased by central bank action. However, we stress that these effects were in fact observable in the market prior to the election of Joe Biden in November 2020. Moreover, this political event must be decomposed between the actual election and the delivery of policies, transcribed within US regulation and implemented in the real world economy, the latter being obviously longer to materialize. Therefore, in terms of timeline, it would be more accurate to posit that *the election of Joe Biden happened in a context where ESG integration in North America had already responded positively to different factors*, rather than indicating that Joe Biden's election had triggered ESG integration. In addition to the importance of *Working conditions* on the social front, and the resilience of companies with strong governance when coming to the bond market, we are also convinced that collective thinking and investor's consciousness have been at play before 2020. Indeed, following Europe's footsteps a few years earlier, the US financial industry has pushed on extra-financial integration, conducing the SEC to increasingly focus on ESG issues (Al-Khatib, 2021). This phenomenon could not have occurred without a gradual rise in collective awareness on key ESG themes. Figure 4, that decomposes performances around the two recent key market events (the pandemic and Joe Biden's election), corroborates this idea, with strong performances of ESG, S and E pillars before the Covid-19. While Governance was lagging behind at that time, it has emerged in the heart of the crisis as the most resilient pillar. Since Joe Biden's election, the Governance momentum slightly faded out, while the Social and Environmental pillars regained importance resuming the trend observed before the pandemic, although for the moment performances are not back at their pre-crisis' levels.

On the Environmental front, the 2019 report from IEA (2020) already released in February of 2020 showed that between 2018 and 2019, CO_{2eq} emissions diminished in the United States. As a matter of fact, it was the country that showed "the largest decline in energy-related CO_{2eq} emissions in 2019 on a country basis – a fall of 140 Mt, or 2.9%, to 4.8 Gt". According to the report, this effect can be

[5] https://www.whitehouse.gov/priorities/

attributed to an improvement in the energy mix, with an increased share of natural gas versus coal used for power generation. However, from Figure 5, we witness that at the time, such improvement on the CO_{2eq} footprint was not yet reflected in the equity market, with negative performance for the *Emission & Energy* sub-pillar. Interestingly, in November 2020 - Joe Biden's election -, a turnaround occurred: since then investors tend to reward companies that limit their emissions. Although the causality with the US election should be examined more closely, 2020 still pointed at an increased integration of CO_{2eq} emission into stock prices.

Figure 5: North America: Emissions & Energy (Long-Short Return %)



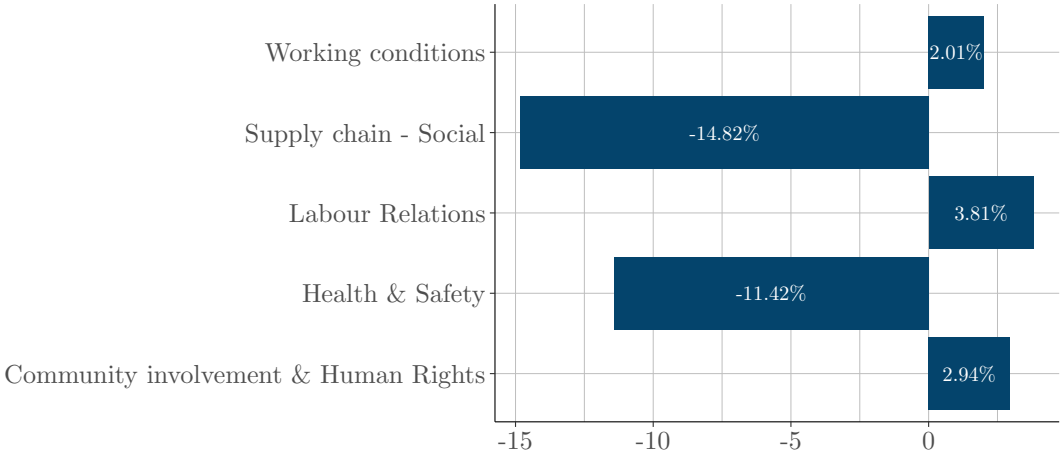
Source: Amundi

3 ESG in EMU

3.1 Not all social facets are equal

We reiterate our Social pillar decomposition of performance, on the MSCI EMU constituents in Figure 6. If in North America the Social pillar was the winning pillar in the first quarter of 2020, characterized by the Covid-19 stress, in EMU it was instead the laggard (Lepetit & Sekine, 2020). Since the Covid-19 outbreak it has posted a slightly negative performance on average. At the difference of North America, we do not witness a very strong return nor dominance over other pillars from *Working conditions* in the EMU. We believe the EMU corporates had the country safety nets (notably with fairly prohibitive laws on layoffs), which was not the case in the US. Therefore the *Working conditions* display a significant discriminant power in North America, but less in the EMU. That being said, companies with sound practices on *Labour relations*, *Community involvement & Human rights* and *Working conditions* have withstood in terms of performance since 2019. In contrast, *Supply chain - Social* and the *Health & Safety* sub-pillars significantly underperformed over the period of analysis. This result is puzzling, and more particularly for the *Supply chain - Social* pillar that exhibited high performance among social themes in North America. We assume that supply chain related controversies across the globe (Tamayo-Torres *et al.*, 2019), that have recently caught investors' attention in the EMU area may explain this divergence. These recent developments also underline the key role of ethics when assessing a company's supply chain.

