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# MAINSTREAMING SUSTAINABLE INVESTING

Michael J. Greis, CFA, Editor



CFA Institute  
Research  
Foundation

In partnership with  
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# INTRODUCTION

*Mainstreaming Sustainable Investing* is the title, tagline, and guiding principle of the annual Sustainable Investing Seminars run by CFA Society Boston since 2013. In that first year, the idea of “mainstreaming” sustainable investing seemed wildly aspirational to many. Yet by the time the society held its fourth annual seminar in November 2016, aspiration had been surpassed by reality, as the increasing attendance and diversity of the audience reflected the change that was under way in the industry.

To put this development into perspective, however, it is necessary to more clearly articulate what is meant by both “mainstreaming” and “sustainable investing.”

A simple and widely used definition of sustainability can be found in a 1987 report on sustainable development prepared for the United Nations by the Brundtland Commission: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”<sup>1</sup> This definition will sound familiar to investment professionals involved with endowments and families, similar to the concept of *intergenerational equity*.

The purpose of investing is to apply capital to productive use, addressing opportunities and challenges facing societies and economies, and thereby building value over time for the investors who supply that capital. But that value-building economic activity does not take place within a hermetically sealed financial system. Value creation takes place in and depends on environmental, social, and governance (ESG) systems. It requires the assets and resources those systems provide. Economic activity that is not sustainable degrades those systems, diminishing their future viability and value. Sustainable economic activity maintains or enhances those systems, increasing their future viability and value. The future value of the investment depends heavily on the future state of those systems.

The investment profession has a well-developed language and formal system for measuring and assessing the value created (or destroyed) by financial capital. We use these financial factors and indicators in this work. We do not yet have, however, a similarly robust system to assess the value created or destroyed by the use or misuse of ESG capital. What we do have is an evolving language of ESG issues, factors, and indicators. The core of sustainable investing is incorporating these ESG issues, factors, and indicators into the investment process.

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<sup>1</sup>World Commission on Environment and Development, *Our Common Future* (Oxford, UK: Oxford University Press, 1987). [www.un-documents.net/our-common-future.pdf](http://www.un-documents.net/our-common-future.pdf).

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Viewed through this lens, considering the ESG impacts on future value contributes to fulfilling our mandate as investment professionals. As Erika Karp, CEO, Cornerstone Capital Group, and the opening speaker at our first Sustainable Investing Seminar in 2013, observed, “Sustainable investing is just investing.”

In this same way, sustainable investors are not that different from other investors. Sustainable investors seek to

- reduce risk,
- obtain alpha (outperformance),
- engage to improve performance of their investments,
- achieve an economic or societal outcome, and
- invest in ways consistent with their values and beliefs.

Reading this list from the bottom up generates the stereotype of the “sustainable” investor. Similarly, reading from the top down generates the stereotype of the “regular” investor. In both cases, the extreme versions of this stereotype would ignore the later items, resulting in the perception that “sustainable” investors are willing to ignore risk and return, whereas “regular” investors don’t care about values or societal outcomes. Both stereotypes are wrong. Each of these motivations can apply to any investor.

Like all investors, sustainable investors prioritize these motivations and weigh their importance differently. The challenge for sustainable investment professionals is to understand their clients’ motivations and then shape their expectations and investment strategy accordingly. Given this range of motivations and the diversity of ESG systems, it should come as no surprise that we have many ways to approach investing sustainably.

Mainstreaming sustainable investing, therefore, is not found as a definitive recipe of three parts “E,” one part “S,” and two parts “G.” Nor is it found in a broad claim of being a “sustainable” or “responsible” investor. Mainstreaming is achieved when ESG issues, factors, tools, and techniques are applied throughout investment practice in support of client requirements.

The 2016 seminar showcased how deeply and broadly ESG issues have reached into the profession of investment management. This research brief, comprising articles written by speakers at the 2016 Sustainable Investing Seminar, showcases the significantly increased activity and innovation taking place and the wide-ranging impact sustainable investing is having on the investment profession.

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At the 2015 Sustainable Investing Seminar, Jean Rogers, founder and former CEO of the Sustainable Accounting Standards Board, highlighted new research from George Serafeim, a professor at Harvard Business School. Professor Serafeim's research showed that firms with good ratings on material sustainability issues significantly outperform firms with poor ratings on such issues.<sup>2</sup> A subsequent paper by Serafeim, published shortly before Professor Serafeim spoke at the 2016 seminar, extended that research to shareholder engagement and provided evidence that filing shareholder proposals on material ESG issues was associated with an increase in Tobin's  $q$ .<sup>3</sup> This research is part of the growing body of work collected over the past five years that demonstrates that ESG information is value relevant.

In his article for this brief, Professor Serafeim moves beyond this important but static analysis at the company level to the broader value of ESG information in assessing the impact of transformational changes in the economy. Using mobility as a case study of large-scale transformation driven by technology and climate change, he describes how robust ESG information on material issues will be necessary to understand which organizations will be successful and how to deploy capital in markets.

The amount and complexity of financial data available to analysts soared during the later years of the 20th century. A parallel explosion in information technology enabled the growth in quantitative approaches to investing. The rapid growth in the availability of ESG information in recent years has led to the emergence of quantitative ESG strategies. It can be challenging, however, to process such an overwhelming amount of data from both financial and nonfinancial sources. The relatively higher proportion of qualitative and unstructured data makes the challenge even greater.

Leveraging the power of big data and machine learning to address this opportunity is the subject of Andreas Feiner's article. Feiner, a founding partner and head of ESG research and advisory at Arabesque Asset Management, describes the development of S-Ray, a tool that aggregates large volumes of sustainability information and applies customizable rules-based analysis on a continuous basis to provide daily snapshots of a company's sustainability. He provides an example of applying values-neutral, unbiased algorithms to generate performance in a values-based context.

For investment practitioners learning about ESG, the first and dominant narrative is about the impact of ESG factors on companies and stock prices, especially large-cap public equities, although rapid growth in green bonds has brought increased attention to fixed-income ESG issues. It is not surprising, then, that analyzing the impact of ESG

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<sup>2</sup>Mozaffar Khan, George Serafeim, and Aaron Yoon, "Corporate Sustainability: First Evidence on Materiality," *Accounting Review* 91 (November 2016): 1697–1724.

<sup>3</sup>Jyothika Grewal, George Serafeim, and Aaron Yoon, "Shareholder Activism on Sustainability Issues," working paper (6 July 2016). <https://ssrn.com/abstract=2805512>.



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factors is much more common in valuing equities than in valuing fixed-income securities. Going a step beyond that—considering factor impacts for a portfolio of equities and fixed-income securities—is complex even in mainstream financial analysis.

Professor Andreas Hoepner of University College Dublin addresses this issue through the emerging discipline of “financial data science.” Financial data science applies advanced statistical analysis to significant amounts of real-world data. It seeks to use the explanatory power of the data in predicting outcomes to suggest appropriate actions and to guide further research. In his article, Professor Hoepner considers the integration of ESG issues into a mixed assets universe, in which equity and fixed-income securities are examined in one analytical setting. Which of the dozens of ESG issues perform well in both equity and fixed-income securities, and especially in the mixed setting? The results are surprising, especially with regard to governance issues.

Steve Lydenberg, CFA, a partner at Domini Social Investments, wrapped up the first Sustainable Investing Seminar in 2013 with a discussion of the challenges and opportunities for security analysts as ESG disclosure inevitably becomes universal, based on standardized metrics, and integrated into financial reporting. For more than 30 years, Lydenberg has been a pioneer in sustainable investing, consistently and presciently identifying and tackling the next challenge in the evolution of the field.

In his article, Lydenberg observes how our understanding of risk and the tools to manage it have evolved—from considering the risk of a single security to risk at the portfolio level. He argues that we must now consider system-wide risk.

