Indexing change

Understanding MSCI thematic indexes

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Executive summary

Thematic investing is a top-down approach to investment that is garnering much interest among institutional and retail investors alike. Some active managers view it as a way to express and demonstrate their stock-selection skill. Meanwhile, a range of indexed products has grown quickly that facilitate ways for investors to gain exposure to themes that may have the potential to re-shape the market, economic and human environment for many years. Some of the trends investors seek to follow, whether through indexed products or funds, are familiar from long-held debates on demographics. Others rely on the dramatic and disruptive impact of new technologies that have only truly played out in the last five years. This approach has changed how certain investors position sector and growth funds, while some of the largest pension funds now have explicit capital allocations to thematic investment teams.

MSCI has now launched nine thematic indexes spanning a broad selection of such trends. These indexes can be the basis of indexed product for investors who have a strong view on the dominance of a particular theme. Equally, they can be used as benchmarks to assess active manager skill for thematic funds. The implementation we have adopted to capture thematic trends also allows investors to analyze an index to see which trends it is exposed to deliberately or inadvertently, to gauge an index for the influence of sub-themes on its construction and to explain its performance from a thematic perspective.

In this paper, we review the concept of thematic investing and the differences between it, and the factor and ESG[1] investment processes. We describe how we have accelerated the research element in developing a thematic index by first building a keyword dictionary from each index objective. We do this using a range of Natural Language Processing techniques (NLP) to gather related concepts, products and services. Within the index methodology, we use this keyword dictionary as an input to identify representative constituents based directly on their financial filings and/or indirectly on information describing their business. We can associate a measure of economic linkage to each such company – a metric we term the "relevance score." It is this relevance score that allows us to select companies with the desired exposure for an index. More generally, it also enables measurement of the thematic exposure of a given portfolio to one of the MSCI theme or carry out a Brinson-style thematic performance attribution.

[1] Environmental, social and governance

What is thematic investing?

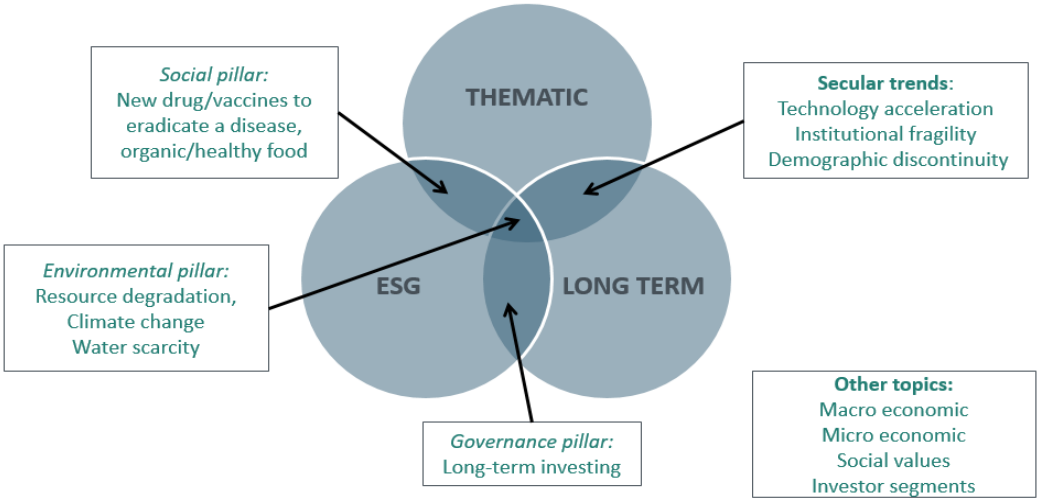
Thematic investing is a top-down investment approach that seeks to identify longer-term, structural trends that are expected to be dominant and important explanatory performance factors in a rapidly-changing world. Broadly speaking, it is aimed at identifying emerging macro-economic, geopolitical and technological trends that are believed to be structural and transformative in nature and hence expected to influence society's behavior and needs over the long term. Such investing strategies are, by their nature, unlikely to be constrained by geographic or traditionally rigid approaches of business or industry classification of companies. A thematic investment process typically focuses on finding companies that may be well positioned to take advantage of the emerging theme and its effect on market conditions. Thematic investing may also offer an alternative for analyzing the market beyond region, country, sector, ESG or factor investing frameworks (Exhibit 1).

Thematic investing differs from investing based on short-term cyclical trends or topical fads. It is a forward-looking investment approach in which the investment process focuses on how the world around us is changing and how the changing world will likely impact businesses and companies. Thematic investing also differs from a focus on narrow stock picking. The thematic approach usually relies on a top-down perspective: first precisely articulating the investment objective and then selecting a diversified basket of companies that may benefit from the wider adoption of the theme, and from the themes playing out.

Thematic investing also differs from factor investing. The foundation of factor investing is based on past equilibria observed and validated through historical data. This data are often found in fundamental sources such as companies' financial statements. A thematic approach is more forward-looking and so effectively relies on the emergence of new equilibria, arising out of new business models, disruptive technologies or changing consumer tastes and behaviors. The data considered for expressing thematic strategies may, therefore, be a combination of financial and non-financial data, for established and early-stage corporate activities, and related to both the tangible and intangible assets of a company.

There is also an abundance of academic literature[2] and practitioners' work[3] that sheds further light on the concept of thematic investing.

Exhibit 1: Thematic investing



The growth of thematic investing

Recently reported statistics illustrate the rapid rise of interest in thematic investing over the last few years. Global X estimated there were 119 U.S.-listed thematic exchange-traded funds (ETFs) as of the end of end Q3 2019, representing assets under management (AUM) of c. USD 25.1 billion.[4] Further, Novethic identified 147 thematic investing funds at the end of 2018 representing EUR 36 billion, up by 18% compared to 2017.[5] Lastly, Morningstar estimated that in 2018, thematic ETFs in Europe quadrupled from four to 16 while annual inflows jumped from c. GBP 158 million in 2014 to c. GBP 1.8 billion in 2018.[6]

[2] For example, "Better than Sectors: Thematic Investing", Journal of indexes, August 2009; "Promoting Sustainability Using Passive Funds", Journal of Index investing, Fall 2019.

[3] For example, "The definition of thematic investing", Blue and Green Tomorrow, September 2011;"What is thematic investing", FT Adviser, May 2013; "Investing In Tomorrow – A Whitepaper On Thematic Investing", Global X, February 2018; "From indexes to insights: The rise of thematic investing", McKinsey & Company, December 2014

[4] "Thematic ETF Report Q3 2019", Global X, October 2019

[5] "The Novethic Indicator", April 2019.

[6] "What is driving the boom in thematic ETF launches?", ETF Stream, March 2019

Our consultations with institutional investors over the last two years have indicated a wide range of objectives and motivations in the adoption of a more thematic approach to investment. We outline below the investment problems they face that they described to us in more detail.

- *How can emergent themes be investable for large asset owners?*
  Thematic investing is often aimed at seeking to identify potential future corporate winners and market disruptors. When identifying such companies at an early stage, institutional investors have treated thematic investing as an overlay of their core existing allocations (a "satellite" approach).
- *How can investors meet their return objectives?*
  Given the allied long-term liabilities, institutional investors such as pension funds seek to invest in assets that may yield long-term returns by looking beyond short-term trends in the market. Investing capital explicitly based on their assessment of structural demographic trends or critical environmental challenges has been of interest to them as potentially a better match to their liability streams.
- *How can medium and long-term risks be hedged?*
  Institutional investors also indicated they face the impact of long-term risks. For example, in 2014, Norway's sovereign wealth fund announced it would boost its investments in clean energy and renewables to hedge an expected long-term decline in the country's oil revenues.[7] Others have adjusted their investment allocations to reflect their assessment of the physical risks of climate change and the economic and business implications of a transition to a lower carbon society. Some have considered which platforms and technologies they believe will dominate, and so which business/delivery models may be "stranded".
- *Are there alternative ways to diversify or measure diversification?*
  Historically, geographic, sectoral, size- and style-based diversification have played major roles in portfolio and index construction. However, during the 2008 global financial crisis and other times of market stress, correlations between these conventional groupings have risen. Assessing a portfolio through the lens of thematic groupings offered other insights in a diversification analysis.
- *Do growth vs. value and sector allocation models need to evolve?*
  The investment process of some institutional investors has involved allocation decisions about sectors and the mix between growth and value. However, positive views on value might, more recently, be considered as short-term views against disruptive technologies, for example. A growth fund might be reassessed

[7] "Norway's Sovereign Wealth Fund To mandate Investment IN Renewable Energy", Think Progress, March 2014

as a multi-theme fund with exposure to the momentum factor. Other themes may point to the potential evolution of the current industry classification schemes on which sector funds are usually based.

