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Creating Markets, Creating Opportunities

Artificial Intelligence Solutions to Support Environmental, Social, and Governance Integration in Emerging Markets

May 2021

Amundi Asset Management (Amundi) and International Finance Corporation (IFC) produced this report.

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Acknowledgments

Amundi and IFC would like to thank all the contributors and internal and external reviewers for their valuable guidance. Special thanks to colleagues at Amundi and IFC who shared their expertise, insights, and time (Amundi: Jean-Jacques Barbéris, Tobias Hessenberger, Timothée Jaulin, Eric Dussoubs, Sergei Strigo, Maxim Vydrine, Caroline Le Meaux, Tegwen Le Berthe, Erwan Crehalet, Reema Desai, Yvoni Ouziel, Matthieu Keip, Rami Mery, Mathieu Jouanneau, Joan Elbaz; IFC: Felipe Becker Albertani, Grant Binder, Atiyah Curmally, Egidio Germanetti, Kathryn Marie Graczyk, Aditi Jagtiani, Haruko Koide, Laure Lepastier, Jean-Marie Masse, Piotr Mazurkiewicz, Sarah O'Sullivan, Blaise Wendwaoga Sandwidi, Florian Skene, Martine Valcin).

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FOREWORD

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"Assessing the environmental, social, and governance (ESG) quality of an issuer is key for investment decisions, not only to take into account the sustainable risks that might weaken the issuer's financial strength, but also to assess the product's impact on key issues that represent a systemic risk for society, such as climate change, fraud and corruption, and social cohesion. To perform this assessment, having access to data is paramount. Today, because of regulation differences, disclosure is different from one region to another. There are nevertheless data sources that are underused and could, if correctly analyzed, strengthen our ESG assessment.

Artificial intelligence and specifically natural language processing (NLP) could enable investors to access new data sources in an efficient way. In particular, it could give us access to signals coming from unstructured data and therefore dramatically increase the scope of our analysis. Unstructured data gives us access to new types of information, but it also provides color and perspective to data already in hand. It could also help issuers make sure the data available are more efficiently communicated and used, and therefore could help combat "ESG reporting fatigue." It is furthermore a way to limit biases due to discrepancies in the means dedicated to corporate social responsibility communication. NLP is therefore particularly useful in the emerging market space.

ESG is a complex, multidimensional field. To understand reality we need to analyze it from different angles, just as we would assess the different sides of an object or a sphere. Discrepancies in data could mean that the angle used is different. Cross-checking sources is therefore an important task for an ESG analyst, to check facts but also to improve the quality of analysis and capture the complexity of cases. Recognizing and tackling complexity, assessing risks, making a professional judgment, and expressing it in a short and intelligible manner: this is what the ESG analyst does.

Quality and traceability of data are also keys for ESG analysts. Having access to raw data is essential for a sound and fruitful dialogue when it comes to engaging with companies to discuss their views and to influencing and encouraging their adoption of best practices and their positive impact on key societal issues such as the Sustainable Development Goals.

Therefore, having access to good-quality data with a large breadth, on a large number of issuers will improve the quality of Amundi's ESG analysis as well as the equal treatment of issuers. It is thus a public good that could improve the quality of ESG assessment, especially in emerging markets."

ABBREVIATIONS AND ACRONYMS

AI: artificial intelligence
CG: corporate governance
E: environment
ESG: environmental, social, and governance
esgNLP: ESG-domain-specific natural language processing model
ESMA: European Securities and Markets Authority
ETF: exchange-traded fund
EU: European Union
FI: financial institution
G: governance
GNI: gross national income
IMF: International Monetary Fund
ISSB: International Sustainability Standards Board
MDB: multilateral development bank
ML: machine learning
MSCI: Morgan Stanley Capital International
NLP: natural language processing
S: social
SBN: Sustainable Banking Network
SDG: Sustainable Development Goal
SEBI: Securities and Exchange Board of India
SFDR: Sustainable Finance Disclosure Regulation
UNSSEI: United Nations Sustainable Stock Exchanges Initiative

EXECUTIVE SUMMARY

This paper describes the potential approaches for institutional investors and asset managers to align their investment strategies for emerging markets with the Sustainable Development Goals through environmental, social, and governance (ESG)-integrated investments. Although investors have historically regarded emerging markets as riskier than developed economies, emerging markets hold the potential for greater financial and development impact returns.

Although the global ESG fund universe has tripled since 2015, most of this growth has been in the developed world.[1] A key challenge limiting the ability of asset managers and institutional investors to invest in emerging market issuances is the lack of ESG data. The boom in ESG investing and advances in artificial intelligence (AI) technologies have the potential to help investors overcome ESG data challenges. This assistance could play a transformative role in unlocking emerging markets for greater investments in the short and medium term.

Investors are making use of AI and emerging technologies to support ESG data collection and analysis for both developed and emerging markets. Research shows that unstructured ESG data, such as news articles; multilateral development bank (MDB) project disclosures; annual, integrated, and sustainability reports; and bond prospectuses are generally underused in analyses of issuers' ESG performance.[2] The use of AI applications, enhanced by a new generation of machine learning (ML) algorithms and cloud computing, has recently led to innovations in the analysis of unstructured text data on a massive scale through the use of natural language processing (NLP) techniques.

Amundi and IFC are collaborating on ESG research, analytics, and tools to increase ESG data, advance issuer transparency, create reporting infrastructure for emerging markets, and support harmonization of reporting standards. In this paper, Amundi and IFC describe the results from one of many areas of collaboration: developing and testing an ESG-domain-specific NLP application (esgNLP) to support the analysis of the ESG performance of emerging market financial institution (FI) issuers of fixed income bonds.

This joint experiment compares Amundi's controversy and ESG scores for a group of FI issuers of hard currency debt with an NLP analysis of short-term ESG controversy and long-term ESG performance signals that have been extracted from unstructured data.

The experiment successfully demonstrates the potential for esgNLP analysis to provide additional validation of Amundi's ESG scores by identifying the correlation between esgNLP and Amundi's scores. In cases where the scores diverged, additional analysis into the drivers of negative and positive sentiment offered further insights. This insight can help identify gaps in performance and areas for improvement at the issuer level. It can also help support engagement strategies. Further, the esgNLP analysis was able to supplement information for the FIs for which Amundi had no scores. This finding established esgNLP's potential as an additional ESG data analysis and scoring tool.

The experiment also illustrates the value of unstructured data as a source of insight into ESG performance for emerging market issuers. The experiment demonstrates the potential for AI solutions such as NLP to unlock value from such unstructured data. Algorithms such as esgNLP have the potential to analyze massive amounts of unstructured text from public sources and extend the analytical capabilities of investors. This tool allows for a rapid, comprehensive, and at-scale analysis.

Conducting an analysis by document type and as a corpus allows for the comparison of the sentiment profiles of different sources of information and types of documents. The observation of the difference between sentiment profiles of issuer-disclosed information and of analyses of text from media and other sources supports the case for greater transparency in material nonfinancial disclosures. This also makes the case for independent verification and assurance of disclosed information.

This analysis also provides useful insights to identify baselines for the state of emerging market disclosure. Even when such disclosures were available, non-English text posed an additional complexity. This is a shortcoming of the esgNLP model that will be addressed in future iterations through training in additional languages.

Data analysis at scale is constrained by the decentralized location of ESG information. Investors face an array of manual steps when preparing data for analysis. This requires identifying and downloading individual reports, performing text extraction, and conducting data cleaning before any analysis can be conducted. These processes constrain analysis at scale. The number of recent initiatives to increase ESG data availability and access are welcome.

Transparency about the limitations of esgNLP is essential to ensure that the tool provides an effective complement to the analysis of human experts. It is important to be able to explain how such models make decisions so that users can understand model output. Future iterations of esgNLP will include explainability features to increase model transparency and trustworthiness. Transparency is also essential with regard to training data and data bias. Future iterations of esgNLP will integrate refinements to manage data bias, such as ensuring diversity of data sources, tracking geographic and sector data coverage, and ensuring high-quality training data. Another common challenge with ML models is model drift. Model drift can be managed by periodically retraining and redeploying the model to align with inference data.

esgNLP is in beta testing and has not been validated by IFC through operations. The arguments made in this paper for efficiency gains and for the use of sentiment scores as proxies of ESG risk require additional testing. Future refinements will include adjustments to the analysis to account for FI size.

