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About SDGs, reading the manual with NLP

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Amundi ASSET MANAGEMENT

About SDGs, reading the manual with NLP

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Abstract

In recent years, asset management has embraced the Net-Zero paradigm for portfolio construction and the formation of mid- and long-term views. However, delays in climate transition go along with poor achievement of the Sustainable Development Goals (SDGs). With only a few years remaining to reach the objectives set for 2030, this paper aims to examine the SDGs' framework and question its implementation by companies. We present a modern, NLP-driven perspective to map the SDGs to the transformations framework, while bringing back to the forefront SDG17, "partnership for the goals", often brushed away or misinterpreted. In fact, our findings demonstrate that cooperation appears to be lacking for countries from developing countries, that are facing significant financing gaps for SDGs' completion. In that spirit, we propose a news-based approach to track future corporate progress in collaborating with developing countries.

Keywords: Sustainable Development Goals (SDGs), Natural Language Processing (NLP), Large Language Models (LLM), SDG17, Foreign Direct Investments (FDIs), news analytics, financing developing economies.

JEL classification: C8, O3, Q01.

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Key takeaways

- Sustainable Development Goals (SDGs) were adopted by the United Nations (UN) in 2015 to guarantee peace and prosperity for people and the planet. But SDGs targets achievements are not on track to meet 2030's objectives: currently only 15% of targets have been reached.
- UN Sustainable Development Solutions Network (SDSN) promotes integrated approach to implement the SDGs and in this spirit, proposed the concept of SDG transformations, designing six-inter related long-term transformations, such as zero-carbon energy systems or universal health coverage.
- Using NLP and similarity measures, we map the 17 SDGs goals and targets to these transformations, augmented by a geographical focus to account for developing countries broad financing gap. Such synthetization step was thought by policymakers as a mean to push for broader and faster achievements of the SDGs.
- We found that each transformation covers around 6 SDGs. Most SDGs are covered by at least one of the transformations.
- While the transformation "zero-carbon energy systems" combines equivalently SDG7 (affordable and clean energy), SDG8 (decent work and economic growth), SDG9 (industry, innovation and infrastructure), SDG11 (sustainable cities and communities), SDG12 (responsible consumption and production) and SDG17 (partnership for the goals), we also highlight the relevance of the latter–SDG17– in all transformations but more particularly for the geographical focus.
- Despite having highlighted the importance of the partnership and cooperation, particularly within the geographical dimension, we witness that SDG17 is often disregarded in the financial industry, which considers that SDGs can be achieved in both developed and developing countries separately. Still, companies can contribute significantly to SDG17's achievement –but also to those of SDG3, SDG4, SDG9 and SDG12– through the financing of developing economies.
- Foreign Direct Investments (FDIs) are one obvious channel for closing developing countries financing gaps while they can foster new market share and performance gains (productivity, profitability...) for the investing companies.
- We stress that companies undertaking "North-North" FDIs do not truly contribute to SDGs compared to those involved in "North-South" FDIs in the sense that the latter close developing countries' financing gap. Yet, all "South" countries are not subject to high geopolitical risk, that usually dissuades investors to engage in FDI.
- However, filtering on a pool of events extracted from news for MSCI World companies (a developed market index), we find that cooperation does not seem to occur in developing countries (those under official development assistance)

1 Introduction

The Sustainable Development Goals (SDGs) were adopted by the United Nations (UN) in 2015. They aim to address burning environmental and social challenges by 2030, in order to achieve a more sustainable future for humanity. Achieving such an agenda requires progress from both governments and the private sector, and their collaboration. SDGs go one step further the non-binding Global Compact initiative on climate, which was signed by the UN in 2000, encouraging firms to disclose their progress on sustainability issues (namely human rights, labour, environment, and anti-corruption).

From an investor's perspective, the fact that a company is a signatory to the Global Compact was a first step in tilting a portfolio toward sustainable stocks. However, companies in the MSCI World Index have not set their emissions trajectories to achieve net-zero emissions globally by 2030. For example, in Le Guenedal *et al.* (2020), we highlighted that the power generation sector is the only high-emitting sector that has undergone a significant transformation, at time of writing, with a projected emissions reduction of 50% by 2030.

The Paris Agreement has transformed the governance of climate change from a state-led regulatory approach (Hale, 2016; Jordan *et al.*, 2018) to a polycentric structure "in the sense of having many different locations of authority arranged largely non-hierarchically". Within this new governance we find "large corporations" (Liefferink & Wurzel, 2018), which are particularly relevant to investors (due to their importance in market capitalization-weighted global equity indices). This structure is still considered weak or nascent (Bernstein & Hoffman, 2018). Unfortunately, it is also understudied, as Bennich *et al.* (2020) provide an overview of over 70 peer-reviewed articles on SDG interactions and find that none "consider interactions between the actors responsible for implementing the SDGs".

As a matter of fact, Kotz *et al.* (2024) describe that at the aggregate level, the current situation is that the expected damages over the next 25 years will be six times greater than the mitigation costs of achieving the Paris Agreement. This demonstrates the current lack of efficiency of the new polycentric climate governance. On a positive note, Bingler *et al.* (2022) note that companies engaged through the Carbon Action 100+ initiative appear to have expunged their communication of "cheap talk". In addition to witnessing a lack of transformation through corporate emissions trajectories, we also find that clean tech in the mainstream news remains in a "niche" where it can take a few days for news about hot innovations to go viral after their initial release. Slow or deteriorating climate action is not a stand-alone issue. It has consequences for nature, political stability and inequalities, especially in low-income countries. Ouzillou *et al.* (2024) provide empirical evidence of these linkages from data for the period 2000-2020. Environmental risk is translated very differently across countries according to their level of development: while high-income countries are more concerned with transition risk, physical risk dominates in low-income countries (Semet *et al.*, 2021), highlighting the relevance of such a distinction, already proposed in the 1950s by Solow (1956) to explain different growth paths across countries. The inability to meet the climate sub-targets is logically accompanied by the failure of the SDGs. The United Nations Department of Economic and Social Affairs (2023) indicates that, disappointingly, only 15% of the SDG targets are on track to be achieved by 2030, the horizon for the SDGs. Of the 140 trackable targets, 48% are moderately or severely off track and 37% are stagnating or regressing. That leaves 15% on track. In this context, the United Nations Department of Economic and Social Affairs (2023) suggests that the climate emergency and sustainable development challenges should be solved together.

In this paper, we aim to bring a Natural Language Processing (NLP)-based approach to the understanding of the SDGs. Following our previous work (Ouzillou *et al.*, 2024), we keep a specific focus on the low-income countries, where the largest losses are expected in

the near future (Kotz *et al.*, 2024). We will also seek to respond to investor's questions on the role that issuers in their equity or bond portfolios can have on the achievement of the SDGs. Indeed, we will see that countries are not the sole stakeholders for the SDGs.

This paper is structured as follows. Section 2 presents the transformations framework proposed by the UN Sustainable Development Solutions Network (SDSN)[1], halfway through the "2030 agenda for sustainable development" resolution which was adopted in September 2015 by 193 UN member states (United Nations, 2015). We will apply a systematic NLP approach to measure how the various SDGs are channeled through this new transformation framework. In Section 3, we will focus on SDG17, "partnership for goals" that aims to "strengthen the means of implementation and revitalize the global partnership for sustainable development" (United Nations, 2024). SDG17 could be qualified today as the "forgotten-SDG" but which is central to the proposed transformations according to our metrics. We also shed light on the drivers behind Foreign Direct Investments (FDI) to low-income countries, which are instrumental to the achievement of the SDGs. In Section 3.3, we use alternative data to test whether the cooperation component of the SDGs is indeed targeting the countries most in need of funding. Finally, Section 4 offers some concluding remarks.

2 From SDGs to Transformations

In previous research, we have identified that modern NLP models can "approximate specialist know-how"İndeed in Stagnol *et al.* (2023), we were able to reconstruct approximately 90% of the specialist know-how on the specific minerals required by given clean technologies from our collection of topical documents. Our objective is to analyze the goal and targets of each SDG. We propose to check the "fit" of each SDG against the transformations proposed by the UN SDSN (Sachs *et al.*, 2019). An SDG stimulus has been called for to reverse the downward trend in their achievement (United Nations, 2023) and the introduction of transformations –a kind of summarizing exercise– should set out in that direction. The transformations are "universal quality education and innovation-based economy", "universal health access and coverage", "zero-carbon energy systems", "sustainable ecosystems, sustainable agriculture, and climate resilience", "sustainable cities", "transformation to universal digital access and services". In addition to these transformations, we add a geographic focus, as employed by Sachs *et al.* (2023) to explicitly highlight the financing gap faced by the low-income countries (LIC) and the lower middle-income countries (LMIC). We illustrate this analysis in Figure 1 and we will describe it below.

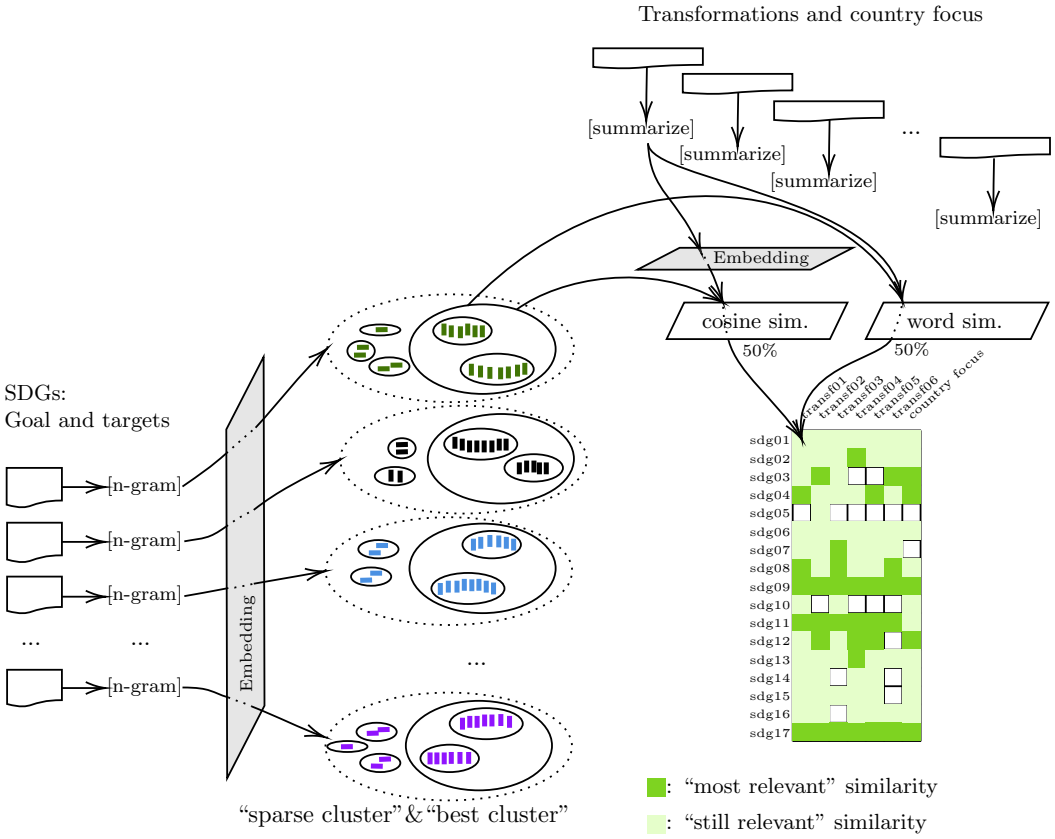
NLP treatment of the transformations and the geographic focus