By balancing the efficient discipline of portfolio management with certain specific intentional actions, investors can manage risks and rewards at these system-related levels as well as within their portfolios. System-level considerations have the potential to generate a “smart beta” play, with the management of risks and rewards at these levels increasing the performance of whole indexes, as opposed to helping generate increased “alpha” for individual portfolios.

The topics considered in these articles—transformational economic change, quantitative investing, performance of a multi-asset-class portfolio, and systemic risk management as a source of smart beta—demonstrate the ongoing effort toward mainstreaming sustainable investing.

At the same time, each topic builds upon a robust base of ESG concepts that definitively place them within a values-based framework of sustainable investing. Because, as Karp reminds us, “sustainable investing is just investing.”

# INVESTING IN AN ERA OF DISRUPTION AND TRANSFORMATIONAL CHANGE: THE VALUE OF MATERIAL ESG INFORMATION

George Serafeim

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When I started conducting research in the environmental, social, and governance (ESG) space, about 10 years ago, it was still a niche area largely disregarded by most mainstream institutions. The situation is very different now, with investment products being launched almost every day and investment teams being recruited systematically across institutions. This is the result of many factors, including not only a growing client interest in ESG issues but also numerous studies and evidence showing that ESG factors are informative about future financial performance.<sup>4</sup> The market seems to be learning as evidenced by the increasing number of investors attempting to incorporate different ESG data based on a company's strategy, industry, and country of operations (something that has come to be known as the differential materiality of ESG data).

ESG investing, however, still entails a rather static incorporation of data around companies' policies, processes, product profile, and impact without a systematic and rigorous analysis of the vast change that is happening in our society and economy. Therefore, ESG investing still has not reached its full potential of making investors part of the change process and beneficiaries of forward-looking assessments.

In this article, I analyze the future of mobility to show how large-scale transformation in how we move will have ripple effects across multiple sectors. When I started working in the area of mobility in late 2013, this transformation in mobility was questioned, with many industry insiders and commentators doubting the magnitude and speed of change. Tesla, Inc., was dismissed by incumbents as "going nowhere," autonomous vehicles as "a distant dream," and shared mobility as "a luxury good." Things have changed

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<sup>4</sup>See, for example, Mozaffar Khan, George Serafeim, and Aaron Yoon, "Corporate Sustainability: First Evidence on Materiality," *Accounting Review* 91 (November 2016): 1697–1724; Robert G. Eccles, Ioannis Ioannou, and George Serafeim, "The Impact of Corporate Sustainability on Organizational Processes and Performance," *Management Science* 60 (November 2014): 2835–57.

since then, and now it is more widely accepted that change is happening.<sup>5</sup> Therefore, I will briefly review the dynamics of change and then shift my attention to how a robust ESG investment process will seek a thorough understanding of those effects across different sectors.

## A CASE: LARGE-SCALE TRANSFORMATION IN MOBILITY

As the 20th century came to a close, vehicular mobility looked vastly different than it did the 100 years prior; innovations in mobility had profoundly changed human life, allowing for a higher quality of living and greater personal freedoms. For example, Americans owned 8,000 cars in 1900, 8 million by 1920, and more than 220 million by 2000. But these vehicles exhibited very low utilization. As of 2017, privately owned internal combustion engine (ICE) vehicles driven by humans had a utilization rate averaging 4% during a given day.<sup>6</sup> A fleet of electric, shared, autonomous (ESA) vehicles was expected to increase vehicle utilization tenfold while decreasing the costs of mobility by an even greater factor.<sup>7</sup>

As a significant contributor to greenhouse gas emissions, the transportation sector's decarbonization provides potential for climate change mitigation. In the United States, the transportation sector contributes 27% of total CO<sub>2</sub> emissions,<sup>8</sup> of which 59% could be attributed to light-duty vehicles' fuel combustion and 22% to medium- and heavy-duty trucks.<sup>9</sup> With a fleet of ESA vehicles, in which electricity production simultaneously decarbonizes, CO<sub>2</sub> emissions from light-duty vehicles in 2030 are estimated to be 90% lower compared with business-as-usual models.<sup>10</sup> The degree of the environmental impact of electric vehicles (EVs) compared with ICE vehicles depends on the energy source used to generate electricity. However, even in China, where much electricity is produced by coal, EVs accounted for almost half the carbon emissions per mile driven than the average ICE vehicle in 2015.<sup>11</sup>

<sup>5</sup>George Serafeim and David Freiberg, "The Future of Mobility: Economic, Environmental, and Social Implications," Harvard Business School Technical Note 118-008 (July 2017).

<sup>6</sup>James Arbib and Tony Seba, "Rethinking Transportation 2020–2030: The Disruption of Transportation and the Collapse of the Internal-Combustion Vehicle and Oil Industries," RethinkX Sector Disruption Report (May 2017). [https://static1.squarespace.com/static/585c3439be65942f022bbf9b/t/591a2e4be6f2e1c13df930c5/1494888038959/RethinkX+Report\\_051517.pdf](https://static1.squarespace.com/static/585c3439be65942f022bbf9b/t/591a2e4be6f2e1c13df930c5/1494888038959/RethinkX+Report_051517.pdf).

<sup>7</sup>Ibid.

<sup>8</sup>US Environmental Protection Agency, "Sources of Greenhouse Gas Emissions" (2016). [www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions](http://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions).

<sup>9</sup>US Department of Transportation, "Transportation and Climate Change Clearinghouse" (2017). [www.transportation.gov/climate-change-clearinghouse](http://www.transportation.gov/climate-change-clearinghouse).

<sup>10</sup>Arbib and Seba, "Rethinking Transportation 2020–2030."

<sup>11</sup>McKinsey & Company and Bloomberg New Energy Finance, "An Integrated Perspective on the Future of Mobility" (October 2016). [www.bbhub.io/bnef/sites/4/2016/10/BNEF\\_McKinsey\\_The-Future-of-Mobility\\_11-10-16.pdf](http://www.bbhub.io/bnef/sites/4/2016/10/BNEF_McKinsey_The-Future-of-Mobility_11-10-16.pdf).

## **Changing the Driver: Automation**

In August 2016, Ford Motor Company announced it would manufacture a fleet of Level 5 autonomous vehicles, without steering wheels or pedals, for commercial operation by 2021.<sup>12</sup> Ford joined BMW of North America, LLC, which had announced it would produce an all-electric, Level 3.5 autonomous vehicle by 2021.<sup>13,14</sup> As of 2017, all Tesla vehicles had “the hardware needed for full self-driving capability at a safety level substantially greater than that of a human driver,” despite still requiring a human to sit in the driver’s seat to take over if the autopilot failed.<sup>15</sup> In June 2017, General Motors Company claimed it was the only automaker currently capable of mass-producing self-driving vehicles and announced plans to spend \$600 million annually on autonomous vehicle development.<sup>16</sup> Technology giant Apple announced it was working on developing “autonomous systems” and had received permits to begin testing self-driving sport utility vehicles in California beginning in April 2017.<sup>17</sup>

The onset of autonomous vehicles raises the question of how vehicles might be used differently in the future. Because no passenger needs to drive the vehicle, the traditional interior design format of vehicles is potentially unnecessary. For commuting individuals, a car could resemble an office space to more effectively use time spent commuting. By freeing the driver from the task of driving while simultaneously increasing safety, autonomous vehicles have forced manufacturers and consumers to rethink how a car will be used and thus how it should be designed.

## **Changing Ownership: Sharing**

Ride-sharing is significantly disrupting private ownership of cars. Although it is too early to make definitive conclusions on the magnitude of disruption, some studies have provided clues about the future. Studies examining the effects of ride-sharing often have done so in the context of autonomous vehicles. Such studies have found

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<sup>12</sup>Jamie Condliffe, “2021 May Be the Year of the Fully Autonomous Car,” *MIT Technology Review* (17 August 2016). [www.technologyreview.com/s/602196/2021-may-be-the-year-of-the-fully-autonomous-car](http://www.technologyreview.com/s/602196/2021-may-be-the-year-of-the-fully-autonomous-car).