What are the challenges of thematic investing?

Whatever the particular motivation for adopting a thematic investment perspective, we can describe some common challenges:

- **Distinguishing trends from fads or other short-term drivers:** Cyclical changes in monetary or fiscal policy, for example, are important to investors but have not often represented a paradigm shift in market forces and were more likely to be transient in nature. On the other hand, the impact of disruptive technologies, for example, may be more likely to play out over the longer-term and thus represents a structural trend. We believe there are two key attributes that real trends must possess: first, long-term potential for growth and disruption of existing business models and, second, the scope for wide market adoption.
- **Stock selection:** Identifying the potential economic beneficiaries of a theme is another challenge. Since themes are often forward-looking, their relevance to a company's business is not easily reflected in historical data. A stock selection process cannot likely rely only on financial data alone: key evidence may be found in non-financial and less structured data sources such as filings, news analyses, and other media. It may also be difficult to identify stocks that will be part of a trend's sustainable growth rather than perhaps only provide low-cost access and infrastructure for second-round participants. (The latter was the role of 19th century railroad stocks and internet bubble fiber-optic companies.)
- **Identifying *investable* themes:** Not all thematic trends may be investable. Although space travel[8], for instance, might be considered a long-term theme, there do not yet exist enough public companies that stand to benefit in the long-term to create diversified exposure. In contrast, themes such as ageing societies and clean energy have not only seen early adoption but also appear to have supportive demographic and regulatory tailwinds - and classes of investors for whom such an exposure is already a natural aspect of their investment approach

[8] While there are a few ETFs that track aerospace and defense themes and by extension, space exploration, none is available to seek pure exposure to commercial space travel in a diversified way. "7 ETFs That Allow You to Invest in Space", US News, March 2017.

(e.g., changes to the population age profile and the impact on consumption may interest a pension fund manager).

- **Scope of the theme:** To articulate the theme as an investment objective, investors often ask themselves whether they are only interested in companies that are direct beneficiaries of the theme, only "pure plays" associated with a theme, or whether they wish to capture companies in the entire value chain that may have a less direct association. For example, should an investment process for robotics companies also consider companies manufacturing precision instruments and high-speed gears for such robots?
- **Assessing a thematic strategy:** How should the strength of the strategy's exposure to the theme be measured relative to a cap-weighted benchmark or other proxy? For systematic approaches, what length of backtest or exposure assessment might be informative? For emergent themes, how useful is an evaluation over a period when the theme was likely not even in play? To what extent does the expression of the investment objective into products and services benefit from hindsight? There may not always be enough historical data to validate the theme in a traditional way. Indeed, the performance of a fixed basket of current securities may provide a better guide for prospective risk and return than a true point-in-time history.
- **Entry and exit:** Although the nature of long-term investing has largely mitigated the adverse impacts of incorrect entry and exit points, timing thematic investments may be a challenge. What extent of market adoption is enough to justify entry at a given point? How robust is the investment trend to shorter-term market volatility? For example, how might timing considerations be affected by a short-term cyclical or trade-war motivated sell-off in technology stocks?

Typical investment models for thematic investing

There are many different models for applying a thematic investing perspective to the market. Whether wrapped in an ETF or an exchange-traded note (ETN), a structured note or derivative product, thematic investing products can take various forms.

Thematic investing is not just on the radar of institutional investors. High-net-worth investors have also increasingly looked beyond traditional asset allocation with an

eye on themes such as sustainable development and infrastructure.[9] How has a thematic perspective been integrated with some common investment approaches?

- **Core allocations:** Institutional investors who have focused on long-term structural trends may shift their core allocation from its current, market-cap influenced allocation into one more closely aligned with the investor view of future thematic economic winners. This has already been observed widely for investors with strong beliefs in sustainability or climate risk-driven themes.
- **Tactical allocations:** As mentioned earlier, thematic investing is associated with long-term structural trends. However, timing entry and exit against the backdrop of market events can lead to investors acting tactically on a focused investment opportunity, one which may not be so easily expressed through traditional groupings. According to McKinsey such allocations are typically made with the aim of improving risk-adjusted returns.[10]
- **Sector investing:** For some investors, thematic investing has provided a way to sharpen the focus of a sector-based investment by being selective within industries. Exhibit 15 illustrates this idea via the example of the thematic MSCI ACWI IMI Digital Economy Index. The chart shows that the precise thematic exposure was not delivered solely from a single broad sector. For instance, an information technology fund could develop a robotics and automation overlay. For others, the theme may have been the original investment rationale — the availability of a specialized thematic alternative to the sector fund may allow for a closer expression of investor purpose. We can see the various thematic exposures built into the pure GICS® information technology sector[11] in Exhibit 14.
- **Growth investing:** Themes have provided a mechanism for some active managers to express the investment aims of a growth fund. Equally, an explicitly multi-theme index can provide more transparent and consistent exposure to specific growth-oriented investment trends. See, for example, Exhibit 17 for the growth and other factor exposures of selected thematic indexes. The exhibit highlights that certain MSCI thematic indexes such as the MSCI ACWI IMI Digital Economy and MSCI ACWI IMI Disruptive Technology Indexes had high exposure to the growth factor.

[9] "High Net Worth Individuals & Sustainable Investment", Eurosif, 2012. "Using themed ETFS in Portfolios" ETF.com, August 2019.

[10] "From indexes to insights: The rise of thematic investing", McKinsey & Company, December 2014

[11] GICS® refers to the Global Industry Classification Standard. https://www.msci.com/gics

- **Long/short investing:** We focus on long-only thematic indexes in this paper. However, thematic investing has been extended to identifying companies who are expected to be the laggards of a structural theme. Short exposure to the potential laggards[12] has been obtained in a variety of ways, including via derivatives. Retail fund launches that have favored internet platforms instead of brick and mortar stores are a concrete example ("bricks vs. clicks"). Other investor interest has related to sustainability or climate related themes.

The MSCI framework for thematic index construction

In this section, we present the framework used to build the MSCI thematic indexes. It can be used for a diverse range of themes. It provides a flexible research approach, as well as a rule-based, automated and efficient way of calculating different thematic indexes. We also present a case study for one of the nine MSCI thematic indexes.

Characteristics of the framework

The framework was designed with the following characteristics in mind:

- **Rules-based constituent selection:** We seek to avoid judgmental overlays in the constituent selection stage. We wanted to identify and articulate long-term investable themes and build diversified exposures, rather than have a narrow focus on stock-picking. We wanted to build the thematic exposures directly – from the idea to the constituent. We do not rely on reverse engineering stock inclusions from an existing, rigid industry classification. We have calibrated the keyword matching rules and relevance score calculation, and by selection of an appropriate eligibility hurdle, we aim to balance the desire to include more than pure plays against the need to control false positives.
- **Global coverage:** Consistent with the unconstrained philosophy of thematic investing, we review a global (as opposed to U.S.-focused) coverage universe of large mid-cap and small-cap stocks for our thematic indexes. We avoid a sole dependence on business information direct from corporate filings.
- **Robust methodology:** Emergent themes are at the heart of thematic investing. By definition, these are likely to evolve over time. The MSCI framework was designed to keep up with the evolution of the theme: not just via semi-annual rebalances, which allow for the evaluation of new business

[12] See, for example, "Global Thematic Long/Short Fund Strategy", Mirante Fund Management January 2019

line disclosure and business description information, but also via an evolution of the theme's defining characteristics and the potential change to the keywords generated.