The paper ends by (a) recommending support for open-access ESG and impact data and analytical tools for emerging markets, (b) reinforcing the need to extend analytics to the development of additional AI and NLP solutions in the short term, and (c) proposing cross-industry collaborations between big finance and big tech to address ESG integration

1. ESG-INTEGRATED INVESTING TO ACHIEVE IMPACT

Since the 1990s, investing in environmental, social, and governance (ESG)—or considering ESG performance in investment decisions for capital markets—has been used as an investment strategy. ESG investing proposes maximizing financial returns while integrating ESG factors to consider investment and portfolio risks and opportunities. Considering the positive and negative impacts of investments on environmental (E), social (S), and governance (G) issues has the potential to deliver positive financial returns or on-par returns with positive impact outcomes.[1]

Investors who operate in capital markets have used different methods to integrate ESG, depending on the mandates they are executing. Such methods are negative or exclusionary screening, positive or best-in-class screening,[2] tracking ESG indices, and buying thematic or labeled assets (such as securities with use-of-proceeds targets for green, social, blue, sustainable, climate, and clean technology-related activities).[3]

The importance of ESG issues has been spurred by the United Nations Sustainable Development Goals (SDGs). The SDGs provide a roadmap to a sustainable future by addressing the global challenges of poverty, inequality, climate change, environmental degradation, peace, and justice. These goals, which are also called "the 2030 Agenda for Sustainable Development," were adopted by the United Nations member states in 2015.[4] ESG-integrated investment strategies can support efficient resource allocation to economic sectors with the potential to contribute to development outcomes that are aligned with the SDGs.

Increasing evidence shows that investors who consider ESG risks as part of their investment decision-making also have lower risk, less volatile portfolios and higher returns.[5] A 2015 survey in the *Journal of Sustainable Finance and Investment* summarized the results of 2,200 academic studies. Almost 90 percent of the study group found a "non-negative correlation" between ESG factors and corporate financial performance.[6] The 2018 World Bank Group paper titled *Incorporating Environmental, Social and Governance (ESG) Factors into Fixed Income Investment* states that "incorporating ESG factors into fixed income investing can not only strengthen risk management but also contribute to more stable financial returns." The report also shows that incorporating ESG into investment decisions does not lead to a sacrifice in financial performance.[7] A 2019 *Harvard Business Review* analysis of interviews with 70 senior executives at 43 global institutional investing firms found that ESG was "top of mind for these executives" and that these "institutional investors and pension funds have grown too large to diversify away from systemic risks, forcing them to consider the environmental and social impact of their portfolios."[8]

Amundi's portfolio research also found positive correlations between ESG and financial performance. Amundi's analysis shows that ESG integration strategies had a positive effect on stock prices from 2014 through 2017. The buying of best-in-class stocks and the selling of worst-in-class stocks generated annualized returns of 3.3 percent in North America and 6.6 percent in the Eurozone.[9] The 2018-19 returns were also positive. Since then, there has been an increasing gap in performance between the two regions, with companies with positive ESG performance significantly over-performing in the Eurozone.[10] The results for euro-denominated investment-grade corporate bonds mirror stock market results. ESG best-in-class bonds outperformed worst-in-class bonds from 2010 through 2019.[11]

IFC's research of its own portfolio shows similar results. IFC considers financial performance, ESG risks, and development impacts as part of every investment. IFC's equity portfolio investments delivered returns in line with or better than the benchmark Morgan Stanley Capital International (MSCI) Emerging Market Index in the vintage years from 1988 to 2016. Debt returns from senior loans were also on par with the J.P. Morgan Corporate Emerging Market Bond Index for the period 2002-07.[12] IFC reviewed the performance of 656 investments during the 2010-15 period and found that clients with better E&S performance financially outperform companies with worse E&S performance by 210 basis points on return on equity and by 110 basis points on return on assets. Clients with high E&S scores outperformed the MSCI Emerging Market Index, which measures equity market performance, by 130 basis points. A deterioration in E&S performance resulted in worse financial performance.[13]

The outperformance of ESG funds against benchmarks in the post-COVID-19 pandemic market has also offered convincing evidence of the value of this investment strategy. Early results show that 62 percent of large-cap equity ESG funds experienced better performance than the wider MSCI World Index.[14] Similarly, the Financial Times Stock Exchange index of environmentally tilted equities was up 35 percent in 2020, which was more than 20 percentage points above global equity indices.[15] ESG funds have also shown more resilience in terms of investment flows. Cumulative flows for ESG exchange traded funds (ETFs) on the US market have increased throughout the duration of the pandemic. This has contrasted with sellouts from traditional equity ETFs over 2020. The average daily growth of shares outstanding for US ESG ETFs was more than four times that for traditional ETFs.[16]

The resurgence in using ESG to make investment decisions has also benefited from several recent government- and investor-driven initiatives.

The European Commission's High-Level Expert Group on Sustainable Finance was mandated by the European Commission in 2016 to steer capital toward sustainable investments and to identify ways to protect the financial system from climate shocks.[17] Since then, the high-level expert group has undertaken a number of regulatory initiatives, including the European Union (EU) Taxonomy. The EU Taxonomy is a framework to classify whether products are sustainable.[18] In November 2019, the EU adopted the Sustainable Finance Disclosure Regulation (SFDR), which requires asset managers to disclose how they incorporate sustainability risks into their investment decisions.[19] Box 1 describes the impact of SFDR on asset managers.

A number of initiatives to drive greater harmonization of ESG standards and frameworks were launched over 2020. The CFA Institute announced the development of a voluntary global industry standard for asset managers to communicate about the ESG features of their investment products. Five of the most significant ESG reporting standard setters or the "Group of Five" (the Global Reporting Initiative, the Sustainability Accounting Standards Board, the International Integrated Reporting Council, the Carbon Disclosure Project, and the Climate Disclosure Standards Board) pledged to work toward a comprehensive corporate reporting system. In 2020, the IFRS Foundation published a consultation paper that called for a single global disclosure standard that builds on the current sustainability reporting initiatives.[20] In 2021, the IFRS Foundation published proposed amendments to its constitution to accommodate the potential formation of a new International Sustainability Standards Board (ISSB).[21]

Box 1: Impact of SFDR on Asset Managers

The European Commission introduced the Sustainable Finance Disclosure Regulation (SFDR) as part of its action plan of March 2018 on financing sustainable growth.[a] SFDR is aimed at increasing transparency and creating standards for reporting and disclosure in sustainable investing. SFDR requires specific firm-level disclosures from asset managers and investment advisers on how they address sustainability risks and principal adverse impacts. SFDR also helps investors choose between products by classifying funds into three groups on the basis of the extent to which sustainability is an investment criterion, with specific disclosures required for each:[b]

- Article 6 covers funds that do not integrate any kind of sustainability into the investment process.
- Article 8 requires disclosures for financial products that promote environmental or social characteristics.
- Article 9 applies to financial products that have sustainable investment as their objective.[c]

The three European supervisory authorities recently published draft Regulatory Technical Standards on content, methodologies, and disclosures under SFDR. This document includes an updated list of environmental and social indicators for principal adverse impacts that financial actors will need to report on in the coming years. The initiative has the potential to help clarify ESG information for reporting by emerging market participants going forward.[d]

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c. Robeco, "EU Sustainable Finance Disclosure Regulation," Sustainable Development Investing, https://www.robeco.com/en/key-strengths/sustainable-investing/glossary/eu-sustainable-finance-disclosure-regulation.html.

d. Joint Committee of the European Supervisory Authorities, *Final Report on Draft Regulatory Technical Standards* (Paris: European Securities and Markets Authority, February 2021).