Figure 6: EMU: Social Sub-Pillars (Long-Short Return % between 28/06/2019 and 30/06/2021)



Source: Amundi

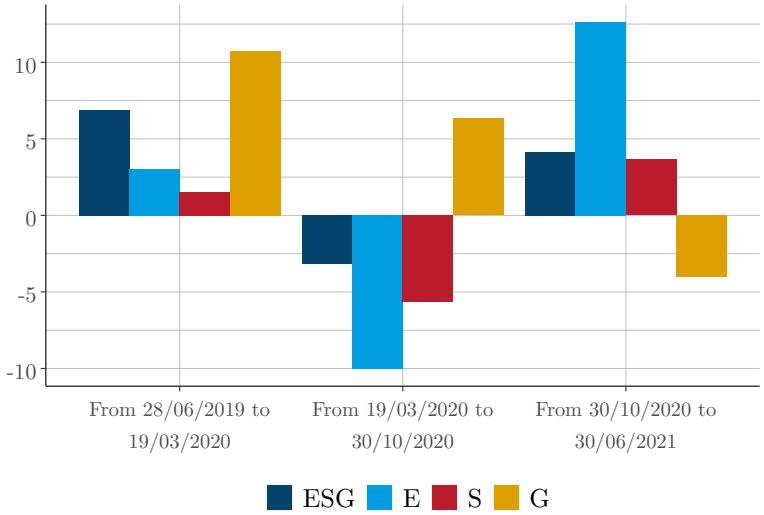
3.2 Governance synonym of resilience

In Figure 7, we decomposed ESG performance over three different time-windows, to reflect on the most recent driving markets events. Before the pandemic outbreak, although all pillars posted positive performance, the main driver of ESG performance in EMU was clearly Governance, unlike the US where social aspects dominated the ESG landscape. It seems that March 2020's events have magnified the trend in EMU. Indeed, companies with strong governance practices outperformed distinctly other pillars, pushed to the background during this period. However, at the difference of North America, the number of bond issuance was fairly contained for MSCI EMU issuers, therefore the cost of debt did not appear as critical during this period.

3.3 An Environmental momentum fueled by Biden's election?

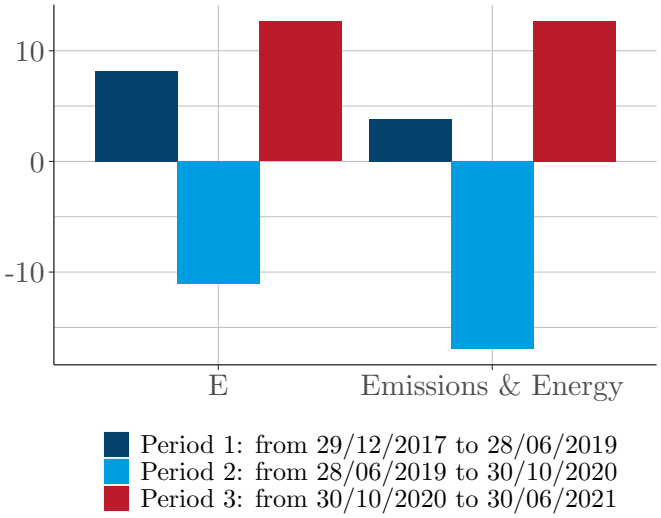
We saw that in North America, Joe Biden's election has coincided with a positive performance of the *Emissions & Energy* sub-pillar so far underperforming, hinting at a growing integration of environmental and climatic issues. On that front, the Eurozone was one step ahead as illustrated in Figure 8 by the *Emissions & Energy* pillar, standing in positive territory in years prior to the Covid-19. It seems that the pandemic outbreak concealed both social and environmental considerations in EMU's equity market, only Governance held its own, as previously mentioned. Nevertheless, this sequence was momentary. Since November 2020, the E pillar made a forceful come-back, driving ESG's performance in the region. Companies scoring well on the *Emissions & Energy* theme have also posted strong performances, even outpacing pre-Covid-19 levels. Biden's election may have fostered market optimism, encouraging a global integration of environmental topics. For instance, its campaign pledge to re-join the Paris Agreement may have pushed into this direction. To conclude, the outcome of the US elections may have brought a "green euphoria" to European financial markets, however we should bear in mind that environmental integration was more advanced in the EMU before the pandemic.

Figure 7: EMU: ESG and E, S and G Pillars (Long-Short Return %)



Source: Amundi

Figure 8: EMU: Emissions & Energy (Long-Short Return %)



Source: Amundi

4 ESG in Emerging Asia

4.1 Particularities of Emerging Markets on the ESG front

Engaging in ESG for Emerging Markets is not trivial. Indeed, these markets are often faced with strong challenges on various sustainability aspects. For instance, Odell and Ali (2016) showed that weak institutions or uneven regulatory regimes may be responsible for social concerns. On the environmental front, the authors argue that Emerging Markets are more exposed to climate change, but also to resources scarcity challenges and local pollution. Moreover, they add that "governance standards and levels of disclosure in emerging and frontier markets are not on a par with those in Developed Markets" highlighting the critical role of governance in these markets. As a matter of fact, when investigating the integration of ESG in Emerging Markets (see Appendix A.2) we came across an insightful result, that corroborates this idea. Investors keen to expose to Emerging Markets are therefore more likely to focus on the transparency and reliability of financial reporting to assess corporate governance, while it is rather considered as a given for Developed Markets. Also, we find that focusing on a fairly homogeneous region should increase the robustness of our results. The composition of the MSCI Emerging Markets being largely titled towards Asia, we choose to focus on this region (Emerging Asia) rather than considering the entire universe in the rest of our analysis.