<sup>13</sup>Although Level 3.5 is not an official level of autonomous vehicle, the BMW iNext was claimed to bridge the gap between Level 3, part-time fully autonomous driving with occasionally needed human intervention, and Level 4, completely free from human driving.

<sup>14</sup>Jimi Beckwith, “BMW Confirms Autonomous iNext for 2021,” *Autocar* (30 May 2017).

<sup>15</sup>Tesla. [www.tesla.com/autopilot](http://www.tesla.com/autopilot).

<sup>16</sup>Brent Snavelly, “GM Says It’s Ready to Mass Produce Self-Driving Cars,” *USA Today* (13 June 2017). [www.usatoday.com/story/money/cars/2017/06/13/general-motors-we-can-mass-produce-self-driving-cars-now/102805626](http://www.usatoday.com/story/money/cars/2017/06/13/general-motors-we-can-mass-produce-self-driving-cars-now/102805626).

<sup>17</sup>Alex Webb and Emily Chang, “Tim Cook Says Apple Focused on Autonomous Systems in Cars Push,” *Bloomberg Technology* (13 June 2017). [www.bloomberg.com/news/articles/2017-06-13/cook-says-apple-is-focusing-on-making-an-autonomous-car-system](http://www.bloomberg.com/news/articles/2017-06-13/cook-says-apple-is-focusing-on-making-an-autonomous-car-system).

that one shared, autonomous vehicle could replace between 9 and 32 privately owned vehicles.<sup>18</sup> A study conducted in Ann Arbor, Michigan, found that a shared fleet could provide instantaneous access to a vehicle using 15% of the total current private fleet.<sup>19</sup> A study conducted in Zurich found that if waiting times up to 10 minutes for a shared fleet vehicle were acceptable, a reduction of up to 90% of the total current fleet could be possible without active fleet management, such as fleet redistribution.<sup>20</sup> Privately owned cars had an average utilization rate of 4%, which research suggests could be increased to 40% if autonomy was coupled with ride-sharing.<sup>21</sup>

## **Changing the Fuel: Electrification**

Technical challenges—primarily battery costs and driving range—have prevented electric vehicles from becoming the predominant form of transportation. As of 2017, the battery was approximately one-third of the cost of the vehicle, which means that to achieve price parity between ICE vehicles and EVs, battery costs would need to continue falling.<sup>22</sup> Average battery pack prices have fallen significantly since 2010, dropping from approximately \$1,000 per kilowatt-hour to approximately \$227 per kilowatt-hour in 2016.<sup>23</sup> In early 2016, Tesla claimed to be producing batteries that cost less than \$190 per kilowatt-hour and expected to reach \$100 per kilowatt-hour by 2020, often considered to be the necessary battery price for parity with ICE vehicles,<sup>24</sup> although some studies have placed the parity point at \$150 per kilowatt-hour.<sup>25</sup> The distance a car could travel on a single charge also remained an issue for widespread EV adoption. Before 2017, Tesla had

<sup>18</sup>For studies on the displacement of private vehicles, see L. D. Burns, W. C. Jordan, and B. A. Scarborough, “Transforming Personal Mobility,” Earth Institute (27 January 2013); P. M. Boesch, F. Ciari, and K. W. Axhausen, “Autonomous Vehicle Fleet Sizes Required to Serve Different Levels of Demand,” *Transportation Research Record: Journal of the Transportation Research Board* 2542 (2016): 111–119; E. Martin, S. Shaheen, and J. Lidicker, “Impact of Carsharing on Household Vehicle Holdings: Results from North American Shared-Use Vehicle Survey,” *Transportation Research Record: Journal of the Transportation Research Board* 2143 (2010): 150–158; D. J. Fagnant and K. M. Kockelman, “The Travel and Environmental Implications of Shared Autonomous Vehicles, Using Agent-Based Model Scenarios,” *Transportation Research Part C: Emerging Technologies* 40 (2014): 1–13; AlixPartners, “AlixPartners Study Indicates Greater Negative Effect of Car Sharing on Vehicle Purchases.” <http://legacy.alixpartners.com/en/MediaCenter/PressReleases/tabid/821/articleType/ArticleView/articleId/950/AlixPartners-Study-Indicates-Greater-Negative-Effect-of-Car-Sharing-on-Vehicle-Purchases.aspx#sthash.4fz4xZRL.nAoB8huJ.dpbs>.

<sup>19</sup>Burns et al., “Transforming Personal Mobility.”

<sup>20</sup>Boesch et al., “Autonomous Vehicle Fleet Sizes Required to Serve Different Levels of Demand.”

<sup>21</sup>Arbib and Seba, “Rethinking Transportation 2020–2030.”

<sup>22</sup>Tom Randall, “Here’s How Electric Cars Will Cause the Next Oil Crisis,” *Bloomberg* (25 February 2016). [www.bloomberg.com/features/2016-ev-oil-crisis](http://www.bloomberg.com/features/2016-ev-oil-crisis).

<sup>23</sup>McKinsey & Company, “Electrifying Insights: How Automakers Can Drive Electrified Vehicle Sales and Profitability” (January 2017). [www.mckinsey.com/industries/automotive-and-assembly/our-insights/electrifying-insights-how-automakers-can-drive-electrified-vehicle-sales-and-profitability](http://www.mckinsey.com/industries/automotive-and-assembly/our-insights/electrifying-insights-how-automakers-can-drive-electrified-vehicle-sales-and-profitability).

<sup>24</sup>Fred Lambert, “Tesla Is Now Claiming 35% Battery Cost Reduction at ‘Gigafactory 1’ — Hinting at Breakthrough Cost below \$125/kWh,” *Electrek* (18 February 2017). <https://electrek.co/2017/02/18/tesla-battery-cost-gigafactory-model-3>.

<sup>25</sup>Björn Nykvist and Måns Nilsson, “Rapidly Falling Costs of Battery Packs for Electric Vehicles,” *Nature Climate Change* 5.4 (2015): 329–332.

offered vehicles with more than 200 miles per charge but only at luxury car prices, but in 2017, Tesla and Chevrolet for the first time began to offer all-electric vehicles with batteries that have more than 200 miles per charge in the \$35,000 price range.<sup>26,27</sup>

Another technical challenge EVs had to overcome was a long battery recharging time. Tesla's standard home charging setup allowed a vehicle to charge up to 52 miles of potential travel per hour, whereas Tesla's Supercharger network allowed for a 170-mile potential to be charged in 30 minutes.<sup>28</sup> Although vehicle charging could occur at one's own home when the vehicle was not in use, particularly overnight, maintaining a charged vehicle required more planning than simply refilling an ICE vehicle at the gas station. Tesla's primary response to this issue was to improve access by continually increasing the size of its Supercharger network, as well as placing charging stations at many high-traffic destination locations, such as hotels, restaurants, and shopping centers. Virtually all major car manufacturers have announced plans to make EVs a significant proportion of their production capacity within the next decade.

### **Trends Interacting**

Independently, the trends of shared mobility, autonomous vehicles, and vehicle electrification are by themselves disruptive. The economy-wide disruptive potential, however, is tied to the complementary nature these trends possess—each trend augmenting the other two. First, adding self-driving vehicles in the context of shared mobility could profoundly disrupt private vehicle ownership by greatly reducing the cost of ride-hailing services. Next, the higher utilization rate associated with shared mobility favors the economics of EVs and would accelerate electrification. Finally, self-driving cars increased mobility consumption and would favor EVs because they offer a lower total cost of ownership because of a lower marginal cost of mobility. Additionally, self-driving cars alleviated EVs' charging time concerns because they would be able to charge themselves as needed during low-utilization periods and when electricity prices were lowest.