The transformations and the geographic focus are summarized with a simple "summarize" prompt with OpenAI (2023). The full summarization strings are provided in Appendix A.1. We control this summarization step by comparing the output of alternative summarization prompts. For instance, a "super summarize" prompt[2] for transformation 3 returns an inconsistency. Indeed, the prompt returns:

"*Transformation 3 focuses on achieving universal access to modern energy and decarbonizing energy systems by mid-century, aligning with the Paris Agreement. Despite over 130 countries pledging net-zero commitments, there's a significant gap between declared ambitions and actual policies. Notably, G20 countries lag in adopting measures sufficient to*

[1] https://www.unsdsn.org/our-work/SDG-transformation-center/ accessed on May 10^{th}, 2024
[2] Retrieved in April 2024.

Figure 1: SDGs Goal and Targets vs. Transformations



Source: Amundi Investment Institute.

meet Paris goals, with the UK being a partial exception. ***Subsidies for fossil fuels in many nations, including under policies like the US's Inflation Reduction Act and the EU's Net Zero Industry Act****, counteract efforts toward decarbonization, even as global fossil fuel subsidies increased in 2022 to ease energy costs for consumers*"

It seems to indicate that the fossil fuel subsidies are explicitly associated with policies such as the Inflation Reduction Act, which is not the case.

NLP treatment of the SDGs

As for the SDGs, we collect the full goal and targets for each SDG from the table "Final list of proposed Sustainable Development Goal indicators" in Annex IV of the United Nations Economic and Social Council (2016). As our objective is to find common concepts between the SDGs and the transformations and the geographic focus, we break each combination of goal and targets into groups of two to four words; called n-grams. Because we seek to isolate "concepts" we vectorize the n-grams in the form of embeddings using the BERT large model (uncased)[3] (Devlin *et al.*, 2018) and we cluster the resulting embeddings following a "best cluster" procedure. The K-means clustering approach (Hartigan & Wong, 1979) remains popular among practitioners (Rai & Singh, 2010). It requires the number of clusters to be pre-specified. Therefore in our "best cluster" procedure, we analyze the quality of the K-means clustering for each number of clusters K between 20 and 200. For each K, we eliminate the clusters which hold less than 2 n-grams. We separately measure the Davies and Bouldin (1979) index (DB_{Id}) which provides a cluster separation measure, and the

[3]We use google-bert/bert-large-uncased.

Caliński and Harabasz (1974) index CH_{Id} which also provides an idea of the integration within the clusters. The CH index is higher for better separated and better integrated clusters, while the DB index is lower for better separated and better integrated clusters. As a way of combining both indices, we measure the ratio of the CH index to the DB index, which we define as the‘“cluster ratio” noted $\mathcal{CR}$.

For l varying in the range of cluster numbers $[20, 200[$, and let $\mathcal{K}_l$ denote the set of clusters with more than 2 elements. The cluster ratio can be defined as:

$$\mathcal{CR}(l) = \frac{CH_{Id}(\mathcal{K}_l)}{DB_{Id}(\mathcal{K}_l)} = \frac{CH_{Id}(\{K_1, ..., K_l\})}{DB_{Id}(\{K_1, ..., K_l\})} \quad \text{where} \quad \mathcal{K}_l = \{K \subseteq X \mid |K| > 2\} \tag{1}$$

where X is the universal set and $|K|$ denotes the cardinality (number of elements) of the cluster K. Then, for each SDG, we retain:

$$K_{SDG} | \mathcal{CR}(K_{SDG}) = \max_{l \in [20,200[} \{\mathcal{CR}(l)\}$$

and we consider the clusters corresponding to k_{SDG} excluding the clusters containing only 1 or 2 n-grams. The rate of n-gram elimination by these sparse clusters is displayed in Table 4 in Appendix. Appendix A.2 illustrates the $\mathcal{CR}$ for SDG1. Finally, similar to the n-gram-based analysis conducted by Michel *et al.* (2011) who create an n-gram corpus from digitized books, we conduct a positive control on our clusters. For SDG1 related to no poverty, we are satisfied to find the following cluster: [‘poverty eradication actions’, ‘accelerated investment poverty eradication’, ‘investment poverty eradication actions’, ‘investment poverty eradication’]. We present the positive control for the 17 SDGs in Table 5 in Appendix A.3.

NLP for matching SDGs vs. transformations and the geographic focus

We measure the cosine similarity between each n-gram retrained by our “best cluster” approach for the 17 SDGs and the embedded summaries of each transformation plus the geographic focus. Cosine similarity ranges from 0 for orthogonal vectors, to 1, for identical ones. It was introduced by Salton (1989). We keep only the top percentile of the cosine similarity values and we count them in the corresponding SDG; transformation pair. We perform the same approach with the word similarity check which relies only on the syntax that we introduced in Stagnol *et al.* (2023). It was a safety net for the outputs of the alBERT model that we used for question-answering. At this syntactic level, we also keep the top percentile word similarity scores and count them in the corresponding SDG; transformation pair. Overall, we average the top percentile counts from the two complementary approaches. We find that this combination of embedding and word similarity is very efficient. We control the following top-percentile “most relevant” matchings:

- Transf. 1 on universal quality education and SDG4 (Quality Education)
- Transf. 2 on universal health access and SDG3 (Good Health and Well-being)
- Transf. 3 on zero-carbon energy systems and SDG7 (Affordable and Clean Energy)
- Transf. 4 on climate resilience and SDG13 (Climate Action)
- Transf. 5 on sustainable cities and SDG11 (Sustainable Cities and Communities)
- Transf. 6 on digital services and SDG9 (Industry, Innovation and Infrastructure)

From the transformation perspective, we can focus on the top one-third of “most relevant” similarity counts (cosine and word similarity) across SDGs and transformations and geographic focus. We measure the “most relevant” ratio as the ratio between the average and the standard deviation of the top third of the “most relevant” similarity counts (cosine and word similarity) for each transformation, including geographic focus. It appears that, on average, each transformation plus the geographic focus has 6 SDGs that fall into this top

one-third category (above its associated relevance ratio), as displayed in green in the Table 1. Figure 2 shows the strong interconnections that exist between SDGs and transformation. We witness that only SDG5 seems to have been left out.

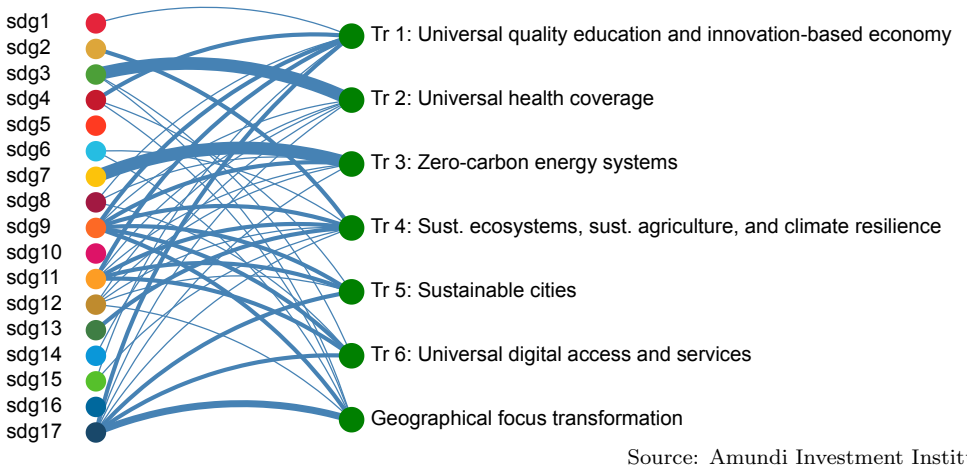
Table 1: Cosine and Word Similarities

	short title	Tr1	Tr2	Tr3	Tr4	Tr5	Tr6	Geo
SDG1	No Poverty	**4.5**	2	1.5	2.5	4	4	3
SDG2	Zero Hunger	1	1	1.5	**11**	1.5	2	2
SDG3	Good Health and Well-being	3.5	**48.5**	3	0	0	**6**	**5.5**
SDG4	Quality Education	**19**	3.5	2.5	2.5	**4.5**	3.5	**6.5**
SDG5	Gender Equality	0	2	0	0	0	0	0
SDG6	Clean Water and Sanitation	4	4	4	**5.5**	3.5	2.5	**4.5**
SDG7	Affordable and Clean Energy	2.5	3	**7**	3	3	3	0
SDG8	Decent Work and Economic Growth	**9**	2.5	**6.5**	3	4	**5.5**	4
SDG9	Industry, Innovation and Infrastructure	**15.5**	**9**	**11**	**11**	**10**	**19**	**15**
SDG10	Reduced Inequality	2	0	0.5	0	0	0	3.5
SDG11	Sustainable Cities and Communities	**10**	**6.5**	**8**	**16**	**14**	**10.5**	1
SDG12	Responsible Consumption and Production	3	**6.5**	**6**	**9.5**	**4.5**	0	**6**
SDG13	Climate Action	3.5	3	1.5	**14**	3	3.5	1
SDG14	Life Below Water	2	**4.5**	0	0.5	0.5	0	2
SDG15	Life on Land	**5**	0.5	0.5	**6**	1.5	0	1.5
SDG16	Peace and Justice Strong Institutions	3.5	2	0	2.5	2.5	4	2
SDG17	Partnerships to achieve the Goals	**17**	**5.5**	**7**	**9.5**	**12.5**	**14**	**29.5**
	Most relevant ratio	1.97	0.78	4.21	2.88	2.05	1.94	1.44

Note: "Tr" stands for the different transformations proposed by the UN SDSN and "Geo" for the geographic transformation we added. Source: Author's calculations, Amundi Investment Institute.