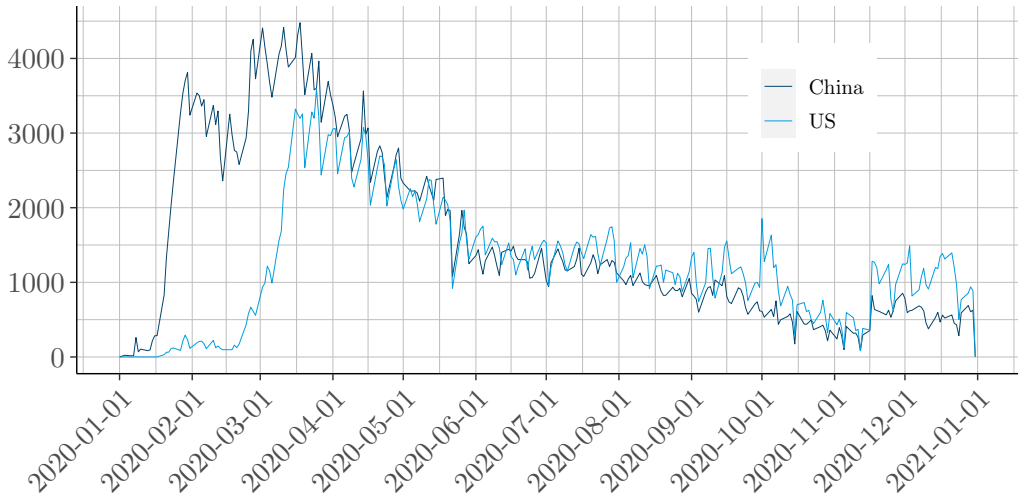
In Sections 2 and 3, we checked the performance of ESG and its different pillars around the dates of March 2020 (the Covid-19 outbreak) and November 2020 (Joe Biden's election). The 18^{th} of March 2020 was chosen as the first break point[6], coinciding with spiking volatility across global financial markets. However, we wonder how relevant is this first break point when working on the Emerging Asia region, accounting for the fact that China was at the epicenter of the Covid-19 crisis in the early months of 2020. Based on news volume data described in Sekine *et al.* (forthcoming), we identify a time-gap in the first local peak of Covid-19 related news volume between the US and China, as illustrated in Figure 9. News concerning Covid-19 development actually started in the first weeks of January in China. We believe that this particular feature, only relevant for Asia, must be accounted for in our analysis. Hence, we adapt our breaking points to fit Emerging Asia earlier attention concerning the pandemic, switching the Covid-19 outbreak from 18^{th} of March to 31^{st} of January 2020.

4.2 Governance and Social inter-linkages

Figure 10 synthesizes the performance of the different ESG pillars over three periods of analysis. We illustrate that over all the periods considered, Governance steadily maintained a positive long-short return. This result corroborates the idea that investors are particularly focused on this pillar, which is of prime concern when analyzing companies in Emerging markets. Accounting quality and disclosure, as well as conflict of interest avoidance should thus be rewarded by market participants when investing in Emerging Markets. Interestingly, we witness that the outstanding governance return's contributor, before the Covid-19 outbreak, but also for the subsequent period, was the *Ethics* sub-pillar. If we investigate this theme's long-short performance more closely, we witness in Figure 11 that it accelerated nearly a month before spikes in the CBOE Volatility Index and the CBOE China ETF Volatility Index. Companies' ethical behavior has been rewarded during the pandemic, but also before, which may hint at growing concerns on this theme in Emerging Asia. We recall that the Covid-19 period also coincided with major supply chain disruptions, that brought the light on complex international networks, but also on unequal working conditions, raising ethical concerns. Besides, the benefits of ethical supply chain practices have been researched and their ties to performance demonstrated (Yusuf *et al.*, 2014). Growing ethical concerns

[6] 18^{th} of March for North America, followed by the 19^{th} of March for EMU.

Figure 9: Covid News Count in the US and China



Note: the volumes were computed summing over three key themes -or taxonomy- grouping by associated countries (Disease Coronavirus, Disease Coronaviruses, Disease Infections)

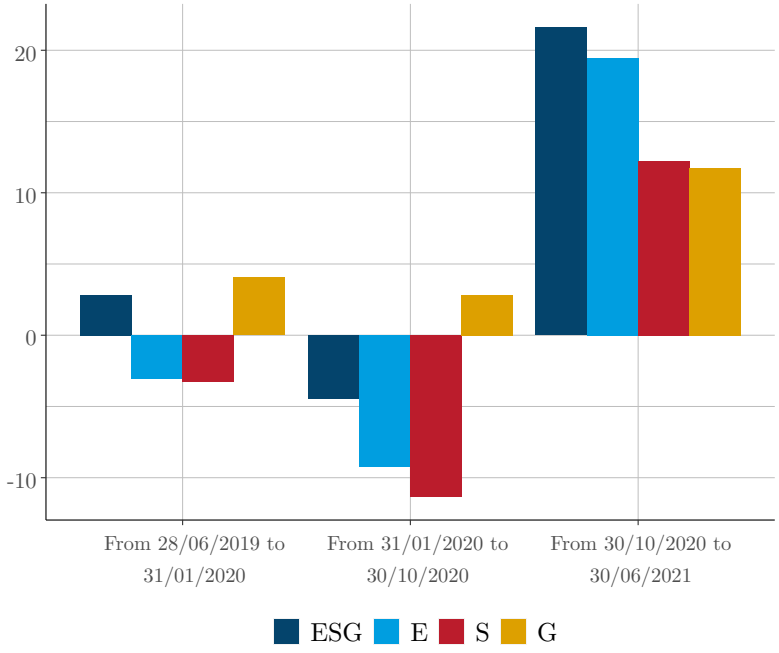
Source: GDELT, Author's calculations

in Emerging Asia and diverging pricing of supply chain considerations in EMU and North America is surprising and raises questions on the social and human aspects embodied in production processes. It is a puzzle that we will revisit in future research.