2. EMERGING MARKETS: OPPORTUNITIES, CHALLENGES, AND PROGRESS WITH ESG INTEGRATION

Opportunities

Emerging markets present the greatest opportunities for investors to achieve impacts through the SDGs because their development needs are the most significant.[22] The funding requirements to meet the SDGs are much larger than the resources allocated to these markets. For instance, between 2017 and 2018, only 3.3 percent of the world's $580 billion in global climate finance flows was invested in Sub-Saharan Africa, a region where climate change is having a significant impact.[23]

In a study released in 2019, the International Monetary Fund (IMF) estimated that an additional $0.5 trillion in investments is needed in low-income developing countries, and an additional $2.1 trillion is needed for emerging markets to meet the SDG agenda by 2030.[24] To meet these targets, an unprecedented amount of capital must be mobilized. Institutional investors can play an important role in achieving the SDGs by aligning their investment goals with ESG and impact outcomes that are connected to the SDGs in emerging markets. Investors have historically regarded emerging markets as riskier than the markets in developed economies. Political instability, data gaps, poor transparency, and weak legal systems and creditor rights frameworks are reasons cited for the higher cost of capital for emerging markets. Investors also cite a narrower investment pool of potential opportunities as a challenge to investing in emerging markets.[25]

Significantly, although issuers in emerging markets have higher risk profiles, emerging markets have a potential for higher returns. A study that examined the history of MSCI indices between 1998 and 2015 to compare the total equity return performance of developed markets with that of emerging markets found that emerging markets have historically outperformed developed markets.[26] This is also the case for debt in emerging markets. Although developed market debt has seen a period of low interest rates since the global financial crisis in 2008, with negative yielding debt peaking at US$16.8 trillion as of August 2019, emerging market corporate debt has proved to be more resilient. Emerging market hard currency corporate bonds yielded an average 5.5 percent over the three years between 2017 and 2020.[27]

With a global size of US$178 trillion, capital markets are one of the most important drivers of economic growth.[28] A well-developed domestic capital market enables governments and companies to access long-term finance in local currency, increases investments toward innovation, and promotes sustainable growth. Capital markets also facilitate the mobilization of more private capital into key sectors such as infrastructure, housing, and climate finance.

Although the global ESG fund universe has tripled since 2015, most of the growth has been in the developed world—in particular, the Eurozone. According to the Institute of International Finance, the total amount of assets under management in emerging market-domiciled funds is $28 billion; less than 3 percent of that total integrates ESG.[29]

Emerging markets are behind in absolute terms when it comes to ESG integration in financial products. In the Middle East and North Africa region, there are $58.2 billion of assets under management in ESG products in emerging markets, dwarfed by $423 billion in developed markets in the region. For Asia Pacific, these numbers are $8.3 billion in the emerging markets and $166.7 billion in the developed markets.[30]

On the other hand, the relative share of ESG products in terms of the total equity and bond markets is higher in the emerging markets than in the developed counterparts. Only 4 percent of the bonds in developed markets in Europe, the Middle East and Africa, and Asia Pacific are classified as ESG products. This figure is three times higher (12 percent) for bonds in emerging markets. Emerging markets have a smaller edge in equity markets. ESG equity product share in emerging economies is 16 percent compared with 13 percent in developed equity markets.[31]

Challenges

Investors who want to integrate ESG considerations when assessing emerging market investment opportunities face several challenges. First, like their developed market counterparts, emerging market issuers face a profusion of ESG reporting standards and taxonomies. This makes reporting challenging for issuers. The lack of harmonization of reporting standards and extra-financial indicators across developed and emerging economies can lead to fragmented policies that can undercut market growth.[32] The lack of harmonized taxonomies to define *green* and other types of eligibility criteria also presents obstacles to investment in emerging markets.[33] Investors therefore face challenges when developing comprehensive and consistent issuer analyses in the absence of comparable information.

Second, ESG-integrated investing in emerging markets is further constrained by gaps in publicly available ESG data. Because a public securities investment evaluation relies on the assessment of publicly disclosed information, missing or incomplete ESG information about issuers prevents asset managers from making ESG-integrated investments.

Third, investors frequently rely on ESG data and ratings provided by data providers to assess a company's ESG performance.[34] ESG data providers' ratings for developed and emerging market issuers have been criticized for using different definitions of materiality, varying indicators, weights, and scoring methodologies to calculate ESG ratings. ESG data providers are third-party providers that offer fee-based intermediation services by collecting, organizing, and analyzing publicly available information that is disclosed by issuers. ESG data providers assess and rate company ESG performance. These ESG ratings are used by institutional investors, asset managers, financial institutions, and other stakeholders to measure, evaluate, and compare a company's ESG performance.[35] The value of global assets that were acquired by applying ESG data to make investment decisions was $40.5 trillion in 2020.[36]

Data providers have also been criticized for using different methods to source raw data and calculate proxies to estimate missing data.[37] Studies have demonstrated the potential for ESG data providers to produce contrary analytical outcomes for issuers. The Aggregate Confusion Project by the MIT Sloan Sustainability Initiative found significant differences in firm-level ratings of six ESG data providers. While the providers agree on some firms, they substantially disagree on others.[38] This makes a comparison of ESG data provider scores difficult. See box 2 for recent consolidation in the ESG data sector.

Finally, and unsurprisingly, ESG data coverage is available mostly for developed markets. Investment universe coverage is not consistent across different providers. There are sector and geographic biases in data collection. The reasons for this are greater disclosure and availability of information as well as better quality issuer-reported ESG information for developed markets. ESG data providers use global equity indices to determine coverage, which can result in a risk for underrepresentation of emerging market companies and bond-only issuers.[39]

Box 2: Recent Consolidation in the ESG Data Sector

The increased focus on ESG issues, especially in the past year, has resulted in considerable dynamism in the ESG data provider space. A number of acquisitions and investments took place over 2020 as rating agencies, data providers, exchanges, and asset managers shored up access to ESG data and analytical tools.

Financial data heavyweight Bloomberg entered the ESG data space in 2020.[a] The sector saw increasing consolidation with acquisitions of specialized ESG data firms by established players over 2019 and 2020. S&P Global acquired ESG ratings firm RobecoSAM in 2019 after having acquired the ESG risk data provider Trucost in 2016 for $18 million. Moody's also made acquisitions over 2019, buying Vigeo Eiris and the climate risk data firm Four Twenty Seven. The indices and financial analytics firm MSCI bought Carbon Delta in 2019. Stock exchanges also made acquisitions, including Deutsche Börse, which bought Institutional Shareholder Services, a firm including an ESG data arm. Signaling greater emphasis on the growing interest in data alternatives and use of artificial intelligence (AI), data provider FactSet acquired ESG data provider TruValue Labs, which uses AI for data collection and analysis.[b] In January 2021, BlackRock, Inc., announced a minority investment in Clarity AI, a sustainability analytics and data science platform.[c]

ESG data quality topped ESG news service *Responsible Investor's* list of investor concerns for 2020[d] in addition to being one of MSCI's top five ESG Trends to Watch for 2021.[e] The data firm Opimas estimated the size of the ESG data market as $617 million in 2019 and predicted that the market could reach $1 billion in 2021.[f] By 2021, asset managers will spend an estimated $554 million annually on ESG data.[g]

The sector has also faced increasing calls for greater oversight. A report commissioned by the European Commission in 2020 recommended the development of industry standards and a certification and supervisory regime for ESG data and ratings providers.[h] The European Securities and Markets Authority (ESMA) has called on the European Commission to address the consolidation in the ESG ratings sector in its upcoming Renewed Sustainable Finance Strategy. Regulators are increasingly signaling their acknowledgement of the need to oversee ESG data. In December 2020, France's Autorité des Marchés Financiers and the Dutch Autoriteit Financiële Markten put forward plans for the mandatory regulation of all ESG data service providers.[i]

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Progress with ESG Integration

A number of emerging market regulators are setting ESG standards aimed at improving corporate disclosure requirements. India's national securities regulator, the Securities and Exchange Board of India (SEBI), announced disclosure requirements for India's largest 1,000 public companies starting in 2022. According to its "Business Responsibility and Sustainability Report," SEBI will require India's largest corporates to disclose sustainability performance metrics that relate to climate and social issues as part of their corporate filings.[40]

The Sustainable Banking Network (SBN), founded in 2012 has seen growing interest by capital market regulators in emerging markets to strengthen the ESG performance and green finance activities of capital market participants. In recent years regulators have helped catalyze green bond markets and have developed national green taxonomies. The 2021 SBN "Global Progress Report" (expected October 2021) will extend the SBN measurement framework to capital markets.