Thus, we find that the transformations as designed by the UN SDSN (Sachs *et al.*, 2019) are well balanced across the SDGs. We would also like to point out the uniqueness of transformation 3 on zero-carbon energy systems. It is the most balanced transformation among the "most relevant" SDGs. Finally, the geographic focus we have introduced is strongly linked to SDG 17 on partnerships to achieve the goals.

Figure 2: SDGs vs Transformations - Main Cosine and Semantic Similarities



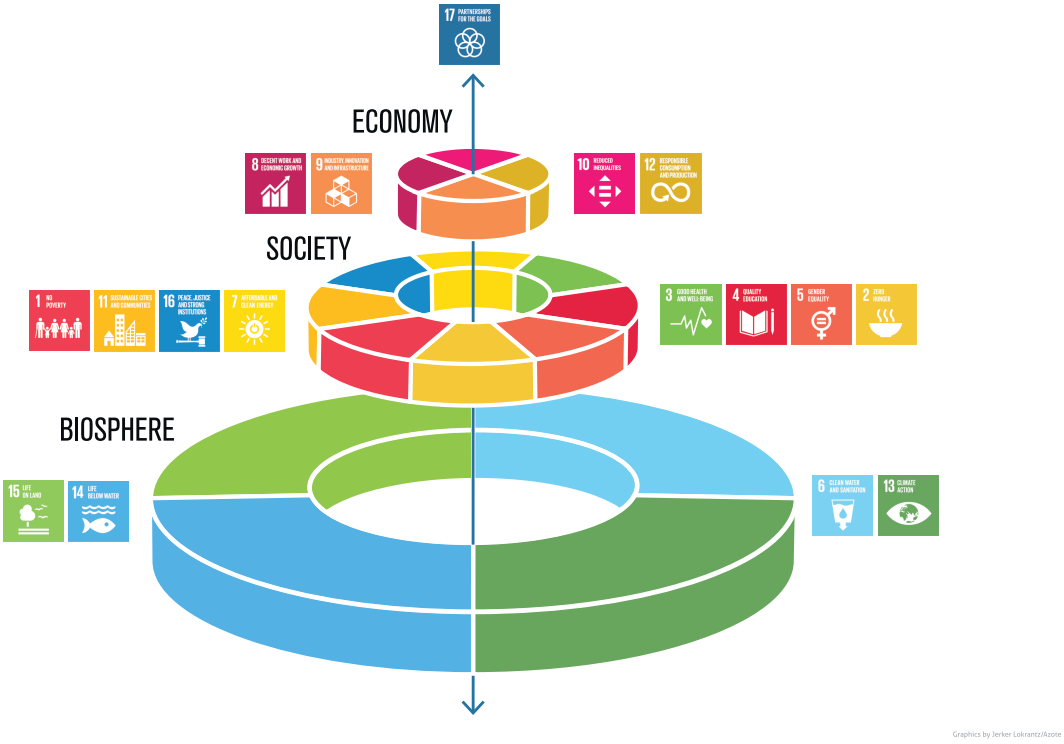
Source: Amundi Investment Institute.

3 What role for corporates in the SDG17 ?

3.1 Supporting developing countries–the case of SDG17

Our cosine and word similarity analysis conducted with our NLP approach in the previous Section highlights that SDG17 is within the most relevant relationships between the SDGs and the transformations (see Figure 2 and Table 1). However, SDG17 is often considered as a stand-alone goal. Indeed, in the 2030 Agenda for Sustainable Development, the United Nations (2015) proposes the 5P approach (people, planet, prosperity, peace and partnership), while specifically highlighting Goal 17 in the "means of implementation and the Global Partnership". Similarly, the SDG "wedding cake" framework proposed by the Stockholm Resilience Centre (2016) groups SDG6, SDG13, SDG14 and SDG15 under the biosphere layer, SDG1, SDG2, SDG3, SDG4, SDG5, SDG7, SDG11 and SDG16 under the society layer and finally SDG8, SDG9, SDG10 and SDG12 under the economy layer. SDG17 is also left as a stand-alone goal here as illustrated in Figure 3.

Figure 3: The SDG "Wedding Cake"



Source: Stockholm Resilience Centre (2016)

On top of this isolation of SDG17, confusion might have been introduced regarding the geographic nature of the SDGs. In fact acting as a pass-through for companies, GSSB *et al.* (2015) ascertain that "the goals are universally applicable in developing and developed countries alike". Voluntary or not, this proposition seems to indicate that the SDGs are goals and targets that can be implemented separately in silos in developing and developed countries. We extract the explicit contexts of support to developing countries or least developed countries from the wording of the targets of SDG17 in Table 2. We find that 79% of

the targets of SDG17 explicitly mention support for developing or least developed countries, confirming the strong connection between SDG17 and our geographic focus transformation that we indicate in Table 1.

Table 2: Developing Countries Focus in the Targets of SDG17

target	area	context for developing countries
17.1	finance	"support to developing countries"
17.2	finance	"official development assistance [...] to developing countries [...] least developed countries"
17.3	finance	"financial resources for developing countries"
17.4	finance	"Assist developing countries"
17.5	finance	"investment promotion regimes for least developed countries"
17.6	technology	"Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation"
17.7	technology	"diffusion of environmentally sound technologies to developing countries"
17.8	technology	"operationalize the technology [...] for least developed countries"
17.9	capacity-building	"implementing effective and targeted capacity-building in developing countries"
17.10	capacity-building	"negotiations under its Doha Development Agenda"[4]
17.11	capacity-building	"increase the exports of developing countries"
17.12	capacity-building	"quota-free market access on a lasting basis for all least developed countries"
17.13	systemic issues	NA
17.14	systemic issues	NA
17.15	systemic issues	NA
17.16	multi-stakeholder partnerships	"support the achievement of the Sustainable Development Goals in all countries, in particular developing countries"
17.17	multi-stakeholder partnerships	NA
17.18	multi-stakeholder partnerships	"support to developing countries, including for least developed countries and small island developing States"
17.19	multi-stakeholder partnerships	"support statistical capacity-building in developing countries"

Source: Annex IV from United Nations Economic and Social Council (2016), Amundi Investment Institute.

3.2 The importance of Foreign Direct Investments for partnerships for goals

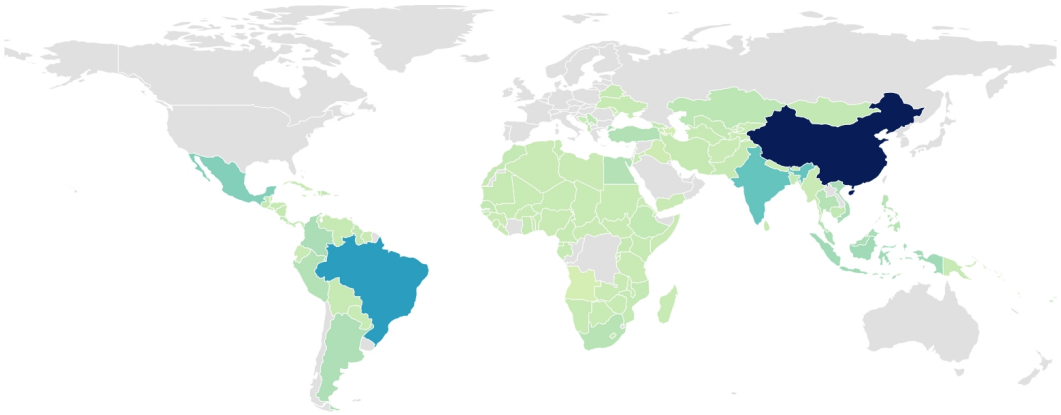
One explicit solution for corporates to participate in SDG17 is through FDIs, which consists of permanent cross-border investments made by a company abroad that ensure a certain degree of influence over the target company. In fact, for target 17.3 (i.e. mobilize additional financial resources for developing countries from multiple sources), the associated indicator 17.3.1 explicitly states "foreign direct investment, official development assistance and South-South cooperation as a proportion of gross national income" (United Nations, 2021). FDIs are an astute way to gain market share abroad and develop globally while ensuring geographic diversification. In such internationalization objective, they also allow

[4] from https://www.wto.org/english/tratop_e/dda_e/dda_e.htm: the Doha Development Agenda as a fundamental objective is to improve the trading prospects of developing countries.

to capture "first-mover advantages" (Chang & Rhee, 2011). FDIs can be vertical, when a firm acquires a company abroad that becomes its supplier (backward oriented) or distributor (forward oriented). They can also be horizontal, when a company establishes a similar business abroad). Hence horizontal FDIs are also known as market-driven and vertical ones as cost-driven investment decisions (Kling *et al.*, 2011).

There are strong links between FDIs, firm valuation and firm performance. For instance, Baker *et al.* (2008) explain how countries with high stock market valuations tend to undertake more FDIs, owing to the "cheap financial capital channel" available to overvalued companies. However, flows do not seem to be sensitive to the stock market valuation of the host country. Considering stock market valuation and capital availability hints at FDI flows from "northern" (i.e. developed) countries. Working on a sample of Italian manufacturing firms, Borin and Mancini (2016) demonstrated that companies investing abroad for the first time (and especially in advanced economies) benefit from an increase in total factor productivity in the following years. This mechanism is driven by the high degree of specialization of the industries undertaking FDIs, but also by the strengthening of white-collar employment in the parent firm. Chang and Rhee (2011) found that, in Korea, firms with superior capabilities and resources undertaking rapid FDI expansion see their profitability increase. Moreover, geographic diversification was found to raise shareholder value (Doukas & Lang, 2003). Still the ability of FDIs to deliver increasing operating margins and returns is highly dependent on the typology of FDI. As Doukas and Lang (2003) point out in their study of US companies, core-related FDIs yield long term-performance, while non-core FDIs lead to losses. For FDI-receiving firms, Yasar and Paul (2007) demonstrate on a sample of transitional economies (such as Poland) that foreign ownership generates strong benefits, in terms of productivity, capital intensity and market share as well as improvements in wages and employment and significant spillover effects on other firm's productivity in the host country.