- **Scalable and flexible** – The framework is not constrained by the unavailability of formal company filings in English and can build exposure from global equity markets. The framework is also flexible and can be applied to a diverse range of themes. The framework is highly customizable and can be quickly adapted to calculate custom index strategies.
- **Leveraging new technologies –** The framework can be used to construct thematic indexes efficiently by reducing the time and effort spent on building familiarity with the themes and the businesses associated with the theme. The framework uses machine-learning techniques to build a dictionary of relevant words associated with the theme and can thereby quickly translate an index objective into a thematic index. This helps reduce the reliance on subject matter experts for each theme and help us identify a robust starting point from which to select potential beneficiaries of these emergent themes.

Framework overview

The indexes are constructed by selecting stocks from the MSCI ACWI IMI based on the following five steps. First, in the research phase, we breakdown the thematic index's objective and thereby generate a set of keywords to help identify potential beneficiaries of the theme, reflecting business activities, products and services. These keywords (words, phrases) are reviewed for soundness in a quality assurance process. Second, we scan companies' self-declared business line names and publicly-sourced business description information to find matches with these keywords to arrive at an eligible universe of stocks. Third, we calculate a metric (the relevance score) for each stock in the eligible universe to quantify their economic linkage to the theme under consideration. Fourth, constituents from the eligible universe are selected by imposing a hurdle rate for the relevance score and systematically applying filters to reduce the risk of potential false positives. Finally, a weighting mechanism is applied to the selected universe to construct the final thematic index.

Building a keyword dictionary

We begin by articulating the index objective to reflect the chosen theme. This objective should include high-level business areas associated with the theme and for broader (e.g. demographic) themes, outline the key sub-ideas that comprise it. The objective text provides the "seedwords" for building of the keyword dictionary.

The keyword dictionary dataset is a key output of the research process and is accelerated by leveraging natural language processing techniques. This process is known as "topic modelling" within the NLP literature. We translate and expand an index objective into a set of relevant words ("keywords") that are representative of the objective. These keywords are then used to shortlist the stocks related to the theme of interest within the index methodology.

Exhibits 2 and 3 illustrate the keyword data generation process. The three steps after the selection of the seedwords are as follows.

Develop a document collection: Using the seedwords, we assemble a suitable collection or "corpus" of documents for building the desired word associations. We access English language documents via open-source search api[13] such as Google and Wikipedia. The corpus is put together from the text of the top search results.

Document topic modeling: We developed a customized *term frequency–inverse document frequency* (tf-idf)[14] weighting to screen across the documents for potential keywords. Tf-idf weighting is a standard class of metrics in NLP topic modeling. Its two components balance word popularity against a gauge of relevance: the phrase's popularity in a document versus the inverse proportion of that word over the entire corpus. This method helps identify the words in a document that contain the most material information. The tf-idf metric assigns a weight to every word (and combinations or "n-grams") with higher weights allocated to potential keywords.

Measure alignment with the objective: We calculate the *contextual similarity score* between the potential keywords derived in step two, and the seedwords. This step is important, as it helps ensure the selected keywords have a "linguistic closeness" or linkage to the index objective. The seed words and keywords are first converted into their "word embeddings"[15] using MSCI and third-party[16] word embedding models and thus each becomes represented by a long vector of numbers. Once the words or phrases are represented by such vectors, we can gauge how aligned they are in meaning by measuring whether the two representative vectors are pointing in a similar direction. We do this by calculating a "cosine similarity" score[17] between the

[13] Application Programming Interface

[14] Wikipedia TF-IDF

[15] Wikipedia Word Embedding

[16] Bert Embedding Documentation

[17] Wikipedia Cosine Similarity

seedword and the keywords. Potential keywords with high similarity scores are selected for review as the final set of keywords for matching.

Exhibit 2: From index objective to a keyword dictionary

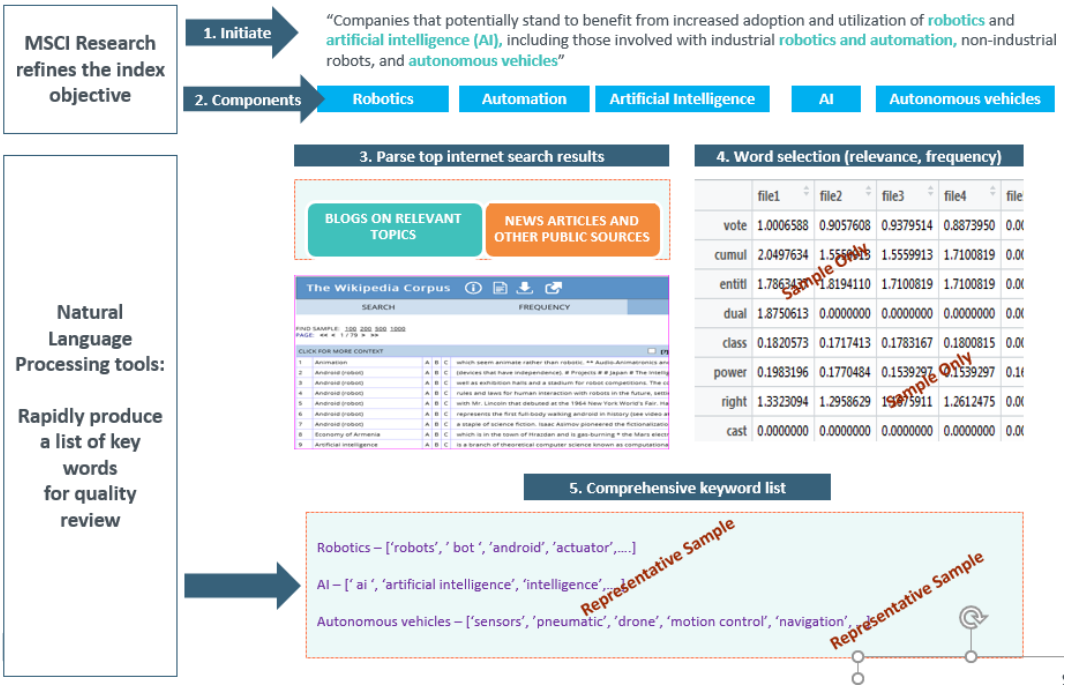
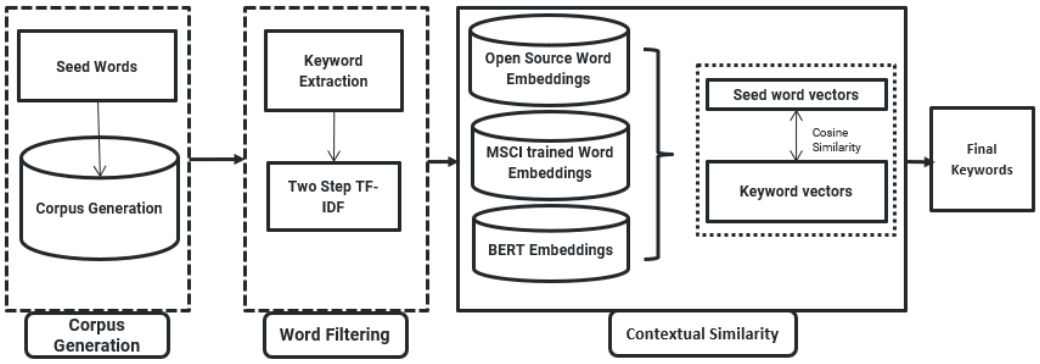


Exhibit 3: Keyword generation process overview



Constituent selection through keyword matching

Constituents are identified for inclusion by two routes: "direct" and "indirect". Stocks may also qualify for inclusion in the index through a combination of both.

Direct inclusion relies on keyword matching against the business line ("business segment" or "segment") descriptions as given by the company for its range of operations. The MSCI business segment description information is derived from integrating company annual reports and multiple vendor data sources, business segment names, assigned SIC codes[18] and related revenue. Exhibit 4 includes an example of such business segment names and associated SIC codes. For stocks included via this route, we consider the entire identified segment economically relevant to the theme.

Indirect inclusion may be achieved when we have distinct keyword matches against a company's business description information. If the chosen company has any business segments with SIC codes assigned that are already used by any companies eligible via the direct route, then that revenue line is also considered linked to the theme. This approach allows us to include companies where the thematic linkage reflects more upstream involvement such as capex and investments or revenue streams yet to be recognized in a distinct filing segment. It also allows us to assign segment revenues for companies that only file a regional breakdown of sales.