Exchanges in emerging markets are also developing solutions for ESG reporting tools and infrastructure for capital markets. IFC and the United Nations Sustainable Stock Exchanges Initiative (UNSSEI) have partnered to strengthen ESG disclosure and reporting requirements for companies in emerging markets. UNSSEI tracks ESG guidance for listed companies with 101 partner exchanges.[41] IFC's Disclosure and Transparency Toolkit was launched in 2018 as a resource on reporting for companies, investors, regulators, exchanges, and standard setters.[42]

Investors are also partnering with other investors, data providers, and technology firms to drive the development of ESG data for emerging market capital markets. These partnerships aim to improve ESG standards and build capacity around responsible investing. The Asian Infrastructure Investment Bank and Amundi have both announced plans with Aberdeen Standard Investments to establish climate and sustainability data sets for companies in emerging markets to inform investment strategies. Allianz, Amazon, Microsoft, and S&P—are a cross-industry grouping working to establish an open-source climate data and analytics platform.[43] IFC has engaged data provider Arabesque to collect ESG information that is disclosed by emerging market bond issuers. IFC's ESG Performance Indicators for capital markets are the disclosure framework for this information. The information will be made available as a global public good for the investment community to advance investments in emerging markets. Amundi and IFC are also partnering to validate the effectiveness of these indicators as an investor framework.

3. AI IN ACTION: USING NATURAL LANGUAGE PROCESSING TO UNLOCK ESG DATA

On average, the ESG teams at the 30 largest asset managers have grown by more than 230 percent between 2017 and 2020, illustrating the investments being made in analytical capacity to service the demand for ESG integration.[44] At the same time, investors are exploring different analytical strategies to process available data to facilitate decisions. The boom in ESG investing, coupled with efforts to address challenges in ESG data and with advances in AI technologies, has the potential to help investors analyze ESG data to make investing in emerging markets faster and more efficient. This use of data science could play a transformative role in unlocking emerging markets to greater investments.

As the pace of ESG investing accelerates, calls from investors for access to financially material ESG data to assess risks and make investment decisions increases. Investors are also exploring alternative data sources to complement financial information with nonfinancial metrics. Examples of such data sets are remote sensing and aerial imagery from satellites, high-resolution land cover information, data from internet of things (IoT), information from social media feeds, and input from open data platforms. The investment house Robeco uses satellite data to observe the physical risks of investment operations in real time.[45]

Research shows that unstructured ESG data such as news articles; MDB project investment information and ESG disclosures; annual, integrated, and sustainability reports; and bonds prospectuses are underused in analyses of corporate ESG performance. Varco finds that investors in emerging markets underestimate the value of information available on corporate ESG performance.[46] Bose and Springsteel note the need for research to establish the incremental value of "each type of unstructured data source" for those who "already incorporate structured ESG data."[47]

The use of AI applications that are enhanced by a new generation of machine-learning algorithms and cloud computing has led to innovations in the analysis of unstructured text data on a massive scale through use of natural language processing (NLP) techniques.

Before unstructured data can be analyzed, investors must collect and organize relevant information. Data collection can be challenging, and most investors rely on data providers to obtain access to raw data or derivative products. Although there are technologies that assist with automated data collection, such as web crawlers, such applications pose legal and reputational risks.[48]

Once the data are collected, there are techniques that allow this information to be organized at scale. Name entity recognition algorithms, such as spaCy, are available to identify *entities*, such as locations, companies, and organization names. Other algorithms can extract keywords from text and allow for the efficient summarizing and mapping of information to specific topics.

Once organized, outputs from unstructured data can be analyzed to derive insights for ESG risks such as identifying high-ESG-risk issuers and those well placed to transition to green business activities. Investors can also use such information to direct resources and technical capacity, set priorities, develop mitigation measures, meet stewardship goals, and define the scope of an engagement program. UBS Wealth Management, for instance, uses NLP algorithms to reduce time for due diligence. "The company (has)… developed an AI… platform which detects negative news by reading vast amounts of documents… (and) hours of human work are… reduced to seconds, freeing asset managers to focus on downstream tasks."[49]

Amundi and IFC are collaborating on ESG research, analytics, and tools to increase ESG data, advance issuer transparency, create reporting infrastructure for emerging markets, and support harmonization of reporting standards. Part of this work has been focused on developing and testing an ESG-domain-specific NLP application or "esgNLP" (see box 3). Amundi's controversy and ESG scores for a group of financial institution (FI) issuers of hard currency debt are used as benchmarks to compare esgNLP analyses of short-term ESG controversy and long-term ESG performance signals derived from unstructured data.

Box 3: Natural Language Processing (NLP) and esgNLP: Training, Data, and Performance

What is Natural Language Processing?

Natural language processing (NLP) is a branch of artificial intelligence dealing with computing capabilities that can understand the way humans learn and use language. NLP is used to identify, extract, and analyze data and inferences from unstructured text data such as annual reports, corporate sustainability reports, and news articles. Common NLP tasks are sentiment analysis, name entity recognition, and text summarization. Research has found that tapping into this reservoir of existing knowledge to generate and benchmark data has several potential advantages, such as increased speed, cost reduction, increased access to information, and the capacity to support research and policy development.[a]

NLP techniques can enable more consistent due diligence through the comprehensive identification of environmental, social, and governance (ESG) risks, text highlighting, and sentiment analysis. This helps with early detection of ESG risks; identification of ESG risk mitigation measures, engagement, and transition strategies; and portfolio oversight and monitoring.

Several companies—from established data providers to technology start-ups—are leveraging NLP techniques to mine ESG information from company text disclosures, news, and social media. NLP-based offerings range from real-time risk monitoring to extracting Sustainable Development Goal-linked indicators and ESG ratings. Providers that use NLP applications include TruValue Labs (acquired by FactSet in 2020), Datamaran, Entis, and MSCI.

What is esgNLP?

IFC has trained an NLP model (Google BERT pretrained model in English general language[b]) through transfer learning to identify ESG domain-specific risks in unstructured text data or *esgNLP*. IFC's established benchmarks for sustainability practices in emerging markets provide the foundational ESG risk taxonomy. esgNLP is trained to identify almost 1,200 ESG risk terms in text and to classify sentences on the basis of positive, negative, and neutral ESG sentiment.[c] For each risk term that is detected and each sentiment that is predicted, the model generates corresponding probabilities of the confidence level of the prediction at the sentence level. Such output is used to create ESG analytics and to derive insights from unstructured data.

Model Training Data

esgNLP is a supervised classification model. Such algorithms are *taught* through examples from a training data set to recognize relationships between input and output data and to use these relationships to predict outputs for new data. esgNLP was trained using a sample of 26,346 manual annotations. This set of annotations comprised 5,344 positive labels, 4,989 negative labels, and 16,013 neutral labels. In addition, another 4,595 labels were used for model testing and validation.

Such annotations are manually labeled by IFC's ESG analysts. Annotation guidelines and interannotator agreements are maintained to ensure high-quality training data. To mitigate against the risk of conflicting labels, only data points with consensus from at least two labelers are eligible for inclusion in training and testing data sets. This measure is intended to improve consistency in the training data set and to manage the inevitable differences among annotators. Consistency of labeling among annotators or interannotator agreement is tracked using Cohen's kappa coefficient. Cohen's kappa coefficient measures the reliability of agreement between two labelers, taking into account the possibility that agreements could occur by chance. This is considered a more robust measure of assessing consistency than just measuring the level of agreement between labelers.

Model Performance

esgNLP performance is measured by using weighted F1 scores. A weighted F1 score is the harmonic mean of model precision and recall metrics. This score is well-suited to measure imbalanced data sets, such as in this case where neutral labels are three times the number of positive and negative labels. esgNLP outperforms out-of-the-box sentiment analysis. The model's accuracy is 87 percent, and its F1 score is 85 percent (table B3.1).

Table B3.1. esgNLP Model Performance

Class	Test data	Precision (%)	Recall (%)	F1 Sc. (%)
Positive	937	81.00	79.80	80.40
Neutral	2,797	90.90	88.40	89.60
Negative	861	80.60	89.10	84.60
Micro-Avg	4,595	86.80	86.80	86.80
Macro-Avg	4,595	84.10	85.80	84.90
Accuracy: 86.80%				

Note: Avg = average; Sc. = score
Source: IFC, 2021.