4.3 The conquest of ESG in Asia

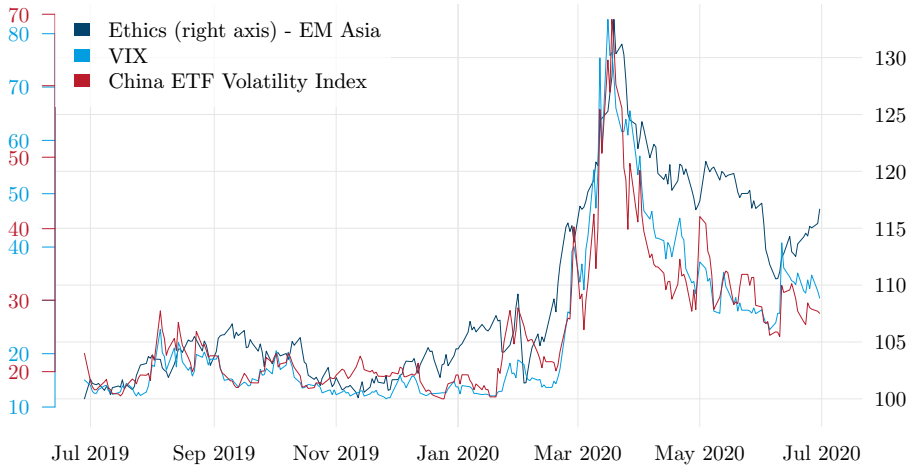
From Figure 10, we notice that prior to the Covid-19, ESG and Governance posted positive returns. The pandemic reshuffled the deck, with performance from ESG, S and G pillars severely hit. Once again, we witness that Governance has been the most resilient pillar during this troublesome market phase. Ultimately, Central Banks have eased the financing needs of corporates in the course of 2020, and risk appetite started to recover. In addition, it should be noted that the number of Covid-19 new cases remained fairly contained in Asia during the fall of 2020, compared to other regions of the world that were hit by new waves. These elements seem to have been supportive for inflows in 2020, that were significant in the Emerging Asia region, as proxied by the global ETF flows from the european ETF market in Figure 13 in Appendix A.1. As a matter of fact, the biggest inflows occurred in the month of November. We hypothesize that the Biden's effect might have been at play again. Indeed, aside of this election outcome on ESG considerations, this event was of significant help for relieving market uncertainty. As aforementioned, this may have reinforced risk appetite and particularly from Western ESG investors that may have seen in Emerging Asia a new market to conquer. This idea is reinforced by Figure 10 that displays very positive returns for ESG and for the E, S and G pillars in the most recent period. In addition, current regulation points at the rising importance of ESG in the region, as illustrated by the China Securities Regulatory Commission (CSRC) that recently set risk disclosure rules applicable to annual and half-year reports. Disclosure on pollution, waste management, efforts for achieving carbon neutrality or poverty alleviation are either required or encouraged, depending whether the firm is identified as a "polluting company" or not (Saiyid, 2021).

Figure 10: EM Asia: ESG and E, S and G Pillars (Long-Short Return %)



Source: Amundi

Figure 11: The Ethics Sub-Pillar Return vs. CBOE VIX and CBOE China ETF Volatility Index



Source: CBOE, Amundi

5 Machine learning based prediction with factors

In this section, the objective is to measure the relationship and the importance of ESG in the market compared to traditional factors across non-linear relationships. We put ourselves in a predictive framework where the forecast is produced on 30% of the data set. This contrasts with our preceding studies on linear factor analysis for the equity asset class (see Bennani *et al.* (2018) or Taleb *et al.* (2020)) where the regression framework implied that we were using 100% of the data set to train the model. The decision to use tree-based regressions was driven by several considerations. One reason is that we are looking for similarities in the returns profile of risk factors and ESG that could not be possibly modeled in a linear framework. Another is that tree-based models tackle collinearity issues for predictive purposes and provide strong accuracy even with small data sets.

5.1 Regression Trees and feature importance

Tree-based methods are powerful for predictive modeling given their capacity to solve both simple and complex problems with accuracy and stability. Breiman *et al.* (1984) introduced the CART models as the acronym of the book title *"Classification and Regression Trees"* for regression or classification forecasting problems. The CART algorithm lays out the premises for models such as random forest or gradient boost. We intend to use these methods to rank the importance of our risk factors to explain and predict the market as these algorithms have the capacities to map non-linear relationships[7].

These techniques provide two valuable outputs: the prediction and the feature importance consisting of the estimate of a feature's relevance. This is commonly computed through the *impurity-based feature importance*, a method introduced by Breiman *et al.* (1984) measuring the average *impurity* for each feature and for all trees in the *forest*. The more a feature appears in the trees with a high score, the more the feature has importance[8].

In our study, we have tested a supplementary approach to determine the importance of our risk factors. Lundberg and Lee (2017) propose the SHAP values for SHapley Additive exPlanations to address the complexity of the interpretation of the feature importance and the explanation of the impact that each variable has on the model's prediction. It is based on the shapley values of the game theory research field that studies interactions between rational parties (see Shapley (1953)). It is described as the average marginal contribution of a feature over every probable "coalitions". In other words, the goal is to compute the average difference of the contribution of each feature to the prediction, to the average prediction for a set of possible combination of features. The added value of SHAP is coming from the representation of shap values as an additive attribution method. In their research, Lundberg *et al.* (2018) proposed the TreeSHAP method as an alternative to SHAP values that is built for tree-based models using conditional expectation instead of marginal expectation. This method solves the problem of features dependence by the conditional expectations. We retain this approach in our analysis. In the next section, shap values are measured on the test set to prevent any over-fitting.

[7] The details of the algorithms are given in Cherief *et al.* (forthcoming).
[8] Figure 14, Appendix A.3 represents one of the trees in the *"forest"*.

5.2 What about ESG sensitivity in a non-linear framework?

We conduct an analysis to estimate the sensitivity of *"traditional risk factors"*[9] and ESG to the market by regressing the market[10] on the long-only features in excess returns adjusted from the market beta during the period from June 2019 to June 2021. To measure the feature importance, we average the shap values in absolute, themselves estimated on the test set. This approach allows us to elaborate a ranking of the variables where the top features have a higher impact on the model (either positively or negatively) and have a higher predictive power, relative to the bottom features.