However, to adjust for the greater uncertainty in such a link, we downweight the assigned revenue using a discount factor. This scaling, which ranges from zero to one, reflects the relative density of keyword hits within the business description information. For example, a company for which the hits are sparse in a very long text would see the linked revenue scaled down more strongly.

Exhibit 4 – Relevance score calculation for an automobile sector company

Segment names	SIC code	Sales (USD millions)	Incl. via direct route?	Incl. via indirect route?	Discount factor	Attributable sales (USD millions)
Automotive seating	*3714*	*8,503*		*Yes*	*0.63*	*5,396*
Interior systems	*3714*	*6,255*		*Yes*	*0.63*	*3,969*
Clean mobility	***3714***	***5,276***	***Yes***		***1.00***	***5,276***
Other	*9999*	-			*0.00*	-
Unallocated	*9999*	-			*0.00*	-
Total		20,033				14,641

Relevance score = 73%

[18] Business segments are assigned an SIC (Standard Industry Classification) description and 4-digit code for its products and services. The schema originated with US government agencies (and can be seen e.g. in SEC filings). It is widely used by data vendors and by quantitative asset managers to allow comparison of company-assigned business segment names

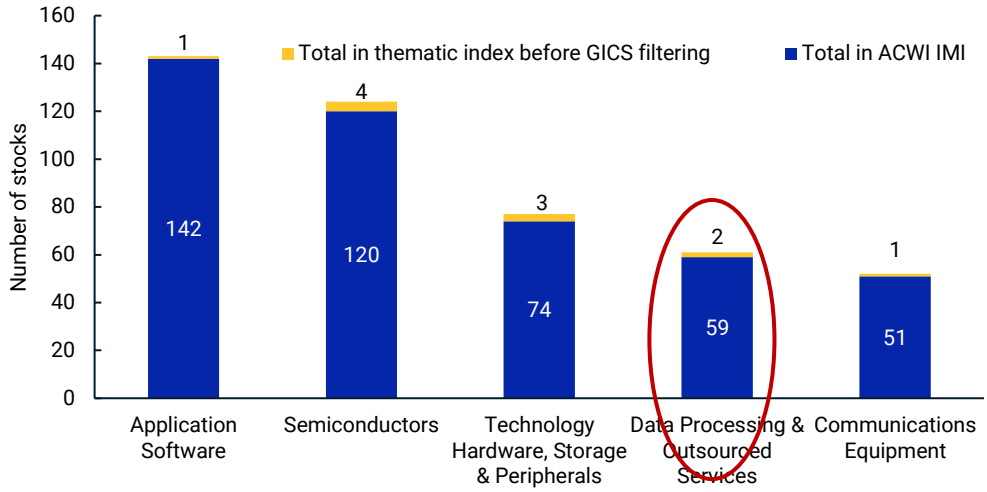
Exhibit 4 illustrates the calculation of a stock's relevance score. We see how revenue identified by the direct route is fully included in the calculation. However, revenue from the indirect route is adjusted downward before it is accounted for in the relevance score. In our standard MSCI thematic indexes, we consider stocks with a relevance score above 25% as eligible to be an index constituent.

Controlling for false positives

The application of a discount factor to selected revenues for a potential constituent coming through the indirect route is one example of our systematic approach to controlling for false positives. Within a specific thematic index methodology, we may additionally apply some GICS® sub-industry filtering of the eligible constituents. We use such filters sparingly and some thematic index methodologies (e.g. the MSCI ACWI IMI Robotics Index) omit such screens.

As discussed, thematic investing is often considered unconstrained by traditional market groupings. Hence the extensive use of an established and rigid classification scheme reflecting current industrial activity to represent a thematic opportunity set can seem fundamentally inconsistent with that objective for some investors. We therefore tread lightly. We only exclude sub-industries if our research has indicated that the balance of signal-to-noise is such that the likely companies to be tagged as keyword hits are overwhelmingly expected to be unrelated.

Exhibit 5 – Examples of impact of GICS filtering on potential "true" selections



Data as of May 29, 2019

Exhibit 5 illustrates the impact of GICS subindustry filtering on the MSCI Ageing Society Opportunities Index. We display the number of stocks in the prescreened universe with a relevance score higher than 25% for each subindustry of the information technology sector (as of May 29, 2019)—the ringed subindustry is the only excluded subindustry in the index methodology. The chart illustrates the small percentage of stocks dropped from the index due to the GICS filtering step.

Weighting a thematic index

Not all popular index weighting schemes are suitable for thematic index construction. Some pros and cons are shown in Exhibit 6.

Exhibit 6: Pros and cons of weighting schemes for thematic indexes

Weighting scheme	Pros	Cons
Equal - weighted	Simple; Diversified exposure to stocks linked to theme	Limits index capacity; Weak exposure to underlying theme
Cap-weighted	Investability Liquidity	Overweights large stocks with potentially low relevance that may be common to many thematic indexes
Score-weighted	Aligned with theme	May lead to high exposure to small caps

To balance this trade-off between investability and liquidity on one hand and thematic exposure on the other, we adopt a "relevance score tilt" for the MSCI thematic indexes: weighting by the product of their relevance score (which ranges from 25% to 100% for eligible constituents) and their float adjusted market capitalization. The weights are then normalized to 100% and issuer-capped at 5% to reduce concentration.

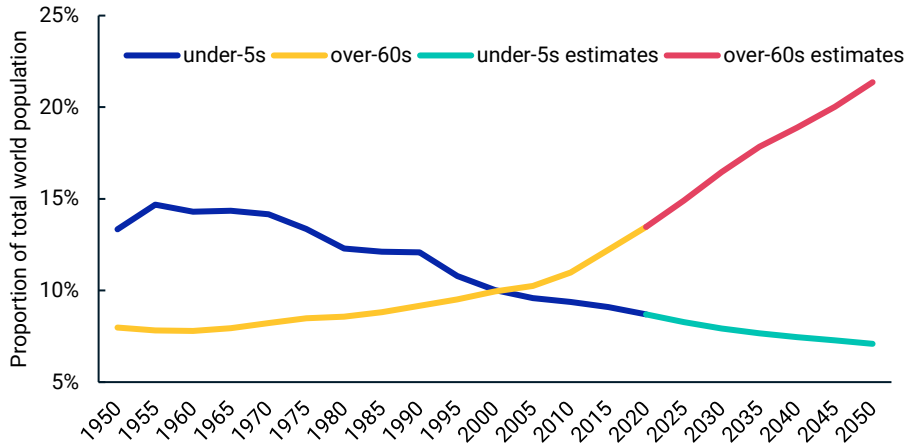
Thematic index construction: Case study

We now present a case study to illustrate how the different aspects of the research process and index methodology played out for a demographics-motivated index – the MSCI Ageing Society Opportunities Index.

As Exhibit 7 shows that for the first time the share of the world's population over 60 exceeds the share of the under-fives and this trend is projected to continue. This ageing population demographic and the increase in accumulated wealth associated

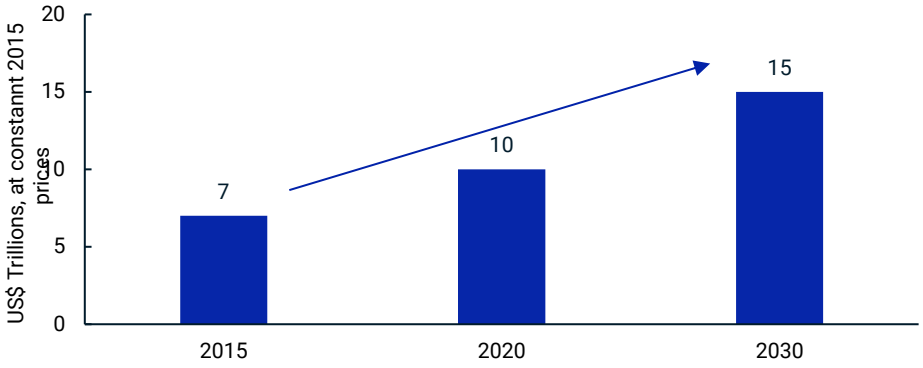
with seniors is expected to lead to a strong increase in the relative spending power of seniors. Exhibit 8 depicts the projection based on two studies that total consumer spending by seniors is expected to more-than-double to USD 15 trillion between 2015 and 2030.[19]

Exhibit 7: World total population—now more over-60 than under five



Source: UN World Population Prospects 2019

Exhibit 8: Projected growth in seniors' consumer spending



Source: US Profile of Ageing 2015, Euromonitor International, Fung Global Retail & Technology.