Figure 4: Official Development Assistance Recipients Countries and FDI received in 2022 (% of World Inward FDI)

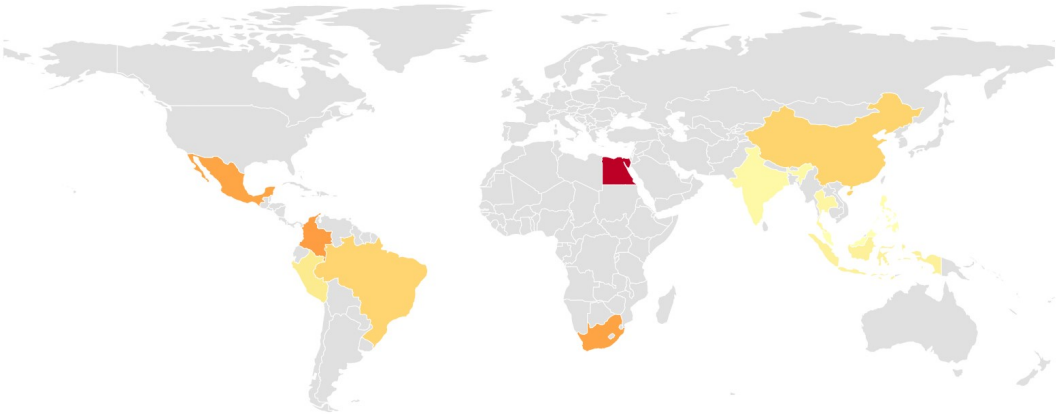


Notes: The darker the color the higher the %.
Source: UNCTAD, OECD, illustration by Amundi Investment Institute.

Although the wealthiest countries have more financial leeway for FDI, meeting the SDGs targets will require these flows to channel to the South. Figure 4 shows the percentage of world FDI for 2022 received by each recipient country of Official Development Assistance (ODA). Sabir *et al.* (2019) point at the importance of countries institutional quality in

attracting such flows. Moreover, among developing countries, they showcase how trade openness and GDP per capita foresee positive impact on FDI inflows. In a similar spirit, clarity on human rights governance in the target country tends to foster multinational enterprises' foreign ownership, with a stronger impact for developed countries multinational enterprises (MNEs) than for emerging markets ones (Rao-Nicholson & Svystunova, 2020). Political risk also plays an essential role (Jun & Singh, 1996), as does economic growth (Dabla-Norris *et al.*, 2010). More generally, economic conjuncture is a key determinant of FDI flows to developing countries: Yeyati *et al.* (2007) indicate how FDI flows to countries in the "South" move in opposite directions with interest rate cycles in Europe and US. Bussy and Zheng (2023) emphasize how geopolitical developments also play an essential role in FDI flows. They distinguish geopolitical risk from geopolitical uncertainty, with the latter having a stronger impact on discouraging FDI. Geopolitical risks can disrupt business internationally, exposing the companies with a global presence (such as joint ventures). In fact, in some severe situations, political turmoil can impede cross-border deals (Khubchandani *et al.*, 2024). Figure 5 shows how vulnerable is Egypt in this regard, according to our proprietary appraisal of political risk based on news (Rosenberg & Stagnol, 2024). Still, in today's geopolitical environment, joint ventures are perceived to be more resilient than traditional merger and acquisition activities, in the event of an economic downturn according to Khubchandani and Gore-Randall (2024)'s survey. In addition, Goraieb *et al.* (2019) showcase how corporates prefer to target companies in countries with similar cultures. Finally, horizontal and vertical FDIs do not respond to the same drivers, as showcased by Kinda (2013). Working on sub-Saharan countries, he highlights how vertical FDIs tend to arise in countries with strong institutional environments and infrastructures, while horizontal ones are more influenced by human capital and financing capabilities and respond positively to strong a trade regulatory framework in the target country.

Figure 5: Local Political Stability for 2024-Q1



Notes: Proprietary calculations based on news sentiment. Sentiment data ranges from -3.28 for Egypt to -0.21 for Malaysia. We only present figures for MSCI EM countries receiving Official Development Assistance (ODA), when data is available
. Sources: Amundi Investment Institute.

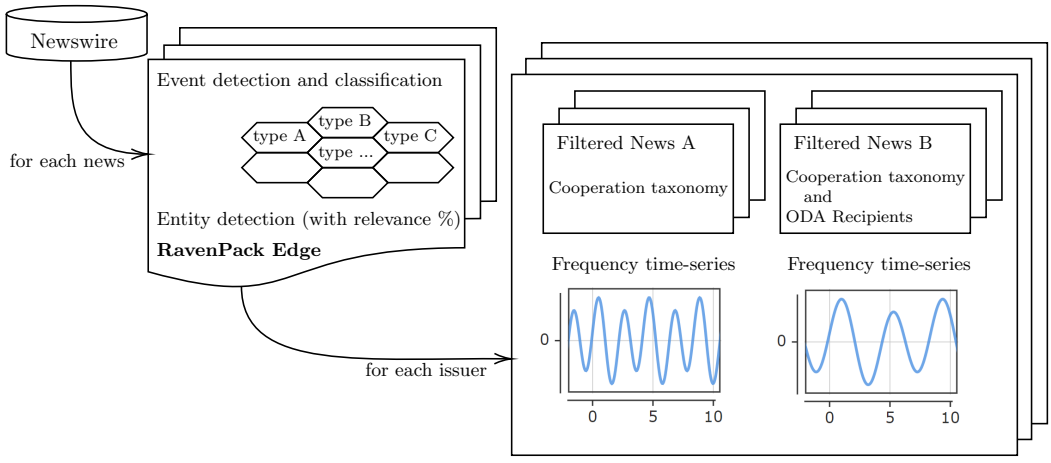
In a nutshell, FDIs are more likely to be triggered when the target country is characterized by low geopolitical risk (Bussy & Zheng, 2023), sound institutional capabilities (Sabir *et al.*, 2019) and cultural proximity (Goraieb *et al.*, 2019). The existence of a regional trade agreement (RTA) is also supportive in the sense that it favors countries' openness by reducing

trade barriers (Cherif & Dreger, 2018). The authors point out the effectiveness of the AFTA Free Trade area and the MERCOSUR common market among South-South FDIs in promoting economic growth and openness. As far as North-South examples are concerned, Japanese flows to Latin America and the Caribbean have been on the rise since the mid-2000's (Gabriel, 2020; Kahn, 2016; Neupert & Montoya, 2000). For developing countries, recent figures from UNCTAD (2024) highlight a slowdown in FDIs to developing countries, pointing at economic uncertainty. Asia has been most affected, while Africa and Latin America and the Caribbean have remained relatively stable. Meanwhile, some developed "conduit" European countries have been attracting more and more FDI. Finally, the number of projects in sectors relevant to the SDGs in developing countries remained flat in 2023, drawing attention to the need to address a significant future shortfall in financing.

3.3 Supporting developing countries–news analysis through NLP lens

In Subsection 3.1, we have identified a potential misunderstanding in the advice given to companies by GSSB *et al.* (2015) regarding support for developing countries in the context of the SDGs. In this subsection, we focus on the 3921 issuers of stocks that were occasionally or continuously included in the MSCI World Index, a global developed market index, from the end of 2017 to the end of February 2024. For these issuers, we extract events as detected by RavenPack Edge from an English-language newswire. RavenPack is a big data analytics company specializing in alternative financial data (Bushman *et al.*, 2017; Mitra & Mitra, 2011). It was recently recognized as a member of the "Top 100 Next Unicorns" by Viva Technology (2024). In total 77 305 861 events are detected. Our process is illustrated in Figure 6. Similar to our approach in Cherief *et al.* (2022) where we measure the share of biodiversity specific news in the general daily news, we propose a "Share of Events in the News" ratio that we note $\mathcal{SoN}$.

Figure 6: Event Filtering in the News



Source: RavenPack, Amundi Investment Institute.

Let $\widetilde{\mathcal{N}}_i(t)$ be the number of events in the news associated to our "cooperation" taxonomy, $\mathcal{N}_i(t)$ the total number of events in the news and $\widetilde{\mathcal{N}}'_i(t)$, the subset of events in the news associated to both our "cooperation" taxonomy and the ODA recipient countries. For each

Issuer i, belonging to MSCI World (in the last 6 years), the share of events in the news can be defined at date t as:

$$\mathcal{SoN}_i(t) = \frac{\widetilde{\mathcal{N}}_i(t)}{\mathcal{N}_i(t)}; \qquad \text{where} \quad \widetilde{\mathcal{N}}_i = |\mathcal{N}_i(t) \cap \mathcal{T}| \tag{2}$$

$$\mathcal{SoN}'_i(t) = \frac{\widetilde{\mathcal{N}}'_i(t)}{\mathcal{N}_i(t)}; \qquad \text{where} \quad \widetilde{N}'_i = |\left(\mathcal{N}_i(t) \cap \mathcal{T}\right) \cap \mathcal{T}_{ODA}| \tag{3}$$

where:

- where $\mathcal{N}$, $\mathcal{T}$ and $\mathcal{T}_{ODA}$ are the subset of events in the news and sample with cooperation taxonomy content and ODA recipients, respectively
- $|\mathcal{E}|$ denotes the cardinality (number of elements) of any ensemble $\mathcal{E}$
- $Taxonomy$ is the "cooperation" taxonomy that we extract from the detailed query repository for all SDGs provided by Bedard-Vallee *et al.* (2023). We isolate items related to cooperation from the SDG17 query.
- ODA is the group of low-income countries and lower middle-income countries eligible for the ODA from the Development Assistance Committee (DAC) of the OECD[5] in 2024 and 2025.

Both the "cooperation" taxonomy and the ODA recipient countries are listed in Table 6 in Appendix A.5.

Once we have defined the $\mathcal{SoN}'_i(t)$ ratio, we dynamically rebase it by the relation of $\widetilde{\mathcal{N}}_i(t)$ to $\overline{\mathcal{N}_i(t)}^{60t}$, the 60-day average of $\mathcal{N}_i(t)$. The main benefit of this adjustment is to correct the daily share of events in the news ratio downwards, if for somereason, the daily news for Issuer i is particularly low and intersects well with the filters. To offset the acceleration of the square function that we have thus introduced, we cap our rebased share of events in the news ratio at 2.25.

$$\widehat{\mathcal{SoN}}_i(t) = \min\left(2.25;\ \mathcal{SoN}_i(t) \times \frac{\widetilde{\mathcal{N}}_i(t)}{\overline{\mathcal{N}_i(t)}^{60t}}\right) \tag{4}$$

We apply the same calculation for $\widehat{\mathcal{SoN}}'_i(t)$.