The culmination of the three forces resulted in the possibility of a ride-hailing fleet of self-driving electric vehicles that would compete with both private vehicle ownership and public transportation. The costs of a pooled self-driving taxi could be between 30% and 60% less than the cost of operating a private vehicle, according to research estimates.<sup>29</sup> One study found a potential annual savings of \$5,600 per vehicle from using an ESA vehicle service as opposed to purchasing a new ICE vehicle in 2021.<sup>30</sup> Transition to an ESA fleet would face certain challenges, such as slower adoption rates in less urban areas and

<sup>26</sup>Tesla, "Model 3" (2017). [www.tesla.com/model3](http://www.tesla.com/model3).

<sup>27</sup>Chevrolet, "Bolt EV" (2017). [www.chevrolet.com/bolt-ev-electric-vehicle-2](http://www.chevrolet.com/bolt-ev-electric-vehicle-2).

<sup>28</sup>Tesla, "Charging" (2017). [www.tesla.com/charging](http://www.tesla.com/charging).

<sup>29</sup>McKinsey & Company and Bloomberg New Energy Finance, "An Integrated Perspective on the Future of Mobility."

<sup>30</sup>Arbib and Seba, "Rethinking Transportation 2020–2030."

a cultural connection to personally owning a vehicle. However, the economic impact of potential savings equivalent to 10% of the average annual income of US households—equating to an extra \$1 trillion in savings for American consumers—is likely to help overcome the obstacles.<sup>31</sup>

## ESG ANALYSIS FOR TRANSFORMATIONAL CHANGE

This section examines what a robust ESG analysis would ask with regard to automobile manufacturers, technology, and energy.

### *Automobile Manufacturers*

A future in which transportation was provided by an ESA fleet would further decrease vehicle sales and significantly disrupt car manufacturers. Although geographically specific, as noted, an ESA fleet could be expected to displace private vehicles at a rate of one shared, autonomous vehicle for between 9 and 32 privately owned vehicles. The resulting decrease in new car purchases would lead to falling revenues and profits, loss of economies of scale, and subsequently higher manufacturing costs for ICE vehicles in particular. Furthermore, because of improved driving efficiency and manufacturing changes, electric autonomous vehicles could increase their lifetime mileage to 500,000 miles, further decreasing sales.<sup>32</sup>

This transportation future threatens to massively disrupt the passenger vehicle value chain. If by 2030 ESA vehicles provide 95% of transportation but represent only 60% of vehicles on the road, it would decrease the industry's revenue from the car value chain more than 70%, from \$1.5 trillion in 2015 to \$393 billion in 2030, despite an increase in passenger miles from 4 trillion to 6 trillion.<sup>33</sup> By 2030, new vehicle annual unit sales would drop 70% and 97 million ICE vehicles would be left stranded.<sup>34</sup> In such a future, incumbent auto manufacturers would be left to redefine themselves within the constraints of this new transportation system or become legacy companies.

A robust ESG analysis would ask the following:

1. Is the auto manufacturer investing to develop capabilities to provide a fleet of ESA vehicles?

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<sup>31</sup>Ibid.

<sup>32</sup>Ibid.

<sup>33</sup>Ibid.

<sup>34</sup>Ibid.

2. Is the auto manufacturer developing the right partnerships with other companies, such as in the technology, retail, and transportation sectors, to test and distribute a fleet of ESA vehicles?
3. Is the auto manufacturer developing or acquiring proprietary technologies in battery development and autonomous mobility or sharing app technologies?

## Technology

Autonomous vehicles require software and hardware that allow them to rapidly and accurately identify the conditions around them and make appropriate driving decisions accordingly, potentially while communicating with other autonomous vehicles in the surrounding vicinity. Sensor identification hardware and software and increased computing power are being engineered to allow autonomous vehicles to reach their full potential. For these technologies to be appropriately developed and used, however, extensive data are required. As of late 2016, Tesla announced it had accumulated 1.3 billion miles of autopilot-equipped vehicle data.<sup>35</sup> For only 222 million of those miles was the autopilot mode activated, but Tesla noted that even when the autopilot was not in active use, it still operated in “shadow mode,” with sensors tracking real-world data as if the car were driving autonomously.<sup>36</sup> Waymo (Google LLC’s autonomous driving technology company) reached 3 million total autonomous miles in May 2017.<sup>37</sup>

Because the hardware portion of the vehicle value chain is likely to become commoditized, the majority of the value in an autonomous vehicle will be found in the key autonomous driving technology and software. Therefore, companies providing the technology behind autonomous vehicles are likely to represent a large portion of the value of the autonomous vehicle market. As an indication of this trend, in March 2017, Intel Corporation purchased Mobileye, a self-driving technology company, for \$15 billion.<sup>38</sup>

A robust ESG analysis would ask the following:

1. Is the technology company investing to develop capabilities to provide technology solutions for a fleet of ESA vehicles?
2. Is the technology company testing autonomous vehicles, thereby accumulating data on their behavior?

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<sup>35</sup>Dana Hull, “The Tesla Advantage: 1.3 Billion Miles of Data,” *Bloomberg Technology* (20 December 2016). [www.bloomberg.com/news/articles/2016-12-20/the-tesla-advantage-1-3-billion-miles-of-data](http://www.bloomberg.com/news/articles/2016-12-20/the-tesla-advantage-1-3-billion-miles-of-data).

<sup>36</sup>*Ibid.*

<sup>37</sup>Waymo, “On the Road” (2017). <https://waymo.com/ontheroad>.

<sup>38</sup>Kirsten Korosec, “Why Intel Bought Mobileye,” *Fortune* (13 March 2017). <http://fortune.com/2017/03/13/why-intel-bought-mobileye>.



3. Is the technology company focused on understanding the part of the value chain from the transition to a fleet of ESA vehicles?

## Energy

Vehicle electrification is poised to significantly decrease demand for oil. As of 2015, transportation accounted for approximately 53% of total demand for liquids (oil, biofuels, and other liquid fuels), whereas cars and trucks represented approximately 44% of total liquids demand.<sup>39</sup> In 2015, 94% of transportation energy demand was met by oil and 3% by biofuels, with the remaining demand met by a combination of gas and other sources, such as renewables.<sup>40</sup> Therefore, the phasing out of ICE vehicles would greatly affect total oil demand.

Bloomberg New Energy Finance has predicted that during the 2020s EVs will become a more economic option than ICE vehicles, with EV sales forecast to hit 41 million and to represent 35% of new light-duty vehicle sales by 2040, replacing 13 million barrels of crude oil per day.<sup>41</sup> Under these EV market adoption assumptions, 2 million barrels of oil would be displaced per day by 2028.<sup>42</sup> Other research has predicted that a mobility revolution in which electrification is coupled with the adoption of a shared and autonomous fleet would cause global oil demand to peak at 100 million barrels per day in 2020 and to fall to about 70 million barrels per day by 2030.<sup>43</sup>

In response to decreasing oil demand from increased EV usage, the price of oil is expected to fall. At low oil price levels, only the lowest-cost producers will produce oil. Moreover, only a few private oil companies would likely be able to exist alongside the lower-cost state-owned companies. Following the 2014–15 oil price drop, many of the large, integrated oil companies decreased the value of their oil reserves because they were no longer economically viable at current or forecast oil prices. In February 2017, ExxonMobil Corporation, the only major oil company not to have done so already, announced it was reducing its proved reserves by 3.3 billion oil-equivalent barrels, bringing total proved reserves to 20 billion oil-equivalent barrels.<sup>44</sup>

A robust ESG analysis would ask the following:

<sup>39</sup>BP, “BP Energy Outlook 2017 Edition” (2017). [www.bp.com/content/dam/bp/pdf/energy-economics/energy-outlook-2017/bp-energy-outlook-2017.pdf](http://www.bp.com/content/dam/bp/pdf/energy-economics/energy-outlook-2017/bp-energy-outlook-2017.pdf).