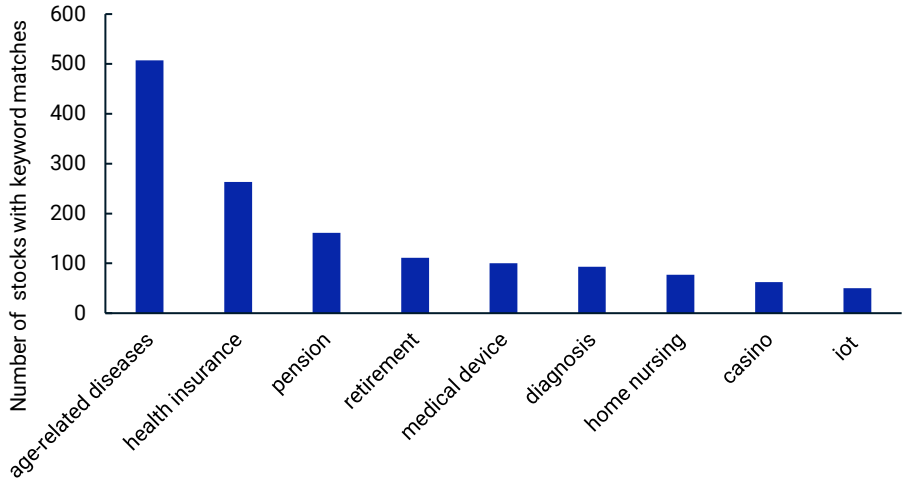
[19] Euromonitor International, Fung Global Retail & Technology "The Silvers Series: Economic Opportunities Arise from the Aging Population", April 2016.

These demographic trends may be of interest to long-term institutional investors. Designed for those investors who believe this relative consumption narrative will be a dominant driver of returns, the MSCI ACWI IMI Ageing Society Opportunities Index is constructed to represent the performance of companies that cater to the health, recreation and lifestyle needs of the older population. Within the index, we identify those related to the business of providing at least one of the following:

- Healthcare services and therapies for age-related diseases such as dementia, cancer, arthritis, loss of hearing, etc
- Senior care housing facilities or assisted living facilities
- Smart housing
- Health insurance and life insurance
- Leisure and tourism services typically preferred by older travelers.
- Age-relevant personal-care products

In this way, companies exposed to this theme through growth in particular healthcare needs, changes in consumption patterns or the necessary supporting financial services are brought into the pool of potential constituents. To illustrate how the range of keywords built from the index objective helps identify companies, Exhibit 9 depicts the number of companies identified by a selection of the keywords corresponding to the previously mentioned subthemes, as of May 29, 2019.

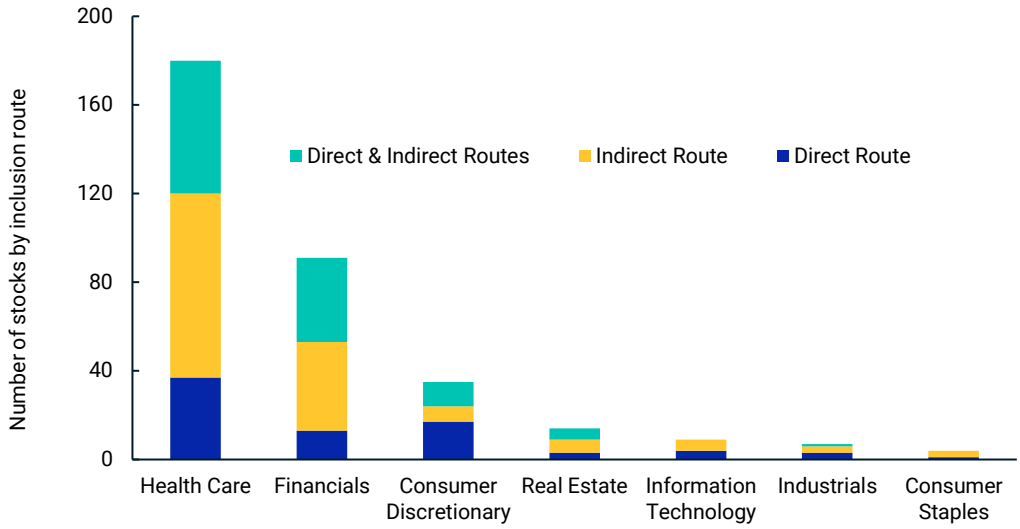
Exhibit 9: Selected leading keywords in constituent identification



Data as of May 29, 2019

We have described the direct and indirect routes for constituent inclusion but in practice, what is the balance between the two? There is a good deal of variation between different thematic indexes. In Exhibit 10, we show that there are strong contributions from both routes – and many companies saw their overall relevance score built up from both.

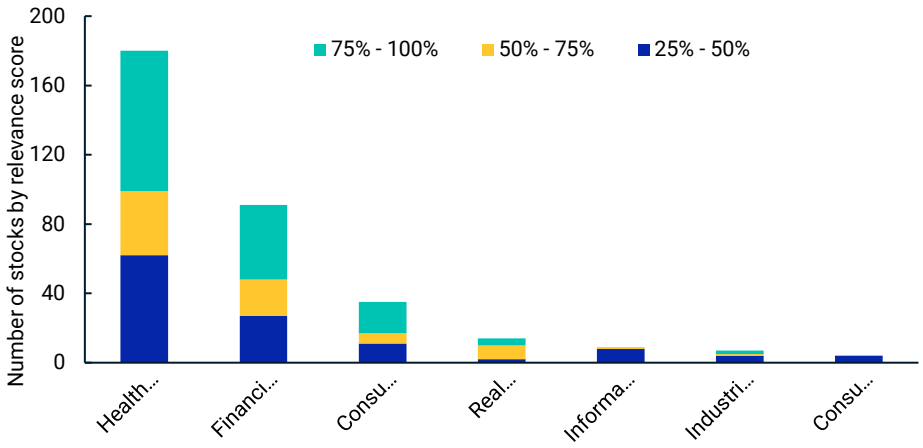
Exhibit 10: Sector-wise distribution of constituents by inclusion route



Data as of May 29, 2019

Taken together with Exhibit 11, we see that exposures were built from a wide range of sectors; from both disclosed business lines as well as more upstream activities; and from a blend of thematic pure plays and currently more diversified companies involved in the value chain of the theme.

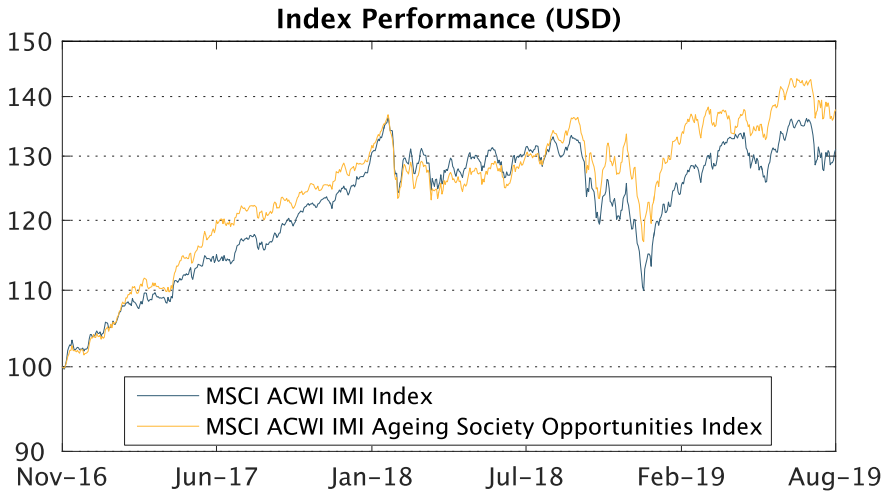
Exhibit 11: Sector-wise distribution of constituents by relevance score bands



Data as of May 29, 2019

Exhibits 12 and 13 chart the headline performance and index characteristics of the MSCI ACWI IMI Ageing Society Opportunities Index.[20]

Exhibit 12: Performance of MSCI ACWI IMI Ageing Society Opportunities Index



Period: Nov. 30, 2016 to Aug. 30, 2019

[20] Simulated or back-tested data is not indicative of current or future returns, which may differ materially. The short backtest period from Nov. 30 2016 up to launch in Oct. 2018 reflects limitations in the availability of history for the relevant data inputs. Please also see the disclosures related to back-tested and simulated data at the end of this paper.