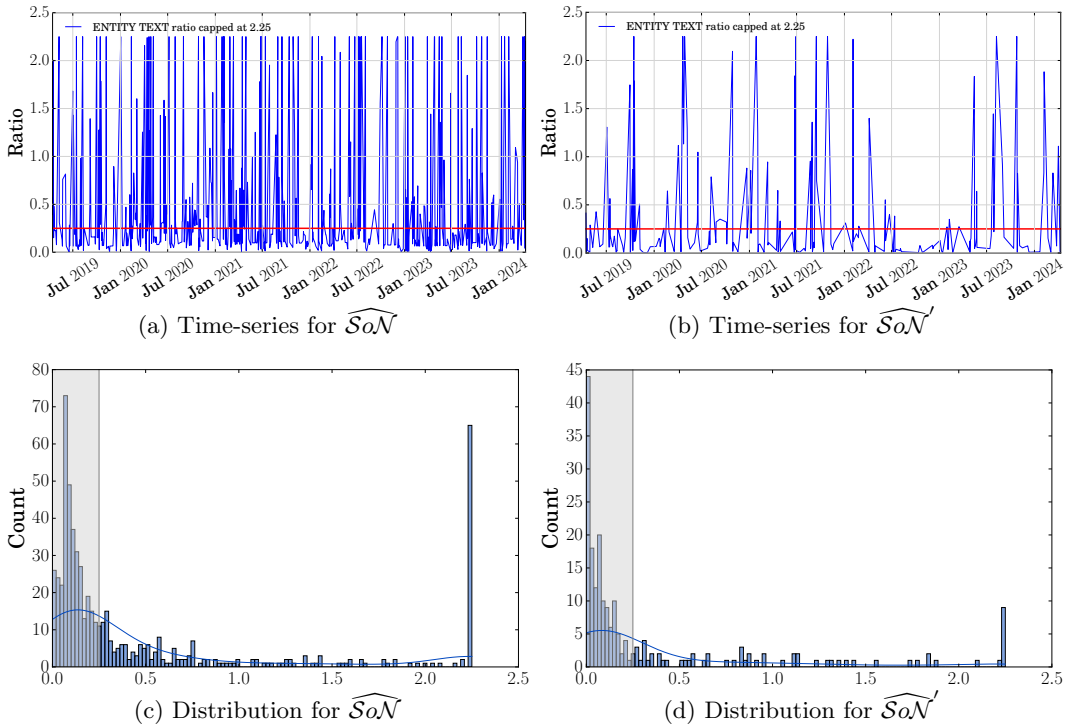
In Figure 7, we illustrate the effect of the two levels of filtering for a given company from the MSCI World Index. In Subfigure 7a, we see the time-series for $\widehat{\mathcal{SoN}}$ where the events identified in the news for the company are filtered solely on the "cooperation" taxonomy. We can summarize this time-series with a distribution graph in Subfigure 7c. We consider that values between 0 and 0.25 of $\widehat{\mathcal{SoN}}$ or $\widehat{\mathcal{SoN}}'$ are neutral relative to the news content targeted by our filters while reaching the upper limit of 2.25 indicates that the events in the news of the day $\mathcal{D}$ of $Issuer\, i$ were responsive to our filters. To represent these thresholds, we can project the time series of $\widehat{\mathcal{SoN}}$ and $\widehat{\mathcal{SoN}}'$ to a distribution ratio defined as follows:

$$\widehat{\mathcal{SoN}}_i\, ratio = \frac{|\mathcal{SoN}_i = 2.25|}{|\mathcal{SoN}_i \leq 0.25|} \tag{5}$$

We also extract a "*gap day*" density metric which is the maximum number of days between days where $\widehat{\mathcal{SoN}}'_i$ consecutively reaches the maximum value (2.25) value during our

[5] https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/daclist.htm.

Figure 7: Rebased Share of Events in the News for
Cooperation (left) and Cooperation and ODA Countries (right)



(a) Time-series for $\widehat{\mathcal{SoN}}$

(b) Time-series for $\widehat{\mathcal{SoN}}'$

(c) Distribution for $\widehat{\mathcal{SoN}}$

(d) Distribution for $\widehat{\mathcal{SoN}}'$

Source: RavenPack, Authors' calculations, Amundi Investment Institute.

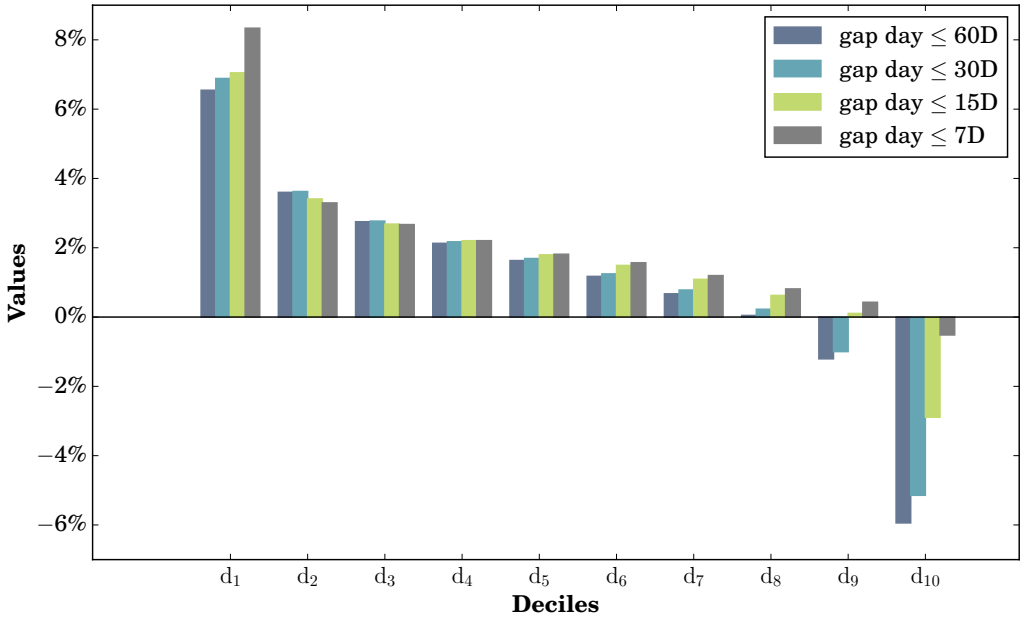
analysis period. As illustrated in Figure 8, the $\widehat{\mathcal{SoN}}$ ratio differential $[\Delta(\mathcal{SoN})]$ –as defined by the difference between the $\widehat{\mathcal{SoN}}$ ratio and the $\widehat{\mathcal{SoN}}'$ ratio–is mostly positive. We display the average value of the differential per deciles, split in equal numbers of issuers along the values of the $\Delta(\mathcal{SoN})$. We find that focusing on issuers with lower "*gap day*" reduces border effects on the lower deciles. As shown in table 3, we find that for issuers that have high relevance on the "cooperation" taxonomy, we lose about 60% of the density when we filter for ODA recipient countries.

Table 3: Density Gap Ratio

gap day	$\leq 60D$	$\leq 30D$	$\leq 15D$	$\leq 7D$
Number of issuers	1 337	1 053	602	217
$\frac{\overline{\Delta(\mathcal{SoN})}}{\overline{\mathcal{SoN}}}$	20.4%	24.8%	38.2%	63.8%

Source: RavenPack, Authors' calculations, Amundi Investment Institute.

Figure 8: Effect of "Cooperation " News Density on $\Delta(\mathcal{SoN})$



Source: RavenPack, Amundi Investment Institute.

4 Conclusion

Similar to our previous work on clean tech (Stagnol *et al.*, 2023), where we had no prior expert knowledge on the technologies, we rely on modern NLP techniques to build intelligence on the SDGs and refine our understanding. We found that the novel transformations for the SDGs proposed by Sachs *et al.* (2023) are well balanced across the SDGs. We measure that SDG3 on zero-carbon energy systems is the more balanced transformation, which aligns well with the joint crisis of climate and SDGs. We also find a strong link between our geographic transformation and SDGs, especially with SDG17, suggesting the importance of cooperation for their successful achievement.

Therefore, our paper then focused on SDG17, which is often left aside in representations of the SDGs. Since the Paris Agreement, corporates have been part of the polycentric governance for climate change. However, we believe that they may have misunderstood the "development" component of the SDGs. In fact, there might be a common belief that the goals can be achieved in both developed and developing countries, while the objective is actually to support developing countries. In terms of FDIs, we argue that "North-South" or "South-South" investments are the ones that can truly contribute to a more sustainable society. Therefore, we propose a news-driven approach to identify the density of events in the news related to the concept of "cooperation" and ODA recipient countries. We find that for companies from a global developed market index (i.e., the MSCI World), there is a 60% density reduction when we apply the ODA country filter to issuers that have frequent "cooperation" news flow. This shows that despite the need to close the financing gap to achieve the SDGs by 2030, cooperation does not seem to be happening from developed to developing countries. We emphasized that geopolitical risk cannot be blamed for this pitfall, as many developing countries benefit from a sound political environment.

Our modern NLP-based approach, which relies on large language models but also on more traditional word similarity metrics, can be applied to many other fields which require intelligence build-up in a short time.We hope that this framework can support the development of this practice in the financial industry, where the pricing of securities can be influenced by different types of information. We believe that this scientific approach can bring a fresh perspective to the existing knowledge bottlenecks. In the case of the SDGs, we have highlighted that supporting developing countries is a key component to achieving the SDGs. We hope that asset managers will keep their universes open to the emerging and frontier markets, explore opportunities in blended finance and seek out ways to incorporate the relevant considerations into their engagement efforts.