<sup>40</sup>ExxonMobil, “2017 Outlook for Energy: A View to 2040” (2017). <http://cdn.exxonmobil.com/~media/global/files/outlook-for-energy/2017/2017-outlook-for-energy.pdf>.

<sup>41</sup>Bloomberg New Energy Finance, “Electric Vehicles to Be 35% of Global New Car Sales by 2040” (February 2016). <https://about.bnef.com/blog/electric-vehicles-to-be-35-of-global-new-car-sales-by-2040>.

<sup>42</sup>Randall, “Here’s How Electric Cars Will Cause the Next Oil Crisis.”

<sup>43</sup>Arbib and Seba, “Rethinking Transportation 2020–2030.”

<sup>44</sup>ExxonMobil, “ExxonMobil Announces 2016 Reserves” (22 February 2017). <http://news.exxonmobil.com/press-release/exxonmobil-announces-2016-reserves>.

1. Are capital expenditures and the cost of production of new reserves justifying the new investments?
2. How is the energy company diversifying its products to mitigate price pressure?
3. Is the energy company transitioning the portfolio from oil to gas or to other sources of energy, and if so, what is the target market for deploying this energy source?

## CONCLUSION

Our economies will experience large-scale change as a result of technologies that interact with environmental and social factors. In this article, I used mobility as the setting to make the case, but it is not the only setting. How we eat, work, interact with each other, and spend our leisure time will also change dramatically in the coming years as advances in 3D printing, blockchain, genomics, and augmented reality will begin to revolutionize industries and have dramatic environmental and social implications—both good and bad.

# MACHINE LEARNING AND BIG DATA ENABLE A QUANTITATIVE APPROACH TO ESG INVESTING

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Machine learning is shaking up the world of finance. Once the preserve of technology firms, the financial industry—from innovative new fintech firms to the giants of Wall Street—is starting to apply the technique to everything from fraud protection to finding new trading strategies, promising to change the global market landscape forever.

This paradigm shift has coincided with another megatrend that we are currently witnessing across finance—the rapidly increasing demand for environmental, social, and governance (ESG) products. As more and more corporate sustainability information flows into the market and as its material value is better understood, machine learning and big data are enabling a new, quantitative approach to ESG investing. They are opening up a new dimension of security analysis and a new dimension of investing.

A silent corporate revolution has been reshaping global markets over the past decade or longer, responding to and anticipating changing framework conditions. Driven by regulatory changes, shifting consumer behavior, natural resource constraints, and social inequality, corporations everywhere are striving to move from industrial era approaches toward cleaner, technology-driven, and socially inclusive business models. The growth of corporate sustainability movements, such as the UN Global Compact and the UN Guiding Principles on Human Rights, illustrate this worldwide trend.

Put simply, sustainable investment considers ESG criteria in order to generate long-term competitive financial returns and a positive societal impact. In practice, the term *ESG* covers a wide range of complex and often interrelated issues, such as water management, community relations, and board structure.<sup>45</sup> Even 20 years ago, no standards and very few guidelines explained how to account for ESG factors. Such considerations as air pollution, child labor, bribery, and corruption simply didn't show up in corporate disclosures. But driven by such initiatives as the Global Reporting Initiative, the

<sup>45</sup>Gordon L. Clark, Andreas Feiner, and Michael Viehs, "From the Stockholder to the Stakeholder: How Sustainability Can Drive Financial Outperformance," Arabesque Partners (5 March 2015). [https://arabesque.com/research/From\\_the\\_Stockholder\\_to\\_the\\_Stakeholder\\_web.pdf](https://arabesque.com/research/From_the_Stockholder_to_the_Stakeholder_web.pdf).

International Reporting Council, and the Sustainability Accounting Standards Board, a robust ESG data infrastructure is now emerging.

Research has shown that more sustainable companies generally outperform their counterparts over the long term, in terms of both stock market performance and accounting performance.<sup>46</sup> Almost three-quarters (73%) of investment professionals worldwide surveyed by CFA Institute consider ESG issues in the investment process.<sup>47</sup> Research published by Bank of America Merrill Lynch in 2017 showed that an investor who factored ESG issues into long-term investment decisions starting in 2008 would have avoided 90% of the US corporate bankruptcies that have taken place within the universe of companies analyzed since then. And companies in the top fifth in terms of ESG ratings for 2005–2010 experienced the lowest volatility in earnings per share (32%) in the subsequent five-year period. In contrast, companies with the worst ESG records averaged 92% volatility.<sup>48</sup>

As the relevance of ESG issues to performance has become clear, momentum has grown. In the largest 50 economies in the world, almost 300 policy instruments support investors in considering long-term value drivers, including ESG factors. More than half of these instruments were created between 2013 and 2016.<sup>49</sup> The European Parliament recently passed a revised EU law on workplace pension funds, the Institutions for Occupational Retirement Provision (IORP) Directive. The directive covers the European pension market, which invests more than €3.2 trillion on behalf of some 75 million Europeans. It contains clear requirements for pension funds to consider ESG issues—the strongest and clearest requirements on such issues seen yet in an EU directive.<sup>50</sup> Moreover, the US Department of Labor has reframed its stance on how pension funds governed by the Employee Retirement Income Security Act can legally consider ESG factors when investing.<sup>51</sup>

Furthermore, there has been an explosion of ESG ratings—by some estimates, there are more than 120 ratings organizations offering over 500 products. Changes to disclosure requirements in many countries, such as the changes in listing requirements of stock exchanges around the globe, will undoubtedly drive this trend forward even more.

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<sup>46</sup>Clark et al., “From the Stockholder to the Stakeholder.”

<sup>47</sup>CFA Institute, “CFA Institute ESG Survey.” [www.cfainstitute.org/en/research/survey-reports/esg-survey-2015](http://www.cfainstitute.org/en/research/survey-reports/esg-survey-2015).

<sup>48</sup>Bank of America Merrill Lynch, “ESG Part II: A Deeper Dive” (1 June 2017).

<sup>49</sup>PRI and MSCI, “Global Guide to Responsible Investment Regulation” (2016). [www.unpri.org/download?ac=325](http://www.unpri.org/download?ac=325).

<sup>50</sup>ShareAction, “IORPs II: Ground-Breaking ESG Risk Protection Measures Afforded to European Pension Savers. The UK Must Afford Savers the Same, Says ShareAction” (24 November 2016). <https://shareaction.org/press-release/iorps-ii-ground-breaking-esg-risk-protection-measures-afforded-to-european-pension-savers-the-uk-must-afford-savers-the-same-says-shareaction>.

<sup>51</sup>Katie Gilbert, “How Investors Will React to the DoL’s New ESG Guidelines,” *Institutional Investor* (19 November 2015). [www.institutionalinvestor.com/article/b14z9ytcjzldly8/how-investors-will-react-to-the-dols-new-esg-guidelines](http://www.institutionalinvestor.com/article/b14z9ytcjzldly8/how-investors-will-react-to-the-dols-new-esg-guidelines).

It is nothing short of a data revolution and a “new normal,” in which the materiality of sustainability information is now recognized across global markets. Transparency itself is becoming a key instrument of change in shifting colossal levels of capital toward those companies that consider the interests of all stakeholders. Consider the example of Dr. Bronwyn King, the founder of Tobacco Free Portfolios, who was galvanized to act when she discovered her pension fund was investing in the same cigarette companies that were killing her cancer patients. Over many years of successful lobbying, she has persuaded more than 35 Australian superannuation funds, which control nearly half the total funds under management, to shun tobacco.<sup>52</sup>

The success of such initiatives as Tobacco Free Portfolios relies on data about investments in tobacco companies and revenues from tobacco activities being made available. The public’s appetite for transparency and accountability is only set to grow further, with 86% of millennials interested in responsible investing and millennials being twice as likely to invest in a stock or fund if there is a social responsibility aspect.<sup>53</sup>

Coinciding with the emergence of ESG data as a global trend is the ability we now have, through artificial intelligence, to make sense of these data on a massive scale. And as ESG disclosure becomes an established norm for publicly listed companies, the real value lies in the increasingly sophisticated tools required to analyze increasing volumes of sustainability data.