Exhibit 13: MSCI ACWI IMI Ageing Society Opportunities Index — key metrics

	MSCI ACWI IMI	MSCI ACWI IMI Ageing Society Opportunities Index
Total return (%)	10.4	12.4
Total risk (%)	11.8	11.7
Sharpe ratio	0.73	0.91
Active return (%)	0.0	2.0
Tracking error (%)	0.0	4.7
Historical beta	1.00	0.91
Number of stocks*	8696	316
One-way turnover(%)	1.7	14.7
Price to book*	2.2	2.2
Price to earnings*	19.5	21.2
Dividend yield* (%)	2.4	2.2

*Period: Nov 30, 2016 to Aug 30, 2019. Annualized. returns in USD. * Monthly averages.*

Thematic allocation and attribution analysis

The process of building a relevance score for every stock in a stock universe allows us to construct a thematic index in a flexible way that has scope for customization. But having that relevance score available with coverage of the MSCI ACWI IMI universe also allows us to answer key questions about the thematic characteristics of any index, about which subtheme is most influential in a single thematic index, and how the thematic exposures influence the performance relative to a market-capped benchmark. In this section, we illustrate briefly how this analysis becomes possible within our thematic framework.

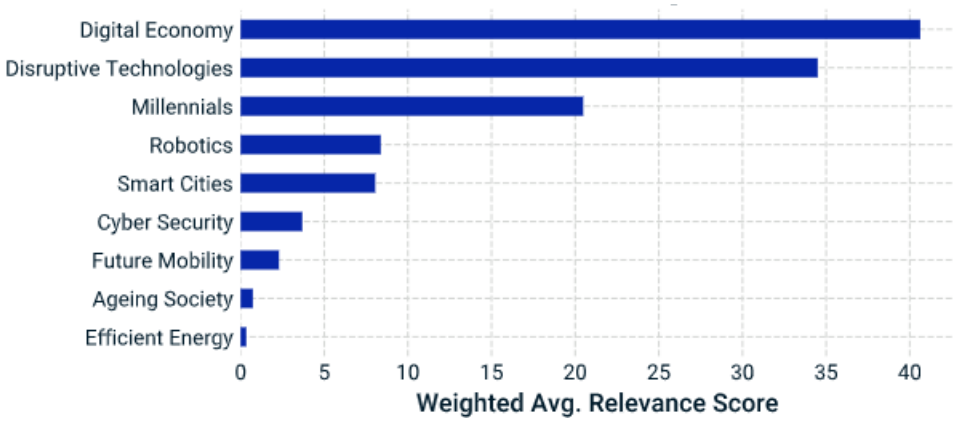
Thematic allocation

The weighted average relevance score of all securities in an index represents the index's exposure to that theme. By calculating weighted average relevance scores using a comprehensive collection of themes, we can build a "thematic exposure profile" for any index. Similarly, for an investment portfolio or fund, we can calculate thematic exposure profiles by using the portfolio weights in combination with the

same relevance scores (for indexes, we use constituent weights). This allows us to review the benchmark-relative (active) thematic positioning of a fund. For illustrative purposes, we use the nine MSCI thematic indexes now launched for the profiling.

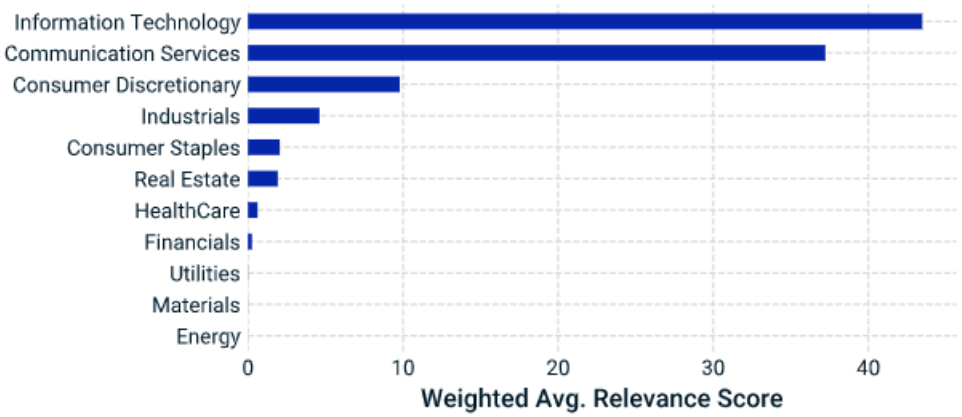
We can first check which themes are closely aligned with sector investing and which ones span many areas of economic activity. But our new analysis can show the underlying thematic exposures of a traditional sector. In Exhibit 14, for example, we see that the MSCI ACWI IMI Information Technology Index is indeed exposed to a number of themes. Precise thematic exposures therefore did not come solely from sectors. Exhibit 15 shows the GICS sector index exposures of the 'Digital Economy' theme. (The index thematic exposure from the relevance score can vary from 0 to 100; the hurdle rate for index eligibility is 25.) Clearly thematic indexes are not restricted by simple sector associations.

Exhibit 14: Thematic exposure of the GICS information technology sector



Data as of May 29, 2019

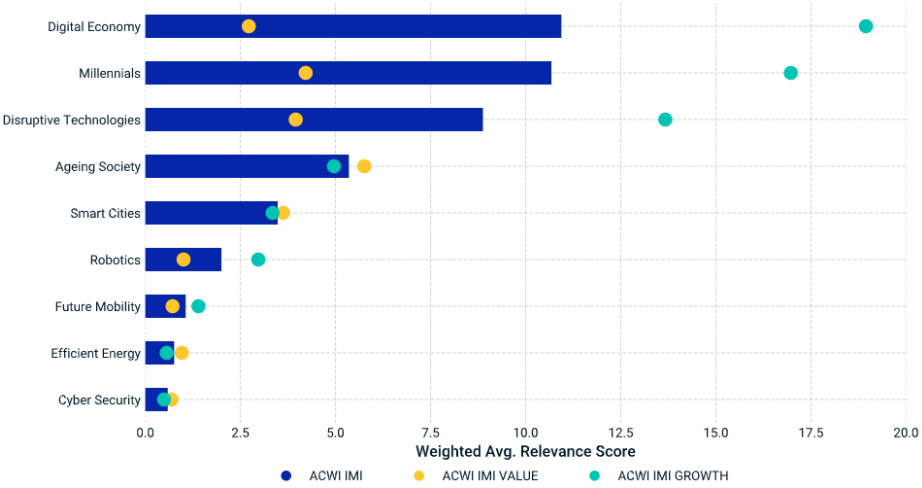
Exhibit 15: GICS sector exposures of the MSCI ACWI IMI Digital Economy Index



Data as of May 29, 2019

This thematic exposure profile can also be used to give insights into non-thematic indexes and help characterize their positioning in various ways. In Exhibit 16, we compare the MSCI Value and Growth Indexes. We see that the traditional growth allocation was much more aligned with some of the most discussed new growth themes than the value index. The growth index was overweight in terms of these exposures compared to the cap-weighted index, whereas the value index was underweight. This thematic exposure profile therefore offers another lens through which to view the recent underperformance of the value factor and value indexes.