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A Appendix

A.1 SDG Transformations and geographic focus

Transformation 1: Universal quality education and innovation-based economy

Education builds human capital, which in turn promotes economic growth, innovation, decent work, and the elimination of extreme poverty, and helps overcome gender and other inequalities. Countries must further expand and transform education systems. SDG target 4.1 calls for universal access to 12 years of free primary and secondary education, with at least 9 years compulsory. This scorecard shows that many countries around the world currently fall short of this target. To reduce inequalities, governments also need to expand social safety nets. These should be complemented by anti-discrimination measures (including those furthering gender equality); improved labor standards; and measures to end all forms of modern slavery, trafficking, and child labor. Investments in research and development will also help to promote economic growth, which can contribute to reducing inequalities. Looking ahead, a lead global indicator must be established to assess country efforts to strengthen their population's and students' knowledge of sustainable development and their ability to navigate an information rich environment. This is important to achieve long-term science-based transformations of all economies, and to build up public support and accountability. According to the OECD, only one in 10 students in OECD countries can distinguish between fact and opinion (OECD, 2018).

Summarized: Transformation 1 emphasizes the critical role of universal quality education in building human capital, fostering economic growth, innovation, and social equity. It aims to provide 12 years of free education, addressing the global shortfall in meeting this target. The strategy includes expanding social safety nets, implementing anti-discrimination and labor standard improvements, and ending modern slavery. Additionally, it calls for increased R&D investments and the development of a global indicator to evaluate knowledge of sustainable development and information literacy, highlighting the need for improved education on distinguishing fact from opinion to support long-term economic transformations and enhance public engagement and accountability.

Transformation 2: Universal health coverage

This Transformation promotes key investments in health and well-being. It aligns closely with SDG Target 3.8, achieving universal health coverage and ensuring that all people have access to the health services they need. In the SDGs, universal health care (UHC) is considered a target in itself. For the SDG Transformation scorecards, however, we consider UHC an enabler (input) for greater health outcomes. Even before the Covid-19 pandemic, the WHO and other international institutions had lamented the slow pace of progress towards achieving universal health coverage (WHO, 2019). Compared with the rest of the world, a higher percentage of people in OECD countries tend to be covered by public or mandatory private health insurance, and incidence rates of catastrophic out-of-pocket health expenditures are lower although there are exceptions, including Mexico, Costa Rica, Poland, and the United States. The SDGs also call on all countries to strengthen their capacities for early warning, risk reduction, and the management of national and global health risks (SDG target 3.d). As a measure of pandemic preparedness, the Global Health Security Index turned out to be a rather poor predictor of effective early response to COVID-19, as measured by the number of cases and deaths (Lafortune, 2020), indicating that important factors are at play that are not yet adequately captured by existing policy trackers. Nevertheless, we have not identified a better policy focused indicator of pandemic preparedness. In the context of the High-Level Pandemic Summit to take place in September 2023 and the forthcoming global pandemic treaty, it remains vital to define solid international measures and monitoring systems that

can better gauge countries' preparedness for global health security threats. But it is also important to address drivers that can lead to the emergence of new pathogens, including environmental drivers, through "One Health" approaches (Sachs et al, 2022; McKee et al, 2021).

Summarized: Transformation 2 focuses on achieving universal health coverage (UHC) as a crucial goal and enabler for better health outcomes, in line with SDG Target 3.8. Despite its importance, progress toward UHC has been slow, with significant variations in coverage and out-of-pocket expenses across countries. The COVID-19 pandemic highlighted the limitations of existing measures, like the Global Health Security Index, in predicting pandemic preparedness. The transformation emphasizes the need for improved international measures and systems to assess preparedness for health threats, suggesting a holistic 'One Health' approach to address the environmental factors contributing to the emergence of new pathogens.

Transformation 3: Zero-carbon energy systems

This Transformation aims to ensure universal access to modern energy sources; decarbonize the energy system by mid-century (in line with the Paris Agreement); and reduce industrial pollution of soil, water, and air. More than 130 countries are signatories to the UN Climate Ambition Alliance, and more than 50 have anchored their net-zero commitment in a law or policy document (Net Zero Tracker, 2023; UNFCCC, 2022). By September 2022, 139 countries had submitted or updated nationally determined contributions (NDCs), with studies finding that new and updated NDCs present more ambitious emission-reduction targets and planning (WRI, 2022). There continues to be a major discrepancy between countries' self-declared ambitions and their tangible efforts and policies. The Climate Action Tracker, an independent scientific analysis of governments' climate actions, finds that no single G20 country has adopted a sufficient mix of policies and actions to achieve the Paris Climate Agreement objectives, with only the United Kingdom reaching an "almost sufficient" level of policy (Climate Action Tracker, 2022). Many countries continue to provide substantial subsidies for fossil fuels, undermining their initiatives to decarbonize the energy system, such as the United States' Inflation Reduction Act (IRA) and the European Union's Net Zero Industry Act (NZIA) (DGAP 2023). While comparable country-level data are not yet available, the IEA has concluded that global fossil-fuel consumption subsidies rose sharply in 2022, as governments attempted to shield consumers from rising energy bills (IEA 2023, OECD 2022).

Summarized: Transformation 3 focuses on creating zero-carbon energy systems, aiming for universal access to modern energy, decarbonizing energy systems by mid-century, and reducing pollution. Despite over 130 countries committing to net-zero goals, there's a gap between declared ambitions and actual policy implementations, with the UK being notably closer to achieving Paris Agreement objectives. However, continued fossil fuel subsidies by many countries, including the US and EU, counteract decarbonization efforts. The IEA noted an increase in fossil fuel subsidies in 2022, indicating a challenge in aligning financial policies with climate goals.

Transformation 4: Sustainable ecosystems, sustainable agriculture, and climate resilience

Unsustainable consumption is strongly interconnected with diets, land-use policies, and the health of major ecosystems. This is why Transformation 4 calls for integrated transformations to address dietary shifts, biodiversity, agricultural systems, and land-use policies. Bringing these elements together is a main difference between the Six Transformations and

the "six entry points for action" presented in the Global Sustainable Development Report (GSDR, 2023), which treats "Sustainable Food Systems and Healthy Nutrition" and the "Global Environmental Commons" as two separate entry points. Today's land-use practices and food systems have led to persistent hunger, malnutrition, and obesity. They account for a quarter of greenhouse gas emissions, over 90 percent of scarcity-weighted water use, most biodiversity loss, the overexploitation of fish populations, eutrophication through nutrient overload, and the pollution of our water and air. Food systems are also highly vulnerable to climate change and land degradation: integrated strategies are vital to ensure that these systems, along with land-use practices and ocean ecosystems, are sustainable and healthy for people. The Convention on Biological Diversity, adopted in December 2022 during the 15^{th} Convention of Parties in Canada, calls to protect and conserve at least 30 percent of terrestrial, inland water and coastal and marine areas by 2030, "especially areas of particular importance for biodiversity and ecosystem functions and services" (UN, 2022). UNEP estimates that 84 percent of Parties to the UN Framework Convention on Climate Change (UNFCCC) have now adopted climate adaptation plans, strategies, laws, and policies (UNEP, 2022). But there is a significant gap in funding these measures. Annual adaptation funding needs are expected to reach US$160 billion to US$340 billion by 2030, and US$315 billion to US$565 billion by 2050 (UNEP, 2022). Establishing mechanisms to ensure that the burden of financing human-induced adaptation is shared fairly and globally, and that the countries responsible pay the costs of loss and damages, remains an important priority for the international community. The SDSN is highly committed to supporting global and national efforts to develop sustainable food and land systems, preserve major ecosystems, and ensure adequate finance for nature and climate adaptation. In close collaboration with the Food and Land Use Coalition (FOLU), the SDSN's FABLE and FELD projects provide support for long-term, sustainable food and land use pathways and policies. Despite the recognized importance of decarbonizing agriculture and enhancing carbon sinks towards achieving the objectives of the Paris Climate Agreement, FELD recently documented the limited integration of food and land policies into NDCs (FELD, 2022). Other flagship projects include the Global Commons Stewardship Initiative (led by the Center for Global Commons at the University of Tokyo in cooperation with SDSN and other partners) and the Science Panel for the Amazon (CGC, SDSN and Yale, 2023; CGC, SYSTEMIQ, SDSN et al, 2022). Considering the complexity and far-reaching nature of this Transformation, we are not yet in a position to present a scorecard for Transformation 4.

Summarized: Transformation 4 advocates for an integrated approach to ensure sustainable ecosystems, agriculture, and climate resilience, highlighting the interconnections between consumption, land use, and ecosystem health. It calls for addressing dietary shifts, biodiversity, and agricultural systems together, distinguishing it from separate considerations in global reports. Current practices contribute to climate change, biodiversity loss, and water scarcity, emphasizing the need for sustainable and healthy systems. Significant challenges include funding gaps for climate adaptation, with substantial financial needs projected for 2030 and 2050. Efforts by SDSN, in collaboration with FOLU and other initiatives, aim to develop sustainable food and land systems and integrate these policies into national climate strategies, despite current limitations in policy integration.

Transformation 5: Sustainable cities

Cities and other urban areas are home to around 55 percent of humanity, and account for 70 percent of global economic output. By 2050, these shares will increase to 70 and 85 percent, respectively (Jiang and O'Neill, 2017). The OECD estimates that 105 of the 169 SDG targets will not be reached without sufficiently engaging sub-national governments (OECD, 2020). the COVID-19 pandemic has had lasting impacts on urban mobility,

land use, property values, and transport systems in developed and developing countries alike. Many urban organizations and associations have mainstreamed the SDGs into their work programs, including C40, UN-Habitat, United Cities and Local Governments (UCLG), and Local Governments for Sustainability (ICLEI), as well as the OECD's Centre for Entrepreneurship, SMEs, Cities and Regions. By design, Transformation 5 calls for regional and local policy trackers. These would notably track efforts at the regional and city level to curb urban pollution, increase housing affordability, and strengthen mobility and access to public transport. Other policy measures could be considered proxies of local government commitment to achieving the triple objective of being economically productive, socially inclusive, and environmentally sustainable. SDSN is working with local partners to strengthen policy frameworks in regions and cities, and to reinforce the science-policy interface at the subnational level. In early 2023, the OECD, SDSN, and the European Committee of the Regions (CoR) conducted a survey to take stock of city and regional SDG progress. Previous surveys on the topic were conducted by the OECD and the CoR in 2019 and 2020.