Quantitative strategies analyze an amount of data that is too vast for any one human mind, sorting through immense amounts of data, and these strategies are rapidly replacing discretionary investment approaches. Today, cutting-edge algorithms and machine learning are quickly becoming an investor’s tools of choice, providing the ability to extract financially material information quickly and effortlessly.

Arabesque Asset Management uses self-learning quant models and big data to assess the performance and sustainability of companies. With a rules-based approach to stock selection that integrates ESG information with financial and momentum analysis, the firm’s technology processes more than 100 billion data points via 250,000 lines of code to construct its strategies.

Earlier this year, my firm launched Arabesque S-Ray, a tool that allows anyone to monitor the sustainability of thousands of the world’s largest companies. Inspired by the impact that the X-Ray had on medicine in the early 20th century, S-Ray is the latest

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<sup>52</sup>Gideon Haigh, “The Doctor Who Beat Big Tobacco,” *Guardian* (1 August 2016). [www.theguardian.com/news/2016/aug/01/the-doctor-who-beat-big-tobacco](http://www.theguardian.com/news/2016/aug/01/the-doctor-who-beat-big-tobacco).

<sup>53</sup>Morgan Stanley, “Are Millennials Democratizing Sustainable Investing?” (6 March 2017). [www.morganstanley.com/ideas/millennial-sustainable-investing](http://www.morganstanley.com/ideas/millennial-sustainable-investing).

technology of its kind to capture a vast amount of sustainability information that now exists on companies and make it relevant and understandable to investors.

S-Ray is a next-generation transparency lens that can empower all stakeholders to make better decisions for a more sustainable future. It works by systematically combining more than 200 ESG metrics with news signals from over 50,000 sources across 15 languages. It is the first tool of its kind to rate companies on the normative principles of the UN Global Compact: human rights, labor standards, the environment, and anticorruption (GC Score). Additionally, S-Ray provides an industry-specific assessment of companies' performance based on financially material sustainability criteria (ESG Score). The two scores are combined with a preferences filter that assesses a company's business involvements.

It is a platform that combines and aggregates sustainability information from a broad and ever-expanding set of sources with values-neutral technology built to streamline vast amounts of ESG data in the market.

Until recently, many investors have struggled to make sense of sustainability-based approaches. A major reason is that big data pertaining to ESG issues has remained scattered, incomplete, incoherent, and unstructured. No uniform measurement or easily applied framework allows investors to assess corporate performance in alignment with personal values and preferences.

The rules-based analysis of extra financial information in S-Ray can improve investment decision making. As an example, **Table 1** compares an S-Ray–screened universe of all global and developed market (DM) stocks with the appropriate conventional benchmarks. The screening consists of the following steps:

1. GC Score: Exclude the bottom 5% performers.
2. ESG Score: Exclude the bottom 25% performers per sector (i.e., worst in class), but reintroduce stocks showing significant positive ESG momentum.
3. Preferences Filter: Exclude companies involved with alcohol, gambling, tobacco, and weapons.

Considering both developed and emerging markets (Global All), a universe constructed using S-Ray outperforms by 0.57% per year, while exhibiting lower annualized volatility (–0.58%), drawdowns (–1.8%), and downside deviation (–0.48%). For developed markets only, the annual excess return is 0.64%, with similar improvements in downside risk performance.

Regarding the cumulative relative performance charts, the Global All universe started outperforming more consistently beginning in 2011. For the Global DM universe, this

**TABLE 1. COMPARISON OF AN S-RAY-SCREENED UNIVERSE AND A CONVENTIONAL BENCHMARK**

	MSCI ACWI NR	Arabesque S-Ray Global All		MSCI World NR	Arabesque S-Ray Global DM	
2007	11.66%	11.27%	-0.39%	9.04%	10.09%	1.06%
2008	-42.20%	-40.38%	1.81%	-40.71%	-39.58%	1.14%
2009	34.63%	31.76%	-2.87%	29.99%	29.35%	-0.64%
2010	12.66%	12.63%	-0.04%	11.76%	12.40%	0.63%
2011	-7.34%	-4.63%	2.71%	-5.54%	-3.61%	1.93%
2012	16.13%	15.78%	-0.35%	15.83%	15.74%	-0.09%
2013	22.80%	23.76%	0.96%	26.68%	26.10%	-0.58%
2014	4.16%	6.15%	1.99%	4.94%	6.35%	1.41%
2015	-2.36%	-1.91%	0.45%	-0.87%	-0.67%	0.20%
2016	7.86%	8.01%	0.15%	7.51%	7.53%	0.02%
2017	23.97%	23.33%	-0.64%	22.40%	23.02%	0.62%
Year to date July 2018	2.57%	2.76%	0.19%	3.57%	3.13%	-0.44%
Return per year	5.23%	5.78%	0.55%	5.43%	5.98%	0.55%
Volatility per year	16.02%	15.46%	-0.56%	15.57%	15.22%	-0.35%
Sharpe ratio	0.24	0.29	0.04	0.26	0.31	0.04
Maximum drawdown	-54.92%	-53.12%	1.81%	-54.03%	-52.80%	1.23%
Downside deviation per year @ 0.00%	11.40%	10.94%	-0.47%	11.08%	10.78%	-0.30%
Sortino ratio @ 0.00%	0.46	0.53	0.07	0.49	0.56	0.06
Upside/down- side capture ratio	1.00	1.03	0.03	1.00	1.03	0.03

Notes: NR = Net return. The light blue shading indicates S-Ray >50 bps above benchmark; the dark blue indicates S-Ray >50 bps below benchmark.

happened in 2009. This is a reflection of overall data quality, which has been improving over time. To better understand the added value of a screening process based on nonfinancial information, **Table 2** highlights a number of stocks that were excluded using S-Ray.

**TABLE 2. STOCKS EXCLUDED USING S-RAY**

Name	Date of Decision	Reason for Not Including	Next-Quarter Return (USD)		
			Company	Benchmark (MSCI ACWI)	Relative Performance
SunEdison	April 2016	Forensic accounting	-69.53%	-1.64%	-67.90%
Valeant	October 2015	Forensic accounting	-41.01	4.71	-45.72
Tesco	July 2014	Forensic accounting	-36.58	-3.84	-32.74
Alcatel-Lucent	July 2011	Not compliant with UNGC	-45.52	-18.11	-27.42
Glencore	July 2015	Not compliant with UNGC	-63.03	-9.51	-53.52
Bankia	January 2013	Poor ESG performance	-57.80	6.16	-63.96
ThyssenKrupp	July 2011	Poor ESG performance	-47.43	-18.11	-29.33
Lafarge	July 2011	Poor ESG performance	-38.67	-18.11	-20.57

*Note:* UNGC = UN Global Compact.

This is exactly where technology-driven approaches, such as S-Ray, can change the market. Its unbiased algorithms harness the power of machine learning, processing big data to produce a daily snapshot of a company's sustainability. By offering investors a modular way of aggregating relevant sustainability big data, S-Ray can improve decision making on responsible investment in the long term—a fourth dimension of security analysis. Indeed, Arabesque and State Street Corporation, the world's second-largest custody bank, recently entered a partnership whereby State Street integrates ESG data into its service offering. State Street will incorporate Arabesque S-Ray scores as a risk management and compliance measure across its \$28.5 trillion custody services starting this year. S-Ray data are also available on Bloomberg.