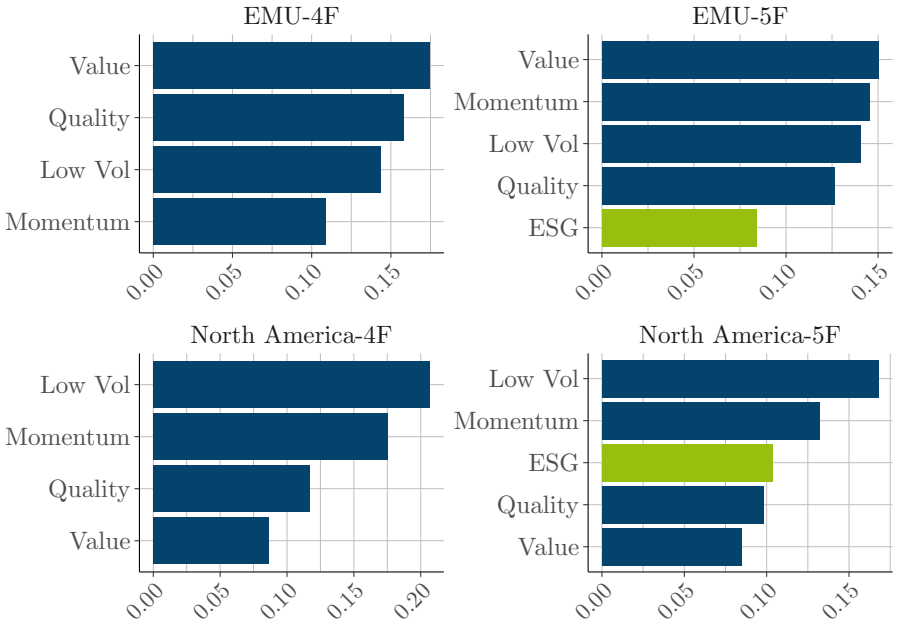
Figure 12 shows the ranking of the risk factors and ESG in explaining the market, based on the mean absolute shap values for the EMU and North America regions. In this analysis, we adopt a sequential approach fitting first the four equity factors to the market and then the four factors augmented with ESG to evaluate their interactions when adding ESG. The top two graphs of Figure 12 highlight value strong (negative) market impact in EMU (as illustrated by the factor's decreasing profile against market in Figure 15 in Appendix A.4) in line with recent market trends (Fama & French, 2021; Stagnol *et al.*, 2021). It also indicates that ESG is ranked last in feature importance for the EMU area. We also observe that factors have reacted differently to the inclusion of ESG: while quality has a lower power within the model, momentum's importance has risen. If we focus on Table 3 on Appendix A.4 representing the covariance between the market and the different equity risk premia (including ESG), we witness that the covariance term between the market and the momentum is unstable between the train and the test sets for the EMU area. Momentum is the only factor having such discrepancy on the covariance. This should explain the increase in importance of this factor in the EMU-5F model. From Figure 12, we also notice that quality dropped from the second to the second to last position while the value factor, despite also losing in significance, manages to maintain its first rank. In Figure 15 of Appendix A.4, we show how the model output is impacted depending on the features' returns. It indicates that ESG and quality have a *positive* impact on the market during the period. We can therefore question ourselves on a potential connection between the quality factor and ESG. Indeed, when the returns of the quality or ESG factor are negative, then the shap values are negative as well, meaning that they contribute negatively (positively) to the model when the returns are negative (positive). For the other equity risk premia, negative returns are associated with a positive impact on the market which implies that on the contrary, factors impact negatively the market when their returns are positive.

For the North America area, the bottom two graphs of Figure 12 illustrate that the low volatility factor has been associated with underperformance (see the decreasing profile of the factor in Figure 16 in Appendix A.4). The reason lies in the fact that low volatility stocks are generally less cyclical (Chow *et al.*, 2014; Stagnol & Taillardat, 2017), low beta, and therefore may have missed the recent pick-ups in the economic cycle. Our results also reveal that ESG is ranked third among the features, switching quality rank from third to fourth. Adding ESG to the features has also led to a reduction of the shap values for quality, low volatility and momentum factors. If we focus on the impact of the factors and ESG on the target variable (see Figure 16 in Appendix A.4), we confirm the similarities identified in the EMU area between quality and ESG factors. Indeed, quality and ESG contribute positively to the model when their returns are positive and inversely when their returns are negative. Still, for a share of high positive returns, they do contribute negatively to the model. Regarding the low volatility and value factors, their contributions to the target variable (captured by the shap values) are a decreasing function of their returns.

[9] The risk factors are low volatility, momentum, quality, and value. Size is already accounted for in our factor weighting scheme.

[10] It is measured by MSCI EMU NR Index for EMU region and MSCI North America NR Index for North America region.

Figure 12: Factors and ESG Ranking of Feature Importance for EMU and North America for the 2019-2021 Period (SHAP Value)



Source: Amundi, Authors' calculations

5.3 Factor analysis: bottom-up approach

For this sub-section, we consider long-only factors with daily excess returns[11] and adjusted from the market beta. The objective is to perform cross sectional tree-based regressions for all stocks of EMU and North America across three different periods. For each range of dates, we split the data between a training set fixed at 70% and a testing set to measure the accuracy of the prediction. Furthermore, data processing is essential even in the case of tree-based regressions. Random forest, for example, tends to assign higher importance to variables with a large range of values. For this reason, we standardize the data. We perform the tree-based regression for CAPM, the five-factor framework including the *"traditional equity factors"*[12], then the five-factor augmented with ESG.

Table 1 shows the improvement of the average *Adj.* R^2 of the 5F and 6F (*5F + ESG*) models[13] compared to the average *Adj.* R^2 of the CAPM model. As mentioned in Taleb *et al.* (2020), ESG brought small value-added for both universes between 2014 and 2019. Between June 2019 and June 2021, the predicting power has improved compared to the previous period in the two regions, although enhancements are more substantial in North America. Indeed, in the region, ESG is a strong contributor in the prediction of stocks' returns during the last period, even outpacing quality and value factors, as illustrated in Figure 12. Hence, our results support ESG as a serious candidate risk factor not only in EMU, but also in North America since 2019.

[11]The market is represented by the daily returns of the MSCI EMU NR Index for the EMU region and by the MSCI North America NR Index for the North America region.

[12]The risk factors are beta, low volatility, momentum, quality, and value. Size is already accounted for in our factor weighting scheme.

[13]The R^2 is centered and adjusted.