At present, esgNLP is in beta testing and so far, it has been tested on more than 11,000 text documents. These documents include the public documents disclosed by IFC through the IFC Project Information & Data Portal. Namely, they are environmental and social review summaries of investment projects, the text of summary of investment information reports for financial institution investments, Environmental and Social Impact Assessment reports for projects, and other associated documents. esgNLP has also been applied to reports that were disclosed publicly by IFC's Compliance Advisor Ombudsman.[d] Thus far, the model has successfully identified more than 4.5 million ESG risk terms (including 917,591 terms detected in a positive context, 186,687 terms detected in a negative context, and 3,372,772 terms detected in a neutral context).

a. Rufus Howard, "Big Data (Gaps) In EIA," presentation at the International Association for Impact Assessment (IAIA) conference, Florence, Italy, April 2015, https://doi.org/10.13140/RG.2.2.34417.28007.

b. Jacob Devlin et al., "BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding." *arXiv*, Cornell University, 2019, https://arxiv.org/abs/1810.04805.

c. IFC's E&S Performance Standards and Corporate Governance Methodology provide a foundational set of ESG risk terms for esgNLP. Positive sentiment is interpreted as being "in line with the Performance Standards." For instance, in the statement *"the factory does not use [child labor],"* the term *child labor* will be detected as a positive sentiment. Negative sentiment is interpreted as "not in line with the Performance Standards." In the sentence *"the factory uses [child labor],"* the risk term *child labor* will be interpreted as a negative statement. Neutral sentiment is interpreted as a sentence that refers to an ESG context but does not have a positive or negative sentiment, or a sentence that is irrelevant in the ESG context. For example, in the statement *"The federal [child labor] provisions, authorized by the Fair Labor Standards Act (FLSA) of 1938, are also known as the child labor laws,"* the risk term *child labor* is interpreted as neutral. esgNLP is also trained to detect a time component. Each sentiment is classified to determine whether it describes the current state or a future development, such as ESG corrective actions that are planned for implementation. IFC's Performance Standards can be found at https://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/Sustainability-At-IFC/Policies-Standards/Performance-Standards and IFC's Corporate Governance Methodology can be found at https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+cg/investment+services/corporate+governance+methodology.

d. See the Compliance Advisor Ombudsman website, 2009, http://www.cao-ombudsman.org/.

Experiment: Unlocking ESG Data for Emerging Market FI Issuers By Using NLP

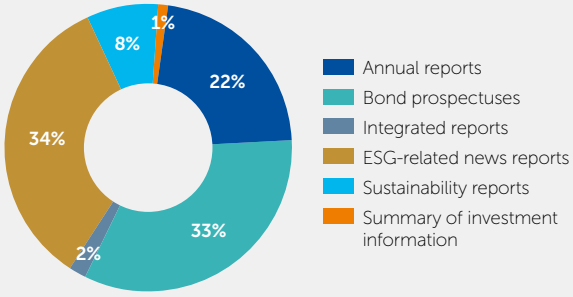
In 2020, IFC released the results of a study titled *Emerging Markets: Assessment of Hard-Currency Bond Market*, which found that FIs are the largest issuers of hard-currency bonds in emerging markets with a 31.2 percent market share.[50] The study identified 804 FIs across 60 markets that had issued hard currency bonds with a total of almost $650 billion in bonds outstanding as of June 2019. China accounted for 52 percent of this amount, followed by the Latin America and Caribbean region with 15 percent. This group comprises 398 banks and 406 nonbank financial institutions.

Data sources for this group of FIs were identified to provide short-term and long-term ESG signals. The study identified 1,260 short-term and long-term ESG relevant documents for 441 FIs for the period 2018-20. Amundi had ESG scores for 205 of these FIs. No ESG disclosures were identified for 45 percent of the total group of 804 FIs.

Short-term signals are inferred from daily ESG-related news articles from a commercial news database. Long-term ESG signals cover at least one year and include summary of investment information documents from the IFC's disclosure portal;[51] annual, sustainability, and integrated reports;[52] and bonds prospectuses. The "summary of investment information" or SII is a summary of the main elements of a potential investment disclosed by IFC. These disclosures are made with the aim of enhancing the transparency of IFC's investment activities and include disclosures of the main E&S risks and impacts of a project and proposed mitigation measures. Annual reports are disclosures of company financial and operational performance and metrics.[53] Sustainability reports also include disclosure and communication of a company's ESG goals and regular reports of progress toward achieving these goals.[54] Integrated reports include financial reporting as well as reporting of E&S impacts. Such reporting is intended to meet the needs of a broad group of stakeholders. A bond prospectus is a legal document that provides details about a bond offering for sale to the public.[55] This typically includes an overview and history of the issuer, management profile, deal structure, details on the use of proceeds, financial information, and a description of the risks involved.[56]

Figure 1. Illustrates the composition of the 1,260-document corpus.

Figure 1. ESG Document Type, Count and Percentage



Source: IFC, 2021.

esgNLP identifies ESG risk terms in text and predicts the ESG sentiment for those terms on the basis of the context of the sentence. Sentence-level sentiment scores can be calculated by subtracting the probability of negative sentiments from the probability of positive sentiments for all sentiments detected in text. The sentence-level sentiment score ranges from -1 (negative) to +1 (positive). This corresponds with the overall risk term polarity of the sentence.

Sentiment Score, at sentence level =
Prob *(POS Sentiment)* - **Prob** *(NEG Sentiment)*

Sentence-level predictions are combined across all documents associated with an issuer to generate issuer-level scores. The sentiment score for an individual issuer is determined by dividing the sum of all sentence-level scores by the total number of negative and positive sentiments across all documents that are associated with the issuer to arrive at a score that ranges from -1 to +1.

$$\textbf{Sentiment Score,}\ \text{at issuer level} = \frac{\sum \textit{(Sentiment Scores, at sentence level)}}{\textit{(No. of Positive Sentiments + No. of Negative Sentiments)}\ \text{across all documents}}$$

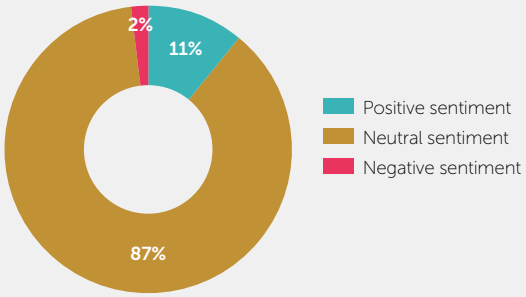
An issuer-level sentiment analysis can be conducted by calculating the weighted average of the total number of negative sentiments divided by the number of positive sentiments. A higher ratio suggests more negative sentiments. These ratios are used to assign sentiment ratings for FIs, ranging from "A" (best) to "D" (worst). The strong correlation between the sentiment score and the weighted average ratio illustrates consistency between the two proxies that are derived from esgNLP.

Findings

The document source and type influence the type of sentiments detected. Figure 2 compares the proportion of positive, negative, and neutral sentiments between document sets disclosed by issuers and publicly available analysis by other parties. The issuer disclosed set comprises bond prospectuses (419), annual reports (274), sustainability reports (101), and integrated reports (28). The set of other party information comprises news reports (425) and SIIs disclosed by IFC (13). The analysis finds that company disclosures have a smaller proportion of negative sentiment than information from other parties, which has more negative sentiment and allows for more balanced insights.

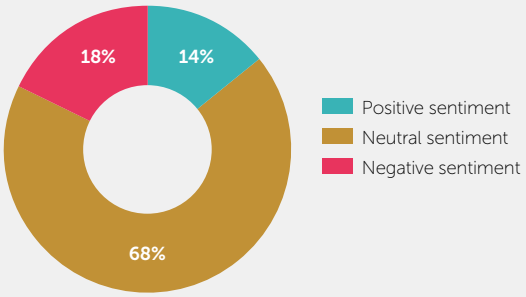
Figure 2. Proportion of Sentiment by Document Type and Source

a. Percentage of sentiment detected in company reports



Source: IFC, 2021.

b. Percentage of sentiment detected in other party information



Source: IFC, 2021.