Summarized: Transformation 5 focuses on making cities sustainable, noting that urban areas, housing 55% of humanity and contributing 70% to global GDP, are crucial for achieving SDG targets. The transformation highlights the need for engaging sub-national governments, as many SDG targets depend on their active participation. The COVID-19 pandemic has significantly impacted urban systems, prompting urban organizations to align their work with the SDGs. Key actions include developing policy trackers to monitor regional efforts towards reducing pollution, improving housing affordability, and enhancing public transport. The SDSN is collaborating with local entities to improve policy frameworks for cities, aiming for economic productivity, social inclusion, and environmental sustainability. Recent surveys assess progress on city and regional SDG implementation, underlining ongoing efforts to align urban development with sustainable goals.

Transformation 6: Universal digital access and services

Artificial intelligence and other digital technologies are disrupting almost every sector of the economy: agriculture (precision agriculture), mining (autonomous vehicles), manufacturing (robotics), retail (e-commerce), finance (e-payments, trading strategies), media (social networks), health (diagnostics, telemedicine), education (online learning), public administration (e-governance, e-voting), and more recently, clerical, drafting, research and creative work (generative AI), as well as other fields in science and technology. Digital technologies can raise productivity, lower production costs, reduce emissions, expand access, dematerialize production, improve matching in markets, enable the use of big and unconventional data, and make public services more readily available. They can also improve resource use efficiencies, support the circular economy, enable zero-carbon energy systems, help monitor and protect ecosystems, and assume other critical roles in support of the SDGs. Yet the disruptive nature of new technologies calls for deliberative exchanges and consultations with multiple stakeholders and careful assessment of distributional impacts and trade-offs. Countries face different challenges depending on the maturity of their digital infrastructure and technologies. Less-connected countries especially need to invest to provide widespread, affordable internet access and promote digital literacy. Yet issues surrounding privacy, cybersecurity, egovernment, digital inclusion, and the robustness of digital regulatory frameworks concern all countries. The Transformation 6 scorecard builds on the World Bank's Digitalization for Development policy framework (World Bank, 2022). It aims to capture efforts made to strengthen digital infrastructure, data security, and government platforms and services, as well as the promotion of key enablers such as digital literacy and privacy and inclusiveness (including bringing a social and gender perspective to digital and technology policies). For now, the scorecard captures a subset of these different elements: we aim to improve

coverage over time. UN DESA's Online Services Index assesses the quality of government provision of online services; the ITU's ICT Regulatory Tracker is a composite score of regulatory and competition framework for the ICT sector; UNCTAD's Global Cyberlaw tracker maps legislation on ecommerce, consumer and data protection and cybercrime; and, finally, the Inclusive Internet Index's policy score assesses a set of policies on digital inclusion for women and children and safety and privacy, as well as policies aiming to increase broadband and 5G access. Further analyses will be needed to capture policies and regulations supporting "last-mile inclusion", particularly in relation to financial services and digital literacy, and participation and trust in digital institutions (BCG 2020, Morell-Ducós 2021, Shree, S., Pratap, B., Saroy, R. 2021, CGAP/World Bank 2020). Trackers are also needed to better gauge the quality of internet regulations, measure access to e-government services and evaluate their quality, and to assess government readiness to respond to and to prevent cybersecurity threats.

Summarized: Transformation 6 highlights the significant impact of digital technologies across various sectors, driving productivity, reducing costs, and supporting the SDGs. It underscores the need for universal digital access and literacy, especially in less-connected countries, while addressing challenges like privacy, cybersecurity, and digital inclusion. The transformation is supported by initiatives to strengthen digital infrastructure, promote digital literacy, and ensure inclusive access to digital services. Key tools include policy frameworks and trackers that evaluate digital policies' effectiveness, regulatory environments, and the inclusiveness of internet access. Future efforts will focus on enhancing digital inclusion, particularly in financial services and digital literacy, and improving the quality and accessibility of e-government services and cybersecurity readiness.

Geographic focus transformation

Close the massive financing gap faced by many developing economies. Greatly increase funding for national and subnational governments and private businesses in the emerging economies, especially the low-income countries (LICs) and lower-middle-income countries (LMICs), to carry out needed SDG actions.

Summarized: Geographic focus transformation aims to address the significant financial shortfall hindering developing economies from achieving SDG goals. It advocates for substantially increasing funding to national and subnational governments, as well as private businesses in low-income and lower-middle-income countries, to support essential SDG-related initiatives.

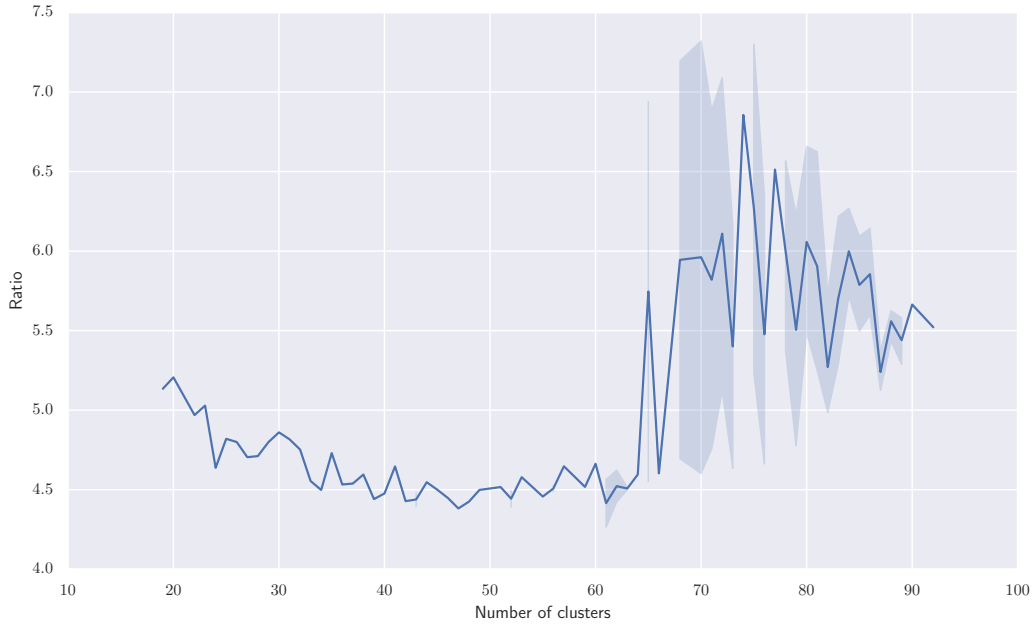
A.2 Best cluster

Table 4: Percentage of N-grams Eliminated Through Best Cluster Approach

SDG	reduction	SDG	reduction	SDG	reduction
SDG1	41.1%	SDG7	87.4%	SDG13	58.1%
SDG2	0.0%	SDG8	0.0%	SDG14	0.3%
SDG3	0.0%	SDG9	0.0%	SDG15	0.3%
SDG4	0.0%	SDG10	27.5%	SDG16	41.8%
SDG5	50.1%	SDG11	0.0%	SDG17	0.0%
SDG6	45.8%	SDG12	0.0%		

Source: Authors' calculations, Amundi Investment Institute.

Figure 9: Choice of the Best Cluster



Source: Amundi Investment Institute.

A.3 Cluster positive control

Table 5: Positive Control for SDG "Best Clusters"

SDG	Control cluster
1. No Poverty	['poverty eradication actions', 'accelerated investment poverty eradication', 'investment poverty eradication actions', 'investment poverty eradication']
2. Zero Hunger	['nutritious sufficient food', 'nutritious sufficient food year', 'sufficient food', 'sufficient food year', 'sufficient food year round', 'proper functioning food commodity', 'safe nutritious', 'safe nutritious sufficient', 'safe nutritious sufficient food', 'infants safe nutritious sufficient', 'development plant', 'development round', '2030 end hunger ensure', 'infants safe nutritious', 'hunger ensure access people', 'goal end hunger achieve', 'hunger achieve food', 'hunger achieve food security', 'food security improved nutrition', 'food year round', 'food year round target', 'hunger ensure access', 'including infants safe nutritious', 'end hunger achieve food', 'end hunger ensure access']
3. Good Health and Well-being	['affordable essential medicines', 'affordable essential medicines vaccines', 'health care services', 'essential medicines', 'essential medicines vaccines', 'quality essential health', 'quality essential health care', 'quality affordable essential medicines', 'access affordable essential medicines', 'health care services access', 'health care services including', 'essential health', 'essential health care', 'essential health care services', 'essential medicines vaccines accordance', 'essential medicines vaccines target']
4. Quality Education	['effective learning', 'leading relevant effective', 'learners acquire knowledge', 'learning environments', 'learning environments target', 'learning opportunities', 'learning opportunities target', 'learning outcomes', 'learning outcomes target', 'leading relevant effective learning', 'lifelong learning opportunities', 'jobs entrepreneurship target', 'lifelong learning', 'lifelong learning opportunities target', 'relevant effective learning', 'relevant effective learning outcomes', 'inclusive effective learning', 'inclusive effective learning environments', 'education sustainable', 'education target', 'effective learning environments', 'effective learning environments target', 'effective learning outcomes', 'effective learning outcomes target', 'education leading relevant', 'education leading relevant effective', 'entrepreneurship target']
5. Gender Equality	['empower women', 'achieve gender equality empower', 'gender equality empower women', 'gender equality empower', 'equality empower women', 'equality empower']
6. Clean Water and Sanitation	['water sanitation management', 'water sanitation target', 'water sanitation related activities', 'water sanitation related']
7. Affordable and Clean Energy	['infrastructure clean energy', 'infrastructure clean energy technology', 'energy infrastructure clean']
8. Decent Work and Economic Growth	['protect labour', 'promote safe', 'promote sustainable', 'promote sustained', 'jobs promotes', 'pay work equal', 'work equal', 'rights promote', 'strengthen capacity', 'support developing', 'safe secure', 'secure prohibition', 'secure working', 'target achieve', 'taking lead', 'support productive', 'sustained inclusive', 'disabilities equal', 'achieve higher', 'achieve productive', 'growth productive', 'immediate effective', 'goal promote', 'goal promote sustained', 'growth accordance', 'growth annum', 'inclusive sustainable', 'innovation encourage', 'improve progressively', 'encourage expand', 'focus high value', 'focus high', 'eradicate forced', 'expand access']