Table 1: Cross-section Regression (Improvement of the Average *Adj.* R^2) on Long-Only Risk Factor in Excess Returns

	EMU			North America		
Improvement vs. CAPM	*2010–2013*	*2014–2019*	*2019–2021*	*2010–2013*	*2014–2019*	*2019–2021*
$5F$	+0.43%	+1.32%	+1.83%	+1.46%	+1.72%	+4.82%
$6F$ (5F + ESG)	+0.40%	+1.40%	+1.53%	+1.82%	+2.39%	+4.97%

Source: Amundi, Authors' calculations

6 Conclusion

In this piece of research, we kept a regional approach. Indeed, we had previously highlighted the *transatlantic divide* between North America and the Eurozone. We had pointed to the Trump administration's conflicting roadmap in terms of ESG policy for a possible justification of the regional difference with regards to ESG. Therefore, we could have expected a "Biden effect" to re-start ESG integration in North America. However, we argue that especially for the Social and Environment themes, investors' rising ESG awareness may have in fact rooted in the collective consciousness, ahead of the election of Joe Biden as the 46^{th} President of the United States. In North America, companies turned to the credit market to fulfill the extraordinary financing requirements triggered by the Covid-19 crisis. Against this backdrop, Governance was the most discriminant pillar as firms with good practices on that aspect of ESG increased their advantage on lower cost of capital. For the Social dimension, we showed that in North America, despite strong performance during the first quarter of 2020, Covid-19's effects hindered the Social pillar's dominance in the following months. Still, the *Working conditions*, *Supply chain - Social* and *Community involvement & Human rights* themes remained rewarded by equity investors. Regarding the Environment dimension, we argue that the election of Joe Biden may have fueled trans-regional "green momentum" which turned into better integration of companies' CO_{2eq} emissions in investors' stock selection. We confirm that North America and EMU contributed to this trend. Moreover, when examining factors in a predictive non-linear framework, our analysis supports the relevance of ESG as a potential risk factor in North America, thus confirming its strong advance since 2019.

For the Eurozone, Governance confirms its champion pillar status. For the Social dimension, *Working conditions* appear less dominant than in North America over the same period, in favor of *Labour relations* and *Community Involvement & Human rights*. Opposite pricing of the *Supply chain - Social* theme across the Atlantic raises questions. We identify that *Ethics* has been a strong driver of the Governance pillar in Emerging Asia. As such, we wonder if it relates to the supply chain considerations in Developed regions. This question will be left for forthcoming research. In Emerging Asia, our analysis also showed that, since November 2020, the region has exhibited the strongest returns on all ESG aspects compared to North America and EMU in the presence of positive investment flows.

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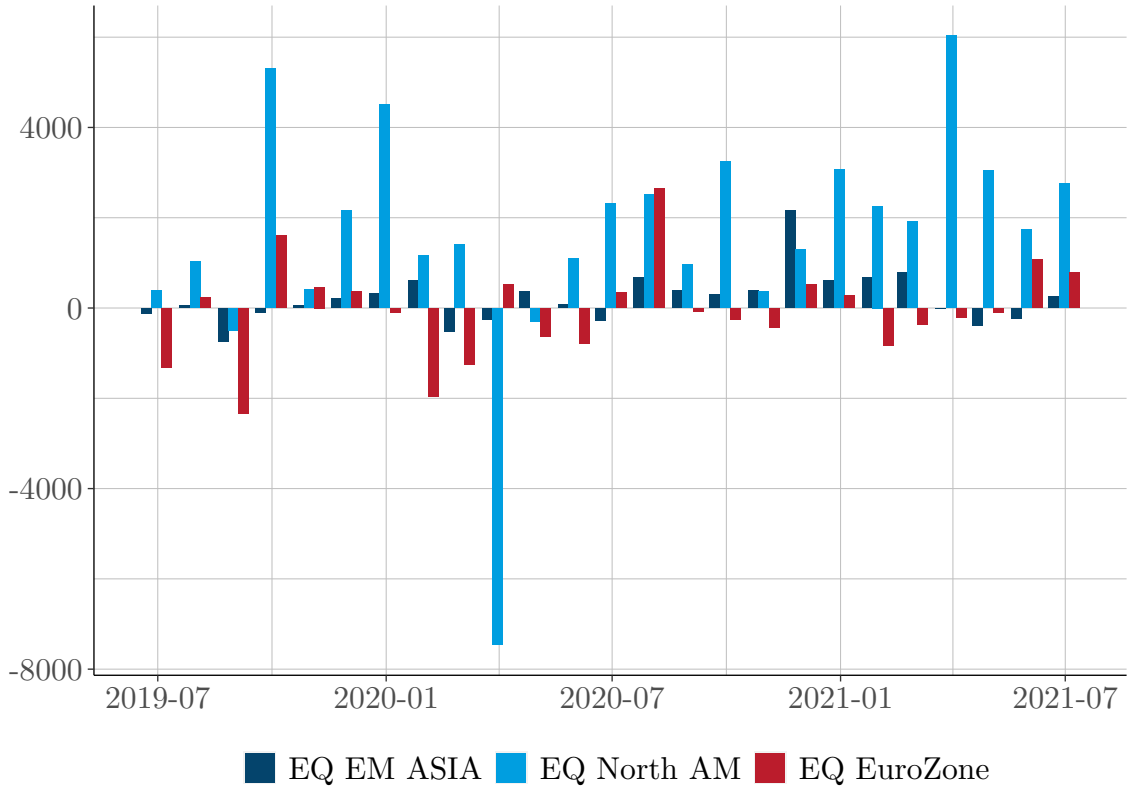
A Complementary materials

A.1 ETF flows

Figure 13: ETF Flows (mEUR)



Source: Amundi ETF

A.2 Global industry integration?

We look at the MSCI ESG score (MSCI, 2020) to isolate the effect of establishing the industry as the dominant peer group when building ESG rating. Indeed, the last step of the score construction before the rating assignment is the normalization of the *weighted average score*[14] against industry peers to calculate the *industry adjusted score*[15]. We analyze the Granger causality (Granger, 1969) for each security in the MSCI World (Developed Markets) and the MSCI Emerging Markets[16] between the ESG metrics and the fundamental or valuation metric lagged by one month on the 2017 to 2019 period. On the given universe, we consider that an ESG metric *Granger-causes* a fundamental or valuation metric if the frequency of statistically significant Granger causality tests (at the 95^{th} confidence level) is larger than 150% of the frequency in the case of randomly generated pairs of monthly series between 2017 and 2019.