Figure 3 depicts the most frequently occurring E&S topics within the 1,260-document universe. Word size represents sentiment count. Among the E&S topics that occur most frequently in this document set are "Risk Management Process," which is associated with the development of Environmental and Social Management Systems, and "Worker Health and Safety," which is associated with Human Resource and Labor policies. This finding reinforces the relevance of standards for management systems and labor policies for financial institutions.

Figure 3. Most Frequently Occurring E&S Topics

a. Most frequently occurring E&S topics with positive sentiment

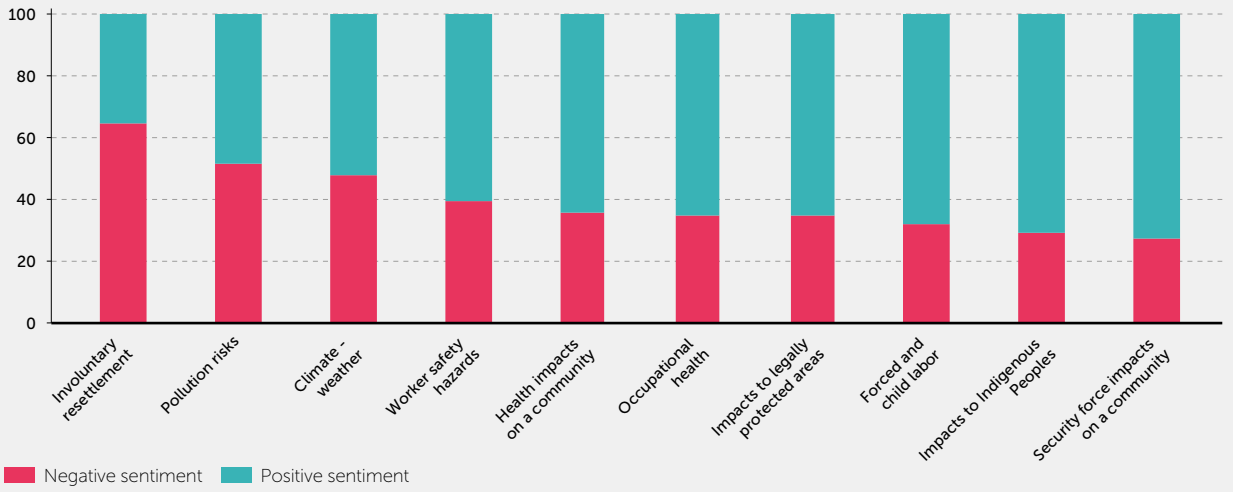
Source: IFC, 2021.

b. Most frequently occurring E&S topics with negative sentiment

Source: IFC, 2021.

An alternative strategy to identify drivers of performance is to consider the proportion of negative to positive sentiment by E&S topic. Figure 4 shows the relative proportion of negative sentiment calculated as a percentage of the sum of positive and negative sentiments for the top 10 E&S topics with the highest proportion of negative sentiment. The E&S topic "Involuntary resettlement" associated with land acquisition is the topic with the greatest proportion of negative sentiment (64 percent) to positive sentiment (36 percent) for this group of institutions. In contrast, the most frequently occurring E&S topic "Risk Management Process" (identified in figure 3) has a lower proportion of negative sentiment, with 18 percent negative sentiment to 82 percent positive sentiment.

Figure 4. E&S Topics with the Greatest Proportion of Negative Sentiment (%)



Source: IFC, 2021.

Figure 5 shows the corporate governance (CG) topics that occur the most frequently in the document sample. The topics "Risk Governance" and "Fraud and Corruption" occur the most frequently. Both topics relate to the "Control Environment" parameter of IFC's Corporate Governance Methodology.[57] This finding reflects the significance of the control environment function, comprising risk governance, internal controls, internal audit, and compliance to FIs. This has been the case since the 2008 financial crisis, with regulatory changes requiring FIs to report and comply with more stringent requirements. "Fraud and Corruption" is the most frequently occurring topic for negative sentiment, appearing five times as often as the second most frequent topic for negative sentiment.

Figure 5. Most Frequently Occurring Corporate Governance Topics

a. Most frequently occurring CG topics with positive sentiment

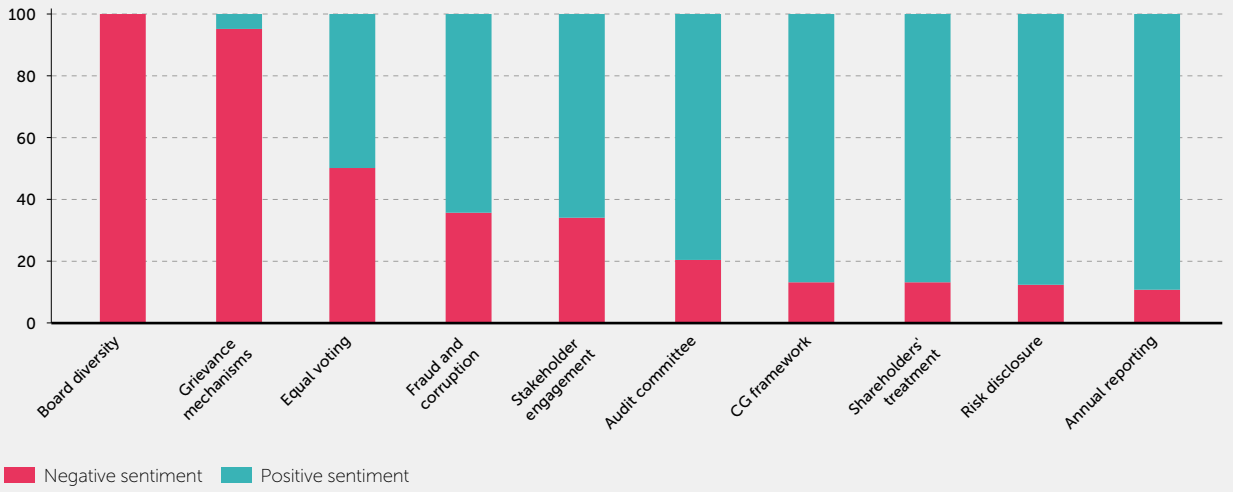
Source: IFC, 2021.

b. Most frequently occurring CG topics with negative sentiment

Source: IFC, 2021.

Figure 6 shows the relative proportion of negative sentiment calculated as a percentage of the sum of positive and negative sentiment for the top 10 corporate governance topics with the highest proportion of negative sentiment. As with the analysis on E&S topics, these insights highlight the corporate governance risks with the highest proportion of negative sentiment in the sample. Two CG topics appear in an almost completely negative context only. These are "Board diversity" (100 percent negative sentiment) and "Grievance mechanisms" (95 percent negative sentiment, 5 percent positive sentiment).

Figure 6. Corporate Governance Topics with the Greatest Proportion of Negative Sentiment (%)



Source: IFC, 2021.

esgNLP Analysis of Short-term ESG Signals

Amundi's controversy scores for a group of 40 FI issuers of hard currency debt are used as benchmarks to compare esgNLP analyses of short-term ESG controversy signals derived from unstructured news data. Amundi assigned High (3), Medium (19), and Low (18) controversy scores to the 40 issuers.

esgNLP sentiment scores for institutions with "High" controversy scores were strongly negative or close to zero. The weighted average ratio scores were also high, suggesting more negative sentiments. These results validate controversy scores from Amundi.

esgNLP found slightly negative sentiment scores for 16 of the 19 FIs that were assigned "Medium" controversy scores by Amundi, also validating Amundi's results. esgNLP scores diverged from Amundi's scores for three institutions. The largest drivers of positive sentiment for these three FIs are "Risk Governance," "Performance monitoring," and "Resource efficiency."

esgNLP scores were consistent for only 2 of the 18 FIs assigned "Low" controversy scores by Amundi. esgNLP identified strongly negative sentiments (rated C and D) for 16 institutions. The largest drivers of negative sentiment for this group of 16 FIs are "Fraud and corruption," "Community engagement," and "Pollution risks." Possible explanations for the divergence in scores are the time lag between when Amundi's controversy scores were last assigned and the dates of the esgNLP analysis. The difference in topics considered by Amundi's controversy assessment framework and the scoring framework developed by IFC for esgNLP is also relevant to the differences.