Another major force driving ESG considerations into the mainstream, facilitated by access to better technology, information, and awareness—and by millennials—is the rise of sustainability as a lifestyle choice. Over the coming years, the baby boomers, the wealthiest generation in history, will transfer roughly \$30 trillion in assets to their generation X and millennial children. And those younger generations plan to invest that wealth in a remarkably different way from their forebearers.

According to a recent global survey cited in the *Harvard Business Review*, 87% of millennials around the world believe that “the success of business should be measured in terms of more than just its financial performance.”<sup>54</sup> Another study, US Trust’s “Insights on Wealth and Worth,” found that high-net-worth millennials are “almost twice as likely as their grandparents to regard their investments as a way to express social, political, or environmental values” and “nearly three-quarters of millennials believe that it is possible to realize market-rate returns investing in companies based on their social or environmental impact.”<sup>55</sup>

As more people understand that through their investments they can express their personal values and contribute directly to sustainable development, finance can now become a catalyst for market transformation by directing capital toward more sustainable companies. People around the world are discovering that money is a powerful driver of change and that their own choices make a difference. The question around ESG issues is shifting from *Why?* to *Why not?*

Such technology as Arabesque S-Ray will ensure that this shift will only accelerate. S-Ray was built with the objective of taking sustainability into the mainstream by making it available in a cost-efficient and practical way to everyone. Through transparency, it has the power to move money from the bottom of the ESG value chain to the top, helping investors take action and forcing corporations to think about their future place in that value chain—truly sustainable finance.

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<sup>54</sup>A. Winston, “9 Sustainable Business Stories That Shaped 2016,” *Harvard Business Review* (December 20 2016). <https://hbr.org/2016/12/9-sustainable-business-stories-that-shaped-2016>

<sup>55</sup>V. Dhar and J. Fetherston, “Impact Investing Needs Millennials,” *Harvard Business Review* (2 October 2014). <https://hbr.org/2014/10/impact-investing-needs-millennials>.

# ANALYZING THE PERFORMANCE OF ESG FACTORS IN A MIXED ASSET SETTING

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Analyzing ESG factor impacts is commonplace for equity portfolios but much less common in fixed income. This article describes the results of research done using financial data science analysis, which integrates environmental, social, and governance (ESG) issues into a mixed asset universe in which equity and fixed-income securities are examined in one analytical setting. I differentiate “mixed assets” from “multi-asset,” because the latter builds asset class portfolios and then integrates them during the asset allocation process, whereas the former analyzes securities or various asset classes in one (mixed) analytical setting. In other words, multi-asset approaches usually involve at least three steps: a security selection process in the first asset class, another security selection process in the second asset class, and an asset allocation process between asset classes. Mixed assets, in contrast, combine security selection and asset allocation in one step, which implies that they require more statistical expertise to design but are more resource efficient to implement once developed.

Our research team’s journey into mixed assets was made possible by the financial data science laboratory of Sociovestix Labs, the financial market artificial intelligence spin-off from the German Research Center for Artificial Intelligence. It was as challenging as it was exciting and had profound implications for my understanding of both ESG investing and investment management of several asset classes with multiple portfolios.

At the start of the journey, we posed a rather simple set of questions: Which of the dozens of ESG factors perform well in equity securities and corporate fixed-income securities? And which perform well in both? Conceptually, we viewed equity to be priced on the basis of a risk–return trade-off with temporary shifts caused by investor preferences for sustainability, whereas we considered corporate fixed income to be priced largely on the basis of central bank decisions and risk expectations. In the absence of central bank changes, investors who bought corporate bonds that turned out to be less risky (riskier) than previously expected would gain (lose). In this context, ESG key performance indicators (KPIs) are particularly interesting, because they tend

to be predictive of downside risks but have a much less predictable relationship with upside opportunities. Hence, our working hypothesis was that ESG KPIs would allow for many more outperformance opportunities in fixed income than in equities.

This hypothesis is consistent with Sanford Grossman and Joseph Stiglitz's 1976 articles on the paradox of market efficiency.<sup>56</sup> The number of investors developing and executing ESG factor-based strategies in equities is currently much larger than that in corporate fixed income, implying less competition and hence more opportunities. However, although we indeed found many more opportunities in fixed income than in equities with respect to environmental and social KPIs, we found fewer opportunities for governance KPIs.

Our natural reaction was to go back to all the potentially relevant details in the governance data. Looking at each indicator in depth, we started to wonder how many were actually aligned in their interest with bond investors. Although certainly all indicators were coded in the interest of shareholders, a substantial number of indicators were for that very reason not necessarily in the interest of every bond investor. This finding made intuitive sense but led us to the intriguing follow-up research question: Which governance KPIs would perform well for both shareholders and bond investors?

To answer this question, we built an investable universe of US equity and corporate fixed-income securities and merged our equity benchmark model (the three-level Carhart model of Andreas Hoepner, Hussain Rammal, and Michael Rezec)<sup>57</sup> with our fixed-income benchmark model (the extended Edwin Elton and Martin Gruber model of Hoepner and Marcus Nilsson).<sup>58</sup> Although merging the securities required only an adequate master list of securities with an asset-class-independent sector classification, such as Sustainable Accounting Standards Board's Sustainable Industry Classification System, the merging of asset pricing models for different asset classes represented uncharted waters. It worked quite well, however, and resulted in more than 90% in-sample explanatory power, as we would expect from a robust financial data science analysis. (Financial data scientists tend to think that the science of data starts at 50% explanatory power and, as one moves upward in explanatory power, one understands more than one doesn't understand. The higher the explanatory power, the lower the noise and, hence, on average, the more robust the prediction.) But merging asset classes unveiled a significant surprise in terms of factor loading: Elton and Gruber's bond

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<sup>56</sup>S.J. Grossman and J.E. Stiglitz, "Information and Competitive Price Systems," *American Economic Review* 66 (1976): 246–253; S.J. Grossman and J.E. Stiglitz, "On the Impossibility of Informationally Efficient Markets," *American Economic Review* 70 (1980): 393–408.

<sup>57</sup>A.G.F. Hoepner, H.G. Rammal, and M. Rezec, "Islamic Mutual Funds' Financial Performance and International Investment Style: Evidence from 20 Countries," *European Journal of Finance* 17 (2011): 829–850.

<sup>58</sup>A.G.F. Hoepner and M.A. Nilsson, "Fixed Income Asset Pricing: Extending the Elton et al. (1995) Four-Factor Model" (2015). [www.fmaconferences.org/Boston/Hoepner\\_&Nilsson\\_-\\_FMA.pdf](http://www.fmaconferences.org/Boston/Hoepner_&Nilsson_-_FMA.pdf).

factors had made Fama and French's value factor rather redundant. In other words, it seemed that high-quality bonds were taking over the role of the value stocks.

Although we will conduct much more research in the mixed asset setting to confirm this result and we have yet to integrate fixed-income securities from other entities, such as sovereigns, we have made a few observations directly relevant to investment management. Specifically, we have found that the interaction between shares and corporate bonds matters. To give an extreme example, it is possible that in crisis scenarios, zero-debt stocks are perceived as less risky than below-investment-grade bonds of highly levered companies. Hence, the systemic interrelationships between stocks and bonds are worth studying, especially in fragile markets.

Furthermore, we observed two potentially business-relevant implications for investment managers who manage various portfolios in multiple asset classes. First, the securities in the portfolios should be analyzed not only with regard to their relationship with securities of the same asset class in the same portfolio but also with regard to their relationships with all securities held by the investor. Otherwise, diversification and risk management may not be as effective from a fiduciary duty perspective. Second, investors may want to consider—at least for their liquid asset classes—whether the traditional multi-layered approach, with multiple individual managers overseeing what may be several separate portfolios per asset class over several liquid asset classes, is actually still resource efficient in this age of data science. Although separating investments among several asset management teams has the advantage of avoiding concentration risk, analyzing individual portfolios or individual asset classes without regard for the greater good of the overall investment portfolio makes little sense.