[14] WGT_AVG_SCORE
[15] IND_ADJ_SCORE
[16] We exclude the state-owned companies.

ESG variable vs. fundamental or valuation variable :
if $Freq\,(Signif\,Granger\,Causality)_{universe} \geq 1.5 \times Freq\,(Signif\,Granger\,Causality)_{random\,pairs}$ **then**

$High\,Signif\,Causality = True$

As displayed in Table 2 the industry peer grouping (IND. ADJ. SCORE) triggers causality relations between the ESG score and both fundamental and valuation metrics in the Developed Markets, while it is less the case for the Emerging Markets. The peer grouping across industries for ESG is an important step for financial materiality of ESG in the Developed Markets while it is not the case for the Emerging Markets. Indeed, for the latter, the score before industry adjustment (WGT. AVG. SCORE.) appears more meaningful.

In addition, we also identify with our analysis that the accounting component within corporate governance[17] which *"evaluates corporate transparency and the reliability of reported financials as an aspect of corporate governance"* exhibits Granger-causality on Sales per Share, Dividends per Share and the Payout Ratio in the emerging markets. Investors seem to pay attention to the variability of the accounting quality in the emerging markets, while it is not a subject in the Developed Markets.

Table 2: Causality of ESG on Fundamental or Valuation

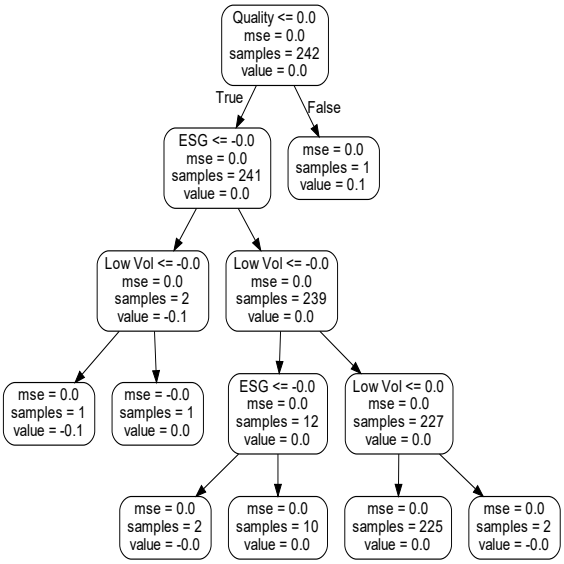
	Developed Markets			**Emerging Markets**		
	ACCNT_ PCTL_ HOME	WGT_ AVG_ SCORE	IND_ ADJ_ SCORE	ACCNT_ PCTL_ HOME	WGT_ AVG_ SCORE	IND_ ADJ_ SCORE
Sales per Share			✓	✓		
Earnings Per Share			✓		✓	
Dividend per Share			✓	✓		
Return On Equity			✓			
Payout Ratio				✓		
Earnings Per Share Year 1					✓	
Earnings Per Share Year 2					✓	
Price To Sales			✓			
Price To Cash Earnings			✓			
Price To Earnings			✓			
Price To Book Value						

Source: MSCI, Author's calculations

[17] ACCNT_PCTL_HOME

A.3 Regression Tree

Figure 14: A Tree Selected from the *"Forest"* for the Regression Based on EMU Region Factors (2019-2021)