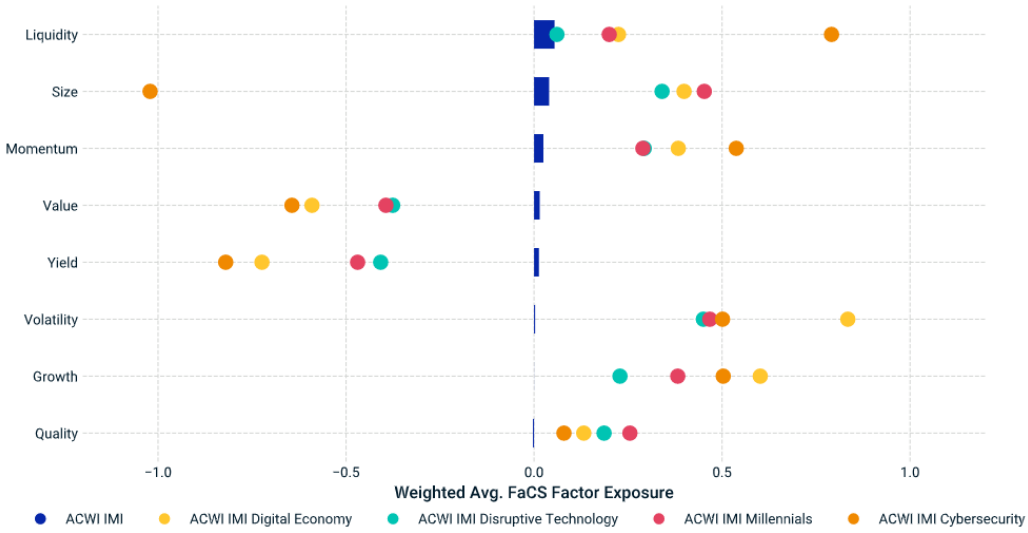
Exhibit 16: Thematic exposure of MSCI ACWI Value and Growth Indexes



Data as of May 29, 2019

Exhibit 17 illustrates two key aspects of a select set of thematic indexes' factor exposures. First, it depicts the intuitive alignment between certain thematic indexes and a focus on growth investing. Second, it shows that these indexes also had high exposure to momentum.

Exhibit 17: MSCI FaCS™ exposure of selected MSCI ACWI IMI thematic indexes

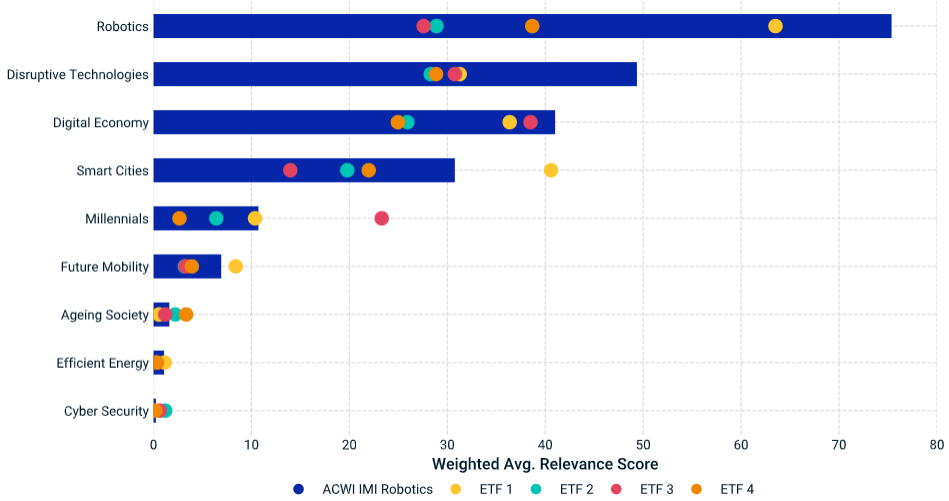


Data as of May 29, 2019

Thematic allocation analysis also helped us understand and compare the thematic exposures of funds stating that they track the same theme, and potentially identify inadvertent exposures. Exhibit 18 shows the thematic exposures of the four most popular third-party ETFs[21] advertised as being in the "robotics-automation-artificial intelligence" space, benchmarked against the MSCI ACWI Robotics Index. We see a wide variation in the strength of exposure to the key robotics dimension. For some ETFs, the index-level exposure was not greatly above the stock-level hurdle rate for MSCI index constituents whereas ETF-1 had exposure closer to that of the MSCI thematic index. We also see that only ETF-1 seemed to have a material exposure to the "Smart Cities" theme whereas ETF-3 had a more anomalous exposure to the less-related broad demographic theme of "Millennials."

[21] An ETF may not track the index and therefore it is not a true comparison. You cannot invest in an index.

Exhibit 18: Thematic exposures of ETFs tracking the robotics theme



Data as of May 29, 2019

Thematic attribution

The relevance scores for the MSCI ACWI IMI universe can also be used for thematic performance attribution using a Brinson style analysis. We can then gauge the performance impact of exposure to the theme on the index set against the influence of selection within the theme in our index which is based on whether a stock is a pure play or has more limited or upstream exposure. We first group the stocks of the MSCI ACWI IMI based on their relevance score as shown in Exhibit 19.

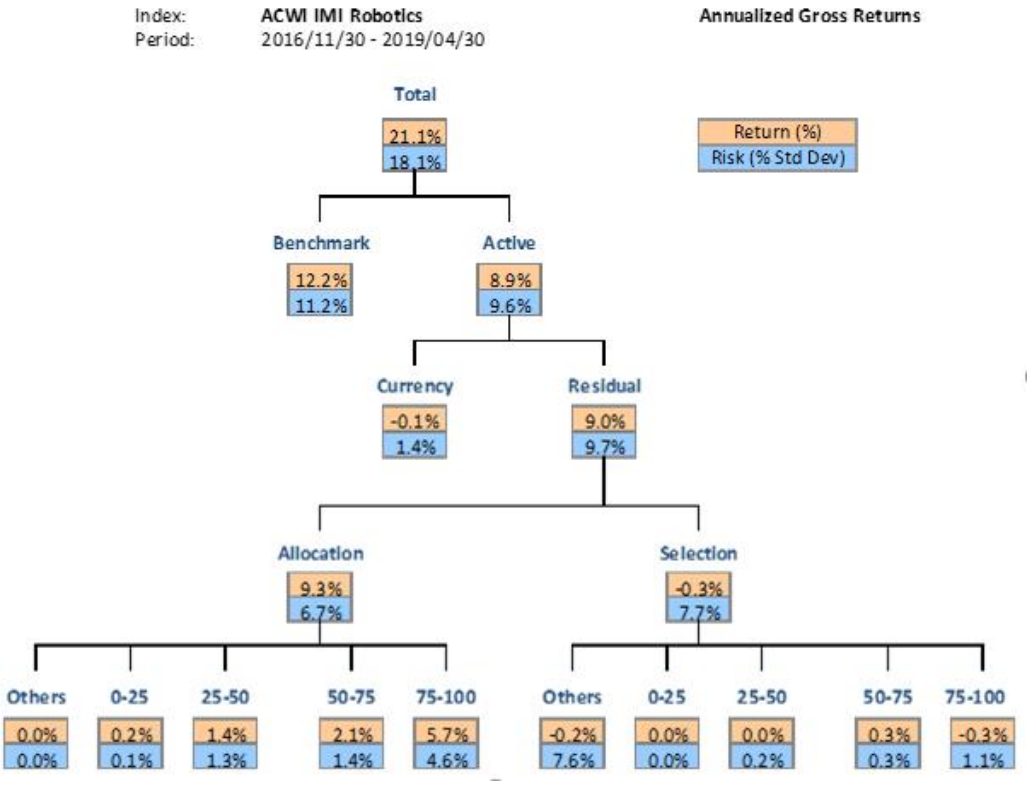
Exhibit 19: Definition of relevance score groups

Relevance score group	Relevance Score
Others	No relevance score. The stock is ineligible.
0–25	Relevance score is less than 25%
25–50	Relevance score is between 25% and 50%
50–75	Relevance score is between 50% and 75%
75–100	Relevance score is between 75% and 100%

In Exhibit 20, we present the relevance score group allocation/selection return attribution for the MSCI ACWI IMI Robotics Index. Over the analysis period of the backtest, the MSCI ACWI IMI Robotics index demonstrated an active outperformance of 8.9% per annum relative to the MSCI ACWI IMI. How does that performance break

down from a thematic perspective?[22] The analysis shows that in this case the outperformance can be attributed to the over-allocation (over-weighting) of stocks, which are selected in the index, above the relevance score hurdle. Indeed, by far the largest part of the return of the MSCI ACWI IMI Robotics Index in excess of its cap-weighted reference was attributed to over-weighting the pure plays on the theme: from the 75–100 group over the 50–75 and 25–50 groups. The contribution from stock selection was slightly negative, which means the pro-thematic weighting scheme within each group was a mild detractor. In other indexes, we also place the effect of GICS exclusion rules under this heading.