Analysis by esgNLP of short-term signals is outlined in the appendix, table A.1.

esgNLP Analysis of Short- and Long-term ESG Signals

Amundi's ESG scores for a group of 205 FI issuers of hard currency debt are used as benchmarks to compare esgNLP analyses of short-term and long-term ESG performance signals derived from unstructured data. This document set comprised 837 documents made up of annual, sustainability, and integrated reports; summary of investment information (IFC project disclosures); and news reports. This analysis did not include bond prospectuses. The analysis found that esgNLP sentiment scores are positively correlated with Amundi's aggregate ESG and disaggregated E, S, and G scores. Institutions with higher esgNLP sentiment scores had higher Amundi ESG scores. The ratio of negative sentiments to positive sentiments was also calculated, and similar results were observed.

Table 1 shows negative correlations between Amundi's scores and esgNLP scores. These findings suggest that banks with higher ratios (or more negative sentiments) have lower ESG scores from Amundi. These findings also suggest a positive relationship between the esgNLP sentiment scores and Amundi's ESG scores and reinforce Amundi's findings.

Table 1. Correlation between Amundi ESG Scores and esgNLP Scores

	ESG scores developed by Amundi				Sentiment Scores derived from esgNLP	
	ESG score	**Env. score**	**Soc. score**	**Gov. score**	**Sentiment score**	**Weighted average ratio**
ESG score	1.000	0.809	0.740	0.830	0.086	-0.112
Env. score	0.809	1.000	0.547	0.451	0.065	-0.045
Soc. score	0.740	0.547	1.000	0.438	0.026	-0.060
Gov. score	0.830	0.451	0.438	1.000	0.048	-0.102
Sentiment score	**0.086**	**0.065**	**0.026**	**0.048**	1.000	-0.924
Weighted average ratio	**-0.112**	**-0.045**	**-0.060**	**-0.102**	**-0.924**	1.000

Note: Env. = environmental; ESG = environmental, social, and governance; Gov. = governance; Soc. = social.
Source: IFC, 2021.

Adding 410 bond prospectuses to the corpus of 837 documents resulted in some differences to the findings. There continues to be a positive correlation between Amundi's aggregate ESG scores and esgNLP sentiment scores. These results are reinforced through the negative correlation between the esgNLP ratio of negative to positive sentiments and Amundi's aggregate ESG scores. There is a negative correlation, however, between the disaggregated Amundi scores for environment (E) and governance (G) and the esgNLP sentiment scores. This suggests the prevalence of a higher level of negative sentiment in the "E" and "G" categories for bond prospectuses. Reasons for this may be that such documents include legal disclaimers that are worded with more negative sentiment to reduce the exposure to legal risks. Prospectus disclosure rules also typically provide for detailed material risk factor disclosure. Additionally, bond prospectuses have more content on market, credit, liquidity, currency, and political risks with the potential to drive negative sentiments. The correlation table that includes bond prospectuses is presented in the appendix, table A.2.

The 205 FI sample was divided into three subgroups based on Amundi ESG ratings: 42 high performers, 86 medium performers, and 77 low performers. Correlation analyses for these subgroups found that esgNLP tends to downgrade FIs that Amundi considers high performers. The largest drivers of negative sentiment for this subgroup are "Fraud and corruption," "Community engagement." esgNLP also upgraded some FIs that Amundi considered poor performers. The largest drivers of positive sentiment for this group of 77 FIs are "Risk governance," "Staff E&S competency," and "Performance monitoring." esgNLP sentiment scores were positively correlated with Amundi's ESG scores for the subgroup of medium performers. This reinforces the results presented in table 1 that show positive correlations between esgNLP sentiment scores and Amundi's aggregate ESG score. Additional details on the analyses for the three subgroups are outlined in the appendix, table A.3.

esgNLP Analysis of ESG Signals for Low Coverage FIs

The document review identified 336 documents for 236 FIs for which Amundi did not have ESG scores. esgNLP analyzed these short-term and long-term unstructured ESG data sources to develop sentiment scores to complement Amundi's emerging market coverage to include these additional issuers. esgNLP identified strongly positive sentiments for 84 FIs, slightly positive sentiments for 27 FIs, slightly negative sentiments for 37 FIs, and strongly negative sentiments for 75 FIs. This resulted in doubling the emerging market coverage available, thus suggesting that the esgNLP model has the potential to help Amundi identify ESG sentiment for additional FIs.

4. CONCLUSIONS, LIMITATIONS, AND RECOMMENDATIONS

Conclusions

The experiment successfully demonstrates the potential for esgNLP analysis to provide additional validation of Amundi's ESG scores by identifying the correlation between esgNLP and Amundi's scores. In cases where the scores diverged, additional analysis into the drivers of negative and positive sentiment offered further insights. This analysis can help identify gaps in performance and areas for improvement at the issuer level. It can also help support engagement strategies that drive the development of environmental and social management systems for FIs.[58] The esgNLP analysis was further able to supplement information for the FIs for which Amundi had no scores. This established esgNLP's potential as an additional ESG data analysis and scoring tool.

The experiment also illustrates the value of unstructured data as a source of insight into ESG performance for emerging market issuers. The experiment demonstrates the potential for AI solutions such as NLP to unlock value from such unstructured data and reinforces recommendations from Varco and Bose and Springsteel.[59] Algorithms such as esgNLP have the potential to analyze massive amounts of unstructured text from sources that include Environmental and Social Impact Assessment reports; MDB project disclosures; nongovernmental organization and civil society organization reports; and social media, industry research, and regulatory reports. Conducting an analysis by document type and as a corpus allows for the comparison of the sentiment profiles of different sources of information and types of documents.

The observation of the difference between sentiment profiles of issuer-disclosed information and of analyses of text from media and other sources supports the case for greater transparency in material nonfinancial disclosures. This also makes the case for independent verification and assurance of disclosed information. Future research will include the study of material information that is missing from disclosures and analysis of the relevance of these findings through the lens of materiality reporting frameworks such as the Sustainability Accounting Standards Board.

Tools such as esgNLP have the potential to extend the analytical capabilities of investors and allow for a rapid, comprehensive, and at-scale analysis. This option enables asset managers to gain insights on the ESG performance of emerging market issuers. The esgNLP tool also has the potential to offer cost and time savings.

This analysis also provides useful insights to identify baselines for the state of emerging market disclosure. For example, no ESG disclosures were identified for 45 percent of the sample group of 804 FIs. Even when such disclosures were available, non-English text posed an additional complexity. Approximately 5 percent of the ESG information that was disclosed by the sample was in non-English text. This is a shortcoming of the esgNLP model that will be addressed in future iterations through training in additional languages.

Data analysis at scale is constrained by the decentralized location of ESG information. Investors face an array of manual steps when preparing data for analysis. This requires identifying and downloading individual reports, performing text extraction, and conducting data cleaning before any analysis can be conducted. These processes constrain analysis at scale. The number of recent initiatives to increase ESG data availability and access are welcome.[60]

Limitations

Transparency about the limitations of esgNLP is essential to ensure the tool provides an effective complement to the analysis of human experts. ML models such as esgNLP are, in part, black box systems. It is important to be able to explain how such models make decisions so that users can understand and interpret model output. Future iterations of esgNLP will include explainability features such as those offered by Local Interpretable Model-Agnostic Explanations or Shapley additive explanations to increase model transparency and trustworthiness.

Transparency is also essential with regard to training data and data bias. Data bias is a common challenge when building ML models such as esgNLP. Data bias occurs when the data available for model training or for inference creation are not representative of the study population. Future iterations of esgNLP will integrate refinements to manage data bias such as ensuring diversity of data sources, tracking geographic and sector data coverage, and ensuring high-quality training data.

Another common challenge with ML models is model drift. Model drift refers to the deterioration in model performance due to changes in data and relationships between input and output variables. Model drift can be tracked by monitoring model performance metrics and can be managed by periodically retraining and redeploying the model to align with inference data.

Future refinements will include adjustments to the analysis to account for FI size. Research shows that company size, measured by the market capitalization or by the number of employees, can significantly affect company media coverage and nonfinancial disclosures. This has the potential to affect sentiment scores because larger companies are more likely to have greater media coverage, to be more visible, and to be held accountable by stakeholders. Duran and Rodrigo describe the "internationalization effect" that causes international companies to receive greater scrutiny from foreign governments and multinational buyers.[61] Larger companies also tend to interact with more groups, such as employees and suppliers, than smaller companies do. Large companies also tend to disclose more nonfinancial information.

esgNLP is in beta testing and has not been validated by IFC through operations. The arguments made in this paper for efficiency gains and for the use of sentiment scores as proxies of ESG risk require additional testing. Such testing will include comparing outcomes from analysis by Amundi experts with output from esgNLP to validate the results and to identify performance gaps.