Continued on next page

Table 5 –continued from previous page

SDG	Control cluster
9. Industry, Innovation and Infrastructure	['inclusive sustainable industrialization', 'promote inclusive sustainable industrialization', 'sustainable industrialization', 'policy environment inter alia', 'raise industry share employment', 'raise industry share', 'research innovation developing countries', 'infrastructure support economic development', 'target enhance scientific research', 'upgrade technological capabilities industrial', 'sustainable industrialization foster innovation', 'sustainable industrialization foster', 'sustainable increased resource use', 'support economic development human', 'support economic development', 'support domestic technology development', 'support african countries developed', 'inclusive sustainable industrialization foster', 'foster innovation target develop', 'foster innovation', 'development human focus', 'industrialization foster innovation target', 'industrialization foster innovation', 'economic development human focus', 'economic development human', 'economic development', 'development human focus affordable', 'environment inter alia', 'environment inter alia industrial', 'encouraging innovation substantially', 'enhance scientific research upgrade', 'enhance scientific research', 'encouraging innovation substantially increasing']
10. Reduced Inequality	['social protection policies', 'social protection', 'wage social protection policies', 'wage social protection', 'fiscal wage social protection']
11. Sustainable Cities and Communities	['public transport', 'transport special attention needs', 'urban rural', 'urban rural areas', 'settlement planning', 'rural areas', 'special attention needs', 'basic services', 'basic services upgrade', 'housing basic', 'housing basic services', 'housing basic services upgrade', 'human settlement planning']
12. Responsible Consumption and Production	['sustainable consumption production patterns', 'practices integrate sustainability', 'practices integrate sustainability information', 'programmes sustainable consumption', 'programmes sustainable consumption production', 'lifestyles harmony', 'lifestyles harmony nature', 'lifestyles harmony nature target', 'people relevant information awareness', 'sustainable practices integrate sustainability', 'sustainable patterns consumption production', 'tools monitor sustainable development', 'technological capacity sustainable patterns', 'transnational companies adopt sustainable', 'sustainable patterns consumption', 'relevant information awareness', 'sustainable patterns', 'sustainability information', 'sustainable accordance national policies', 'sustainable development impacts sustainable', 'sustainable development lifestyles', 'sustainable development lifestyles harmony', 'sustainable management efficient use', 'capacity sustainable patterns consumption', 'companies adopt sustainable', 'capacity sustainable patterns', 'awareness sustainable development', 'awareness sustainable development lifestyles', 'action developed countries', 'harmony nature target', 'health environment target 12', 'human health environment target', 'impacts sustainable tourism', 'global food', 'global food waste', 'global food waste retail', 'information awareness', 'information awareness sustainable development', 'development lifestyles harmony', 'development lifestyles harmony nature', 'development lifestyles', 'development impacts sustainable tourism', 'development impacts sustainable']
13. Climate Action	['operationalize green climate', 'operationalize green climate fund', 'fully operationalize green climate']
14. Life Below Water	['use oceans', 'sustainable use oceans resources', 'oceans resources', 'use oceans resources', 'oceans seas', 'oceans seas marine', 'oceans seas marine resources', 'oceans target 14 minimize', 'oceans target', 'productive oceans target', 'productive oceans target 14', 'oceans resources recalled', 'ocean health', 'ocean health enhance', 'oceans resources implementing', 'sustainably use oceans seas', 'use marine resources', 'use oceans resources implementing', 'use oceans resources recalled', 'use oceans seas', 'use oceans seas marine', 'sea provides', 'seas marine', 'seas marine resources', 'seas marine resources sustainable', 'coastal ecosystems', 'healthy productive oceans target', 'fishers marine resources']

Continued on next page

Table 5 –continued from previous page

SDG	Control cluster
15. Life on Land	['particular forests', 'particular forests wetlands', 'particular forests wetlands mountains', 'mountain ecosystems including biodiversity', 'land water ecosystems control', 'inland freshwater ecosystems services', 'management types forests halt', 'mountain ecosystems', 'mountain ecosystems including', 'mountains drylands', 'mountains drylands line', 'mountains drylands line obligations', 'management types forests', 'water ecosystems control', 'wetlands mountains', 'wetlands mountains drylands', 'wetlands mountains drylands line', 'wildlife products', 'types forests halt', 'use terrestrial ecosystems', 'services particular forests', 'services particular forests wetlands', 'significant resources sources levels', 'conservation mountain', 'conservation mountain ecosystems', 'conservation mountain ecosystems including', 'freshwater ecosystems services', 'freshwater ecosystems services particular', 'genetic resources', 'forests wetlands mountains drylands', 'forests wetlands mountains', 'forests substantially increase', 'drought floods', 'drylands line', 'ecosystems control', 'ecosystems including', 'ecosystems services', 'ecosystems services particular', 'ecosystems services particular forests', 'desertification restore', 'ensure conservation mountain ecosystems']
16. Peace and Justice Strong Institutions	['justice build effective accountable', 'justice build effective', 'access justice build effective', 'access justice build']
17. Partnerships to achieve the Goals	['poor countries reduce debt', 'income official development assistance', 'indebted poor countries reduce', 'indebted poor countries', 'indebted poor', 'macroeconomic stability including policy', 'macroeconomic stability including', 'macroeconomic stability', 'long term debt sustainability', 'long term debt', 'tax revenue', 'tax revenue collection target', 'term debt sustainability coordinated', 'term debt sustainability', 'term debt', 'revenue collection target 17', 'relief debt restructuring appropriate', 'relief debt restructuring', 'relief debt', 'reduce debt distress', 'reduce debt', 'revenue collection target', 'gross domestic product support', 'cent gross national income', 'capacity tax revenue collection', 'capacity tax revenue', 'capacity tax', 'complement gross domestic product', 'attaining long term debt', 'address external debt highly', 'aimed fostering debt financing', 'countries reduce debt', 'countries reduce debt distress', 'external debt highly indebted', 'external debt highly', 'highly indebted', 'highly indebted poor countries', 'highly indebted poor', 'global macroeconomic stability including', 'fostering debt financing debt', 'financing debt relief debt', 'financing debt relief', 'financing debt', 'debt sustainability coordinated', 'debt sustainability', 'debt restructuring appropriate address', 'debt highly indebted', 'debt restructuring appropriate', 'debt restructuring', 'debt relief debt restructuring', 'debt relief debt', 'debt relief', 'debt highly indebted poor', 'debt highly', 'debt financing debt relief', 'debt financing debt', 'debt financing', 'debt distress target 17', 'debt distress target', 'debt distress', 'domestic capacity tax', 'domestic capacity tax revenue', 'duty free quota']

Source: Authors' calculations, Amundi Investment Institute.

A.4 RavenPack events

According to RavenPack (2014) on their event extraction:

- An extensive map of the relationships between entities is also employed to provide more context, to enhance precision and recall, and to reduce ambiguity. This allows the system to make inferences and to detect entities in creative ways.
- Relevant stories about entities are classified into a set of predefined event categories following the RavenPack taxonomy. This taxonomy of over 2000[6] market-moving events is highly granular and allows the identification of the roles played by the individual entities participating in an event.
- In order to be able to detect events [...], it is fundamental to understand the facts in text. The detection technology analyzes the context around the mentions of entities and extracts many different facts, the combination of which allows rules to match and events and roles to be detected. Ranking the information content from these facts also allows the key event to be confidently identified.
- RavenPack has developed an algorithm for computing relevance for the entities that have been detected in a document. Any entity that is detected playing a central role in a story, e.g. a company announcing bankruptcy, automatically gets the highest possible relevance. Any entity that is detected playing a peripheral role in an event, e.g. a rating agency or a news agency, will explicitly get a low relevance.

[6] RavenPack Edge has over 7000 market-moving events as of May 2024.

A.5 Cooperation taxonomy and ODA recipient countries

Table 6: Filters on RavenPack Events

Filter	**Filter content**
"cooperation" taxonomy	"north-south", "south-south", "quota free", "comparative advantage", "cptpp", "north-south cooperation", "south-south collab", "north-south collab", "south-north collab", "import competition", "trade", "fdi", "exit consent", "primary balance", "scheme of arrangement", "borrower", "external debt", "north-south partnerships", "north-south collaboration", "foreign aid", "official development assistance", "development assist", "partner countr", "regional collab", "cross-border", "south-north", "ppp project", "nafta", "usmca", "afcfta", "foreign entry mode", "isds", "investor-state dispute settlement", "trade liberali", "trade facilit", "agreement", "trading facilit", "trading barrier", "duty free", "trade sanction", "trading sanction", "ppp contract", "pp project", "pp participation", "ppp coop", "b&r initiative", "wto", "south-south cooperation", "debt restruct", "debt struct", "sovereign default", "paris club", "fdi inflow", "hipc initiative", "hipc", "financ distress", "fiscal recover", "international cooperat", "triangular coll", "triangular coop", "preferential term", "favourable term", "regional cooperat", "united states-mexico-canada agreement", "regional comprehensive economic partnership", "belt & road initiative", "public-private participation", "private-public participation", "public-private project", "private-public project", "business improvement district", "foreign investment", "foreign direct investment", "public-private coop", "international cooperation", "public-private partnership", "private-public partnership", "development cooperation", "public partnership", "civil society partnership", "trans-pacific partnership", "comprehensive AND progressive agreement for trans-pacific partnership", "south-south co-operation", "global-supply chain", "economic partnership agreement", "sovereign debt restruct", "sovereign debt struct", "highly indebted poor countries initiative", "developmental aid", "international development cooperation", "bilateral aid", "non government development organi", "north-south research partnerships"
ODA recipient countries	"afghanistan", "albania", "algeria", "angola", "argentina", "armenia", "azerbaijan", "bangladesh", "belarus", "belize", "benin", "bhutan", "bolivia", "bosnia", "bosnia AND herzegovina", "botswana", "brazil", "burkina faso", "burundi", "cabo verde", "cape verde", "cambodia", "cameroon", "central african republic", "chad", "china", "china (people's republic of)", "colombia", "comoros", "congo", "costa rica", "cuba", "cote d'ivoire", "north korea", "democratic people's republic of korea", "democratic republic of the congo", "djibouti", "dominica", "dominican republic", "ecuador", "egypt", "el salvador", "equatorial guinea", "eritrea", "eswatini", "ethiopia", "fiji", "gabon", "gambia", "georgia", "ghana", "grenada", "guatemala", "guinea", "guinea-bissau", "guineabissau", "guyana", "haiti", "honduras", "india", "indonesia", "iran", "iraq", "jamaica", "jordan", "kazakhstan", "kenya", "kiribati", "kosovo"

Source: Bedard-Vallee *et al.* (2023), OECD, Amundi Investment Institute.

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