Exhibit 20: Thematic performance attribution



[22] As noted previously, the index has only been calculated out of simulation since Oct. 31, 2018. The definition of the index and the identification of keywords therefore introduced unavoidable hindsight bias for the backtest performance.

Conclusion

Thematic investing is a top-down approach to investment that has become increasingly popular with both institutional and retail investors, whether in terms of investment philosophy or product development. Some active managers see it as an arena where they can demonstrate their stock-selection skills. Index-based products in this space have also grown quickly. These products, active or indexed, propose ways for investors to gain exposure to companies that may benefit from trends that can potentially re-shape the market, economic and human environments. This approach has changed how certain investors position sector and growth funds, while some of the largest pension funds now have explicit capital allocations to thematic investment teams.

In this paper, we first reviewed the concept of thematic investing and the differences between it, and the factor and ESG investment processes. In the second half, we laid out how we model various themes in order to build a rule-based index methodology that represents the performance of companies exposed to a certain trend. We first build a keyword dictionary dataset as part of the research element that captures the concepts, products and services currently associated with the index objective. Within the index methodology, we use this keyword dictionary as an input to identify representative constituents based directly on their financial filings and/or indirectly on their business description information. We described our measure of economic relevance for a given theme, which allows us to select companies with the desired exposure.

MSCI has launched nine thematic indexes to capture a broad selection of thematic trends. These indexes enable clients to gain exposure to the trends they think will be dominant by building funds replicating the indexes and to measure active manager skill by benchmarking their efforts to such indexes. The implementation we have adopted to capture thematic trends also allows us to analyze a given index to see which trends it is exposed to deliberately or inadvertently, to gauge an index for the influence of sub-themes on its construction and to explain its performance from a thematic perspective. Moreover, we can use the same tools to assess the thematic exposure of a fund or portfolio.

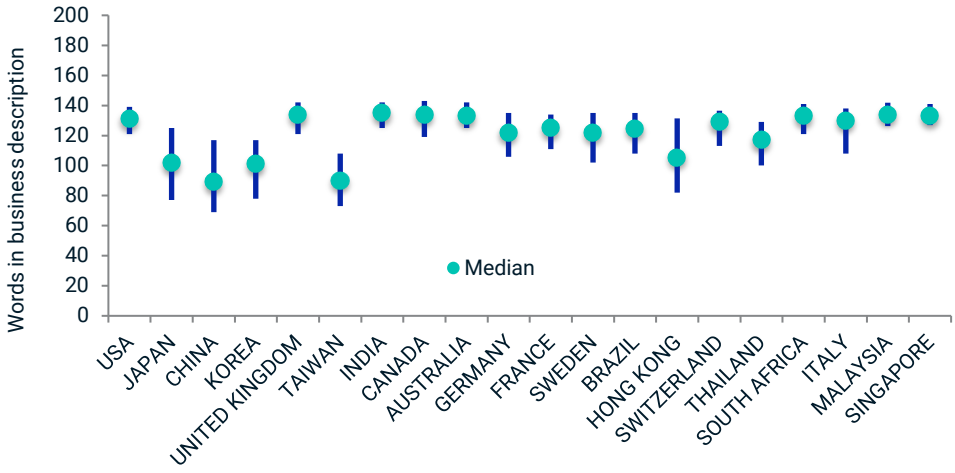
We would like to acknowledge the collaboration of and input from Anu Sagar and Vikash Sharma from the Applied Data Intelligence team during the course of the work to develop the MSCI thematic index framework.

Appendix: Business description information statistics

For constituents selected by the indirect route, the quality of the keyword matching against the business description information source is important. The business description information data sources we use continue to evolve but, at a company level, the summary typically contains information about the main business activities of the company, high-level product and service overviews, as well as recent investments, and mergers and acquisitions (M&A) activities. In this appendix, we present a statistical analysis of the data as of May 2019, for the MSCI ACWI IMI universe that shows that the length, complexity and readability[23] of the information used is broadly similar across companies from different countries.

Exhibit 21 shows that, overall, the average length of the summary descriptions is relatively even across countries. On average, the summary descriptions of Chinese and Japanese companies are of a reasonable length and only modestly shorter than those from other countries.

Exhibit 21: Variation of business description length by country



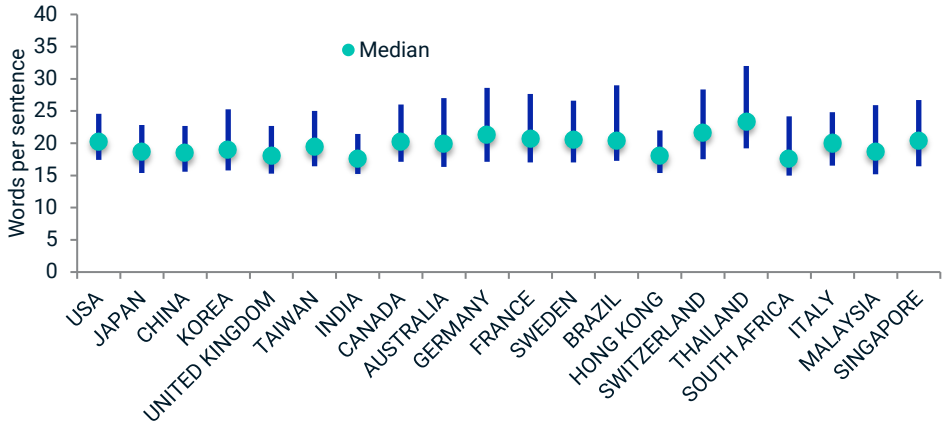
Data as of May 29, 2019. End-points of bars show the 20th and 80th percentiles

Exhibit 22 shows that the average number of words per sentence in the summary description was also similar across all countries in the MSCI ACWI IMI universe. The number of words per sentence is one indicator of the complexity of a text. Exhibit 22

[23] We use the following commonly-used metric for comprehension difficulty- the Dale-Chall readability score

shows that on average, the complexity of summary descriptions of a Chinese or Japanese company was similar to that of a company from the U.K. or U.S.A.

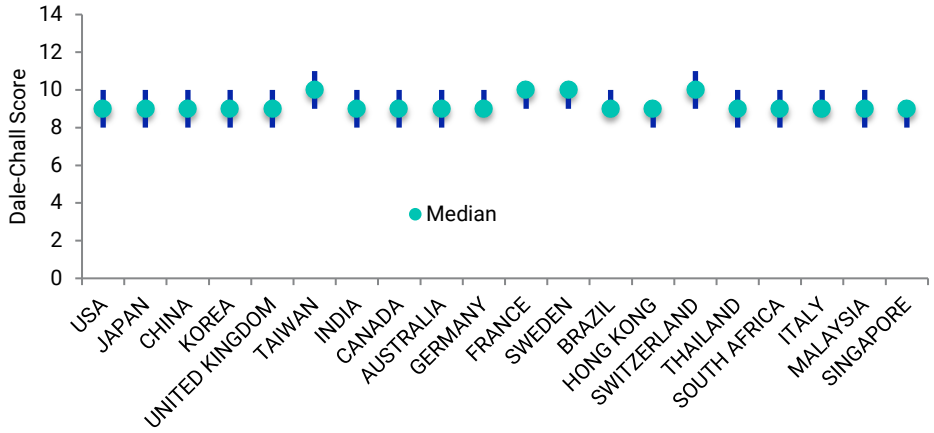
Exhibit 22: Variation of business description sentence length by country



Data as of May 29, 2019. End-points of bars show the 20th and 80th percentiles

Exhibit 23 shows that the distribution of the Dale-Chall readability score was similar across countries. The average Dale-Chall readability score of the MSCI ACWI IMI universe was close to nine, which would indicate that the summary descriptions could be easily understood by first year college students (13th grade).

Exhibit 23: Variability of business description information readability



Data as of May 29, 2019. End-points of bars show the 20th and 80th percentiles

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