Recommendations

Open access data and analytical tools: The findings from this paper reinforce the benefits obtained from the use of AI, ML, and NLP to analyze ESG data. There is a need to support open access ESG and impact data for emerging markets as well as technology solutions with the potential to increase analytical capacity. IFC's data science explorations in support of development outcomes have positive lessons for other MDBs. There are opportunities for development finance institutions such as IFC, which have deep reserves of historical data on ESG performance for emerging markets, to contribute to a data commons—a repository to share information between partners. Such data can be used to conduct analyses and as training data to develop open source ML models. ML tools such as esgNLP enable IFC to extract value from its historical data and to leverage its vast bench of ESG and impact expertise for emerging markets. IFC's ESG and impact specialists support model training, development, and constant improvements through active learning. Once model effectiveness is confirmed, there is also value in making iterations of esgNLP available for access by market participants that have an interest in ESG-integrated investing in emerging markets.

Extending analytics: The number of efforts underway to harmonize sustainability reporting are to be commended. However, there is a need for interim solutions such as those offered by AI, ML, and NLP to organize disparate types of reporting in the short term. The ESG data sets require harmonization to a common benchmark to allow for meaningful comparison. AI and NLP applications—such as taxonomy matching and mapping, fuzzy text similarity, and different semisupervised ML techniques—can be leveraged to accelerate the harmonization of issuer ESG disclosures from various voluntary disclosure regimes.

Cross-industry collaborations between big finance and big tech to address ESG integration: The collaboration between Amundi and IFC further confirms the value of strategic cooperation between asset managers and MDBs to support development in emerging markets. IFC and Amundi have collaborated on the EGO Fund to increase the capacity of emerging market banks to fund climate-smart investments. The AP EGO Fund has 28 green bonds in the portfolio. The avoided emissions contributed by the fund were equivalent to 308,727 tons of CO2 in 2020[62] or the annual greenhouse gas emissions from almost 61,000 passenger vehicles.[63] Amundi and IFC's research also helps build the use case for ESG innovation, data, and technology solutions for emerging markets. Another opportunity for collaboration exists between big technology firms, such as Google, that are open sourcing their tools and systems and the finance community to support the development of sustainability solutions like esgNLP.

This paper suggests a start. The hope is that the experiment findings and recommendations inspire the community of emerging market investors to further explore how AI solutions can help address ESG integration.

APPENDIX - ADDITIONAL TABLES

Table A.1 Correlation between Amundi ESG Scores and esgNLP Scores

Type	Controversy level developed by Amundi	Sentiment score derived from esgNLP	Weighted ratio derived from esgNLP	Rating derived from esgNLP
High controversy				
Banks	High	0.03	1.71	D
Banks	High	-0.18	5.60	D
Banks	High	-0.35	140.00	D
Medium controversy				
Commercial finance	Medium	0.36	0.33	B
Banks	Medium	0.05	1.51	D
Banks	Medium	-0.16	5.21	D
Banks	Medium	-0.16	5.14	D
Banks	Medium	-0.27	14.00	D
Banks	Medium	-0.13	4.17	D
Banks	Medium	0.05	1.44	D
Banks	Medium	-0.06	2.82	D
Financial services	Medium	-0.07	3.00	D
Banks	Medium	-0.03	2.28	D
Banks	Medium	0.24	0.39	B
Banks	Medium	0.35	0.12	A
Banks	Medium	0.06	1.45	D
Banks	Medium	-0.01	2.18	D
Banks	Medium	-0.08	3.13	D
Banks	Medium	-0.31	29.10	D
Banks	Medium	0.05	1.50	D
Banks	Medium	-0.03	2.44	D
Banks	Medium	0.15	0.82	D
Low controversy				
Banks	Low	0.22	0.47	B
Life insurance	Low	0.02	1.81	D
Banks	Low	-0.07	3.00	D
Banks	Low	0.31	0.13	A
Banks	Low	-0.29	19.20	D
Banks	Low	0.21	0.53	C
Banks	Low	-0.23	9.23	D
Banks	Low	-0.36	16.00	D
Banks	Low	0.05	1.53	D
Banks	Low	-0.28	16.86	D
Banks	Low	-0.32	34.67	D
Consumer finance	Low	-0.30	22.64	D
Banks	Low	0.22	0.50	C
Banks	Low	-0.36	24.00	D
Banks	Low	-0.20	6.87	D
Banks	Low	-0.01	2.05	D
Banks	Low	0.27	1.00	D
Banks	Low	-0.20	7.20	D

Source: IFC, 2021.

Table A.2 Correlation between Amundi ESG Scores and esgNLP Scores (including bond prospectuses)

	ESG scores developed by Amundi				Sentiment Scores derived from esgNLP	
	ESG score	**Env. score**	**Soc. score**	**Gov. score**	**Sentiment score**	**Weighted average ratio**
ESG score	1.000	0.809	0.740	0.830	0.014	-0.027
Env. score	0.809	1.000	0.547	0.451	-0.007	0.093
Soc. score	0.740	0.547	1.000	0.438	0.013	-0.109
Gov. score	0.830	0.451	0.438	1.000	-0.034	-0.023
Sentiment score	**0.014**	**-0.007**	**0.013**	**-0.034**	1.000	-0.853
Weighted average ratio	**-0.027**	**0.093**	**-0.109**	**-0.023**	**-0.853**	1.000

Note: Env. = environmental; ESG = environmental, social, and governance; Gov. = governance; Soc. = social.
Source: IFC, 2021.

Table A.3 Correlation between Amundi ESG Scores and esgNLP Scores by Subsample

	ESG scores developed by Amundi				Sentiment Scores derived from esgNLP	
	Subsample of 42 high-performing FIs (rated A or B or C by Amundi)					
	ESG score	**Env. score**	**Soc. score**	**Gov. score**	**Sentiment score**	**Weighted average ratio**
ESG score	1.000	0.181	0.553	0.722	-0.225	0.164
Env. score	0.181	1.000	0.068	-0.276	0.022	0.050
Soc. score	0.553	0.068	1.000	-0.026	-0.108	0.137
Gov. score	0.722	-0.276	-0.026	1.000	-0.214	0.101
Sentiment score	-0.225	0.022	-0.108	-0.214	1.000	-0.921
Weighted average ratio	0.164	0.050	0.137	0.101	-0.921	1.000
	Subsample of 86 medium-performing FIs (rated D by Amundi)					
	ESG score	**Env. score**	**Soc. score**	**Gov. score**	**Sentiment score**	**Weighted average ratio**
ESG score	1.000	0.343	0.020	0.645	0.260	-0.109
Env. score	0.343	1.000	-0.312	-0.061	0.031	0.182
Soc. score	0.020	-0.312	1.000	-0.523	-0.040	-0.064
Gov. score	0.645	-0.061	-0.523	1.000	0.240	-0.164
Sentiment score	0.260	0.031	-0.040	0.240	1.000	-0.816
Weighted average ratio	-0.109	0.182	-0.064	-0.164	-0.816	1.000
	Subsample of 77 low-performing FIs (rated, E or F or G by Amundi)					
	ESG score	**Env. score**	**Soc. score**	**Gov. score**	**Sentiment score**	**Weighted average ratio**
ESG score	1.000	0.481	0.579	0.792	-0.057	0.033
Env. score	0.481	1.000	0.187	0.085	-0.244	0.259
Soc. score	0.579	0.187	1.000	0.162	-0.025	-0.150
Gov. score	0.792	0.085	0.162	1.000	0.018	0.064
Sentiment score	-0.057	-0.244	-0.025	0.018	1.000	-0.789
Weighted average ratio	0.033	0.259	-0.150	0.064	-0.789	1.000

Note: Env. = environmental; ESG = environmental, social, and governance; FI = financial institution; Gov. = governance; Soc. = social.
Source: IFC, 2021.

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