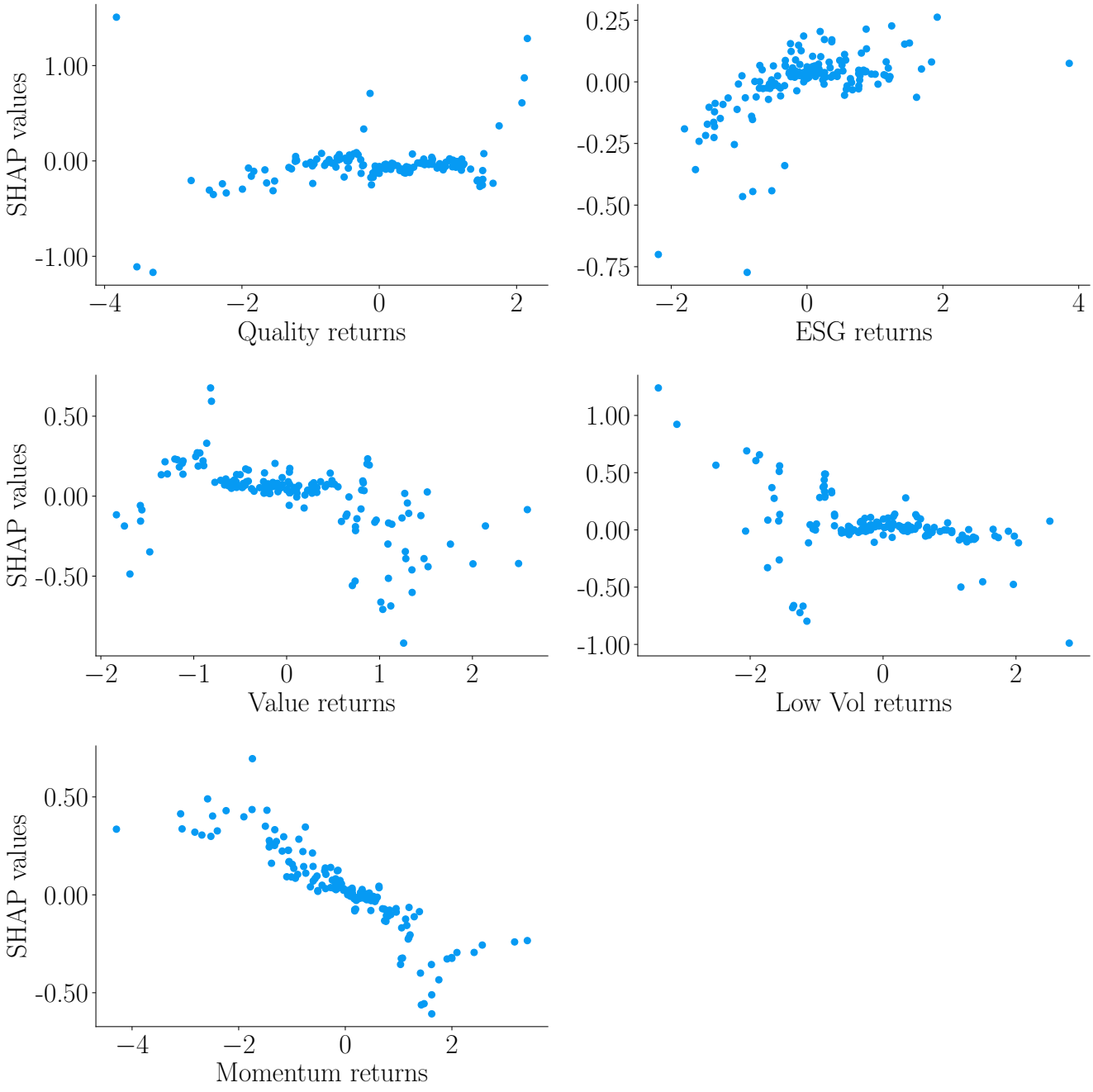
Source: Amundi, Authors' calculations

A.4 Factor picking in the 2019-2021 period

Table 3: Market Variance and Covariance with Equity Factors and ESG

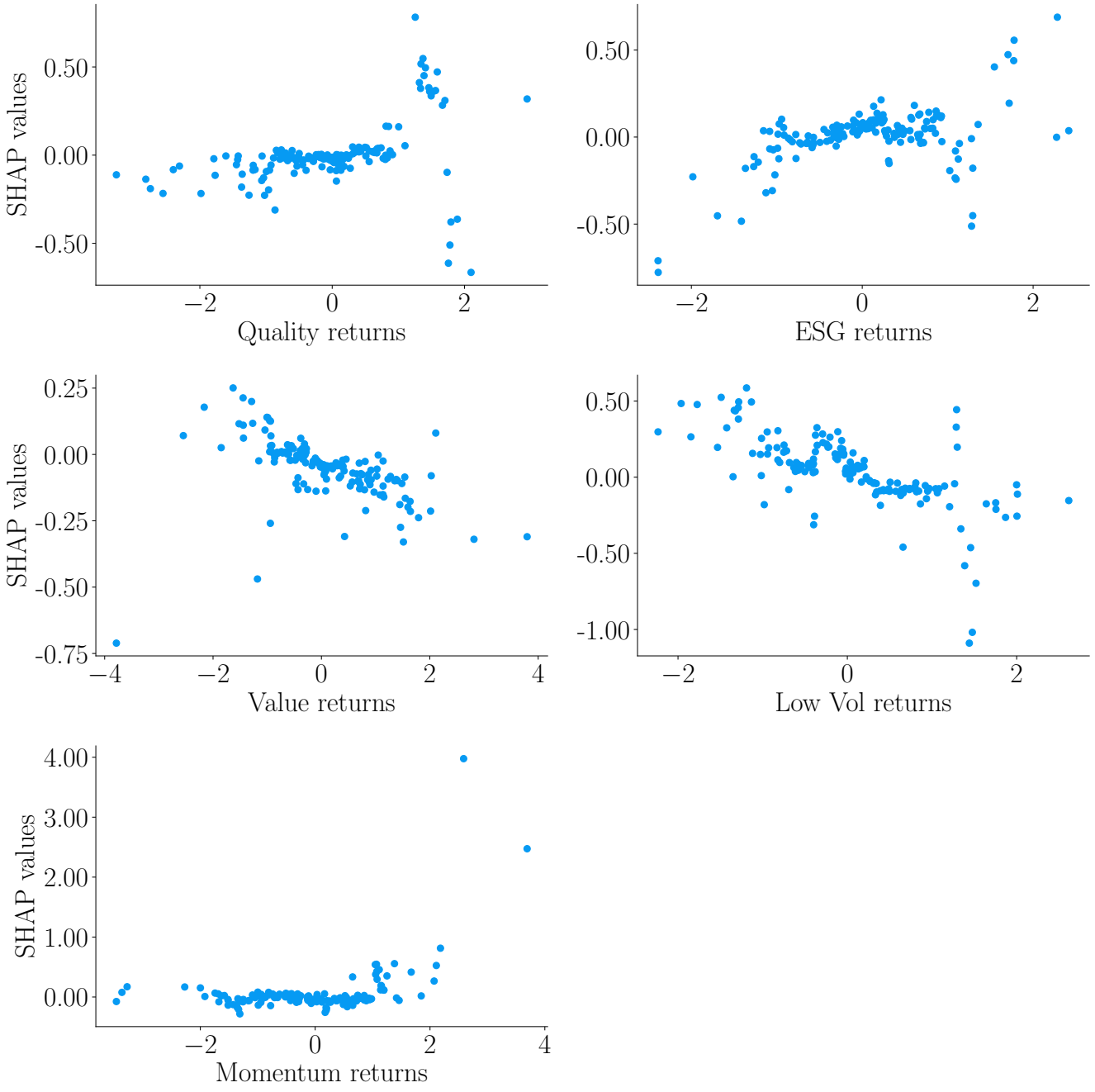
	EMU train	EMU test	NAM train	NAM test
Market	2.63	0.55	3.29	0.64
Low vol	-0.09	-0.02	0.16	-0.03
Momentum	-0.15	0.20	0.14	0.11
Quality	-0.06	0.03	-0.05	0.03
Value	0.14	-0.06	0.05	-0.05
ESG	0.09	-0.06	0.13	0.00

Figure 15: Equity factors and ESG Profile for the EMU Region (2019-2021)



Source: Amundi, Authors' calculations

Figure 16: Equity factors and ESG Profile for the North America Region (2019-2021)



Source: Amundi, Authors' calculations

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