# UNDERSTANDING AND CAPITALIZING ON SYSTEMIC IMPACTS OF ESG FACTORS

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Over the past 100 years, the management of investment risk has evolved through two stages, and it now appears to be entering a third stage. Through most of the 20th century, best practice in investment simply meant avoiding risky securities. Risk was managed at a single-security level, and fiduciaries were limited to investing in so-called legal lists of high-quality bonds and stocks. In the second half of the century, a new stage emerged as the theory of finance evolved. Tools were developed to measure and manage risk at the portfolio level. Fiduciaries could now include risky securities so long as, through diversification, the overall risk of their portfolios was not increased. Risk management was conducted at both the security and portfolio levels.

Today, investment may be on the verge of another evolution. Investors—particularly pension funds, sovereign wealth funds, family offices, and other investors with long-term investment horizons—are increasingly aware of the feedback loops between investment decision making and the sustainability of the environmental, societal, and financial systems they operate within. This increasing awareness stems from the nature of our hyper-connected world economy, in which the powerful forces of finance have the ability to “rock the boat” of these foundational systems or, conversely, to create a “rising tide” of investment opportunity based on the stabilization and preservation of these foundations.

That investors can affect these systems and that these systems can affect their portfolios in return was made apparent during the 2008 financial crisis and underlies the ongoing conundrum of prudent investment decision making in a time of climate change. This implicit understanding accounts in many ways for the global attention being directed toward the integration of environmental, social, and governance (ESG) factors into investment. Investors are becoming increasingly aware not only that ESG factors are important for specific security valuation and the management of portfolio risks but also that they can affect the markets as a whole. Moreover, given the \$250 trillion in investable assets globally, investors recognize that their cumulative policies and practices can influence the health of the systems on which these markets depend.

What is emerging is, in effect, an understanding that such factors have the potential both to provide opportunities for “alpha” generation when markets fail to recognize their implications and at the same time to influence the creation of a form of “smart beta,” through the cumulative management of risks and rewards at these system levels. This “beta play” is one in which investors recognize that there are environmental, societal, and financial system–related fundamentals that underlie entire markets and cut across asset classes, contributing to their overall investment performance. Equally important, these investors also understand that their cumulative decision making contributes to the performance of these systems.

Certain active managers have come to see the virtue of this approach. “What is the job of the aggregate asset manager?” asked Yves Choueifaty, CEO of TOBAM, for example. “It cannot be to beat the benchmark. The job is to make the benchmark go up. . . . If active managers allocate capital to companies that create value, the economy will prosper.”<sup>59</sup> Similar long-term perspectives are starting to penetrate markets on the passive side as well. In 2017, Japan’s Government Pension Investment Fund (GPIF), the largest pension fund in the world, commissioned the creation of three indexes with ESG tilts for its passively managed Japanese public equity holdings, because it believes that

it makes sense for GPIF—a universal owner with a massive portfolio—to try and maximize long-term investment returns through minimizing negative externalities relating to environmental and social issues. Furthermore, GPIF expects that considering ESG factors should improve risk-adjusted returns by mitigating risk over a long period.<sup>60</sup>

These investors understand both the possibility of creating alpha through the incorporation of ESG factors into individual security valuation or specific industry analysis and the long-term reward that comes from creating value in the whole economy by strengthening systems. These systems are the ecosystems that make up the entirety of our natural world and provide the energy, raw materials, and agricultural goods that fuel our economy. They are the societal constructs, the labor supply, and the built infrastructure that facilitate the conducting of business. They are the technology, legal, and political frameworks that provide trust in our financial markets and commercial enterprises.

Financial theory has historically treated these systems as exogenous factors, uncontrollable aspects of the economy over which investors have no influence and about which they need not be concerned. Yet in today’s increasingly complex world, the ability of global finance to affect these systems either positively or negatively should no longer be ignored.

<sup>59</sup>Yves Choueifaty, “Anti-Benchmark, Pro-ESG,” interview by Hugh Wheelan, *ESG Magazine* 3 (Spring 2016). [www.unepfi.org/fileadmin/banking/ESGissue03.pdf](http://www.unepfi.org/fileadmin/banking/ESGissue03.pdf).

<sup>60</sup>“GPIF Breaks into ESG-Investing Sphere,” *Asia Asset Management* (8 August 2016). [www.asiaasset.com/news/GPIF\\_ESG\\_CH0508\\_FS.aspx](http://www.asiaasset.com/news/GPIF_ESG_CH0508_FS.aspx).

By complementing the efficient discipline of portfolio management with specific intentional actions, investors can manage risks and rewards at these system-related levels. Through their investment belief statements, security selection, engagement with issuers of securities, and targeted investment programs, long-term investors have begun to adapt traditional investment practices to this new understanding.

It is no longer unusual to find such statements as the following, from the French national supplemental pension fund, ERAFP: “Investments based solely on the criterion of maximum financial profit fail to account for their social, economic and environmental consequences.”<sup>61</sup> Nor is it exceptional when, through its Green Initiative, the California State Teachers’ Retirement System incorporates environmental risk assessments, such as exposure to fossil fuels, air quality, water quality, land protection and usage, and climate change. In addition, in keeping with the growing emphasis of “impact” in investing, Dutch pension fund manager PGGM has allocated up to \$20 billion of its assets to a targeted fund that is seeking to find solutions to the basic environmental and social challenges of climate change, water scarcity, health care, and food security.

Moreover, an increasing number of investors with concerns such as these are taking up nontraditional tools specifically designed to address issues at system levels—such as additionality, standard setting, collaborative action, and public policy advocacy.

The term “additionality,” for example, is starting to show up among investment disciplines. The Irish Strategic Investment Fund uses this principle to identify investments in the Irish economy that are sustainable and that do not “displace” existing companies or industries or act as a “dead weight” on the economy. The New Zealand Superannuation Fund is one of many investors that uses standard setting based on international norms as the basis for its decision to no longer invest in companies involved in the manufacturing of cluster bombs. The California Public Employees’ Retirement System is one of many institutional investors that promotes collaborative action among peers on such system-related issues as climate change, water scarcity, and labor practices. Aviva Investors, the asset management division of the UK insurance company Aviva, believes that its fiduciary duty includes “putting pressure on policy makers to address key sustainability challenges within our capital markets and our broader economy.”<sup>62</sup>

This combination of traditional and nontraditional techniques facilitates initial steps toward managing risks and rewards at system levels—that is, toward enhancing and preserving these systems’ sustainability—while simultaneously continuing to monitor

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<sup>61</sup>SRI Charter, as adopted by ERAFP’s Board of Directors on 18 October 2016 ([www.rafp.fr/en/sites/rafp\\_en/files/publication/file/rafp-charte\\_isr-2016-uk-web-page.pdf](http://www.rafp.fr/en/sites/rafp_en/files/publication/file/rafp-charte_isr-2016-uk-web-page.pdf)).

<sup>62</sup>Euan Munro, foreword to “A Roadmap for Sustainable Capital Markets,” by Stephen Waygood, Aviva Investors (2016, updated October 2017): 7. [www.aviva.com/social-purpose/thought-leadership/roadmap-for-sustainable-capital-markets/](http://www.aviva.com/social-purpose/thought-leadership/roadmap-for-sustainable-capital-markets/).

security-level and portfolio-level risks. The Investment Integration Project has documented a variety of these practices in its study “Tipping Points 2016.”<sup>63</sup> This evolution in finance, which can help investors to act intentionally to create a rising tide of investment opportunity for all, is taking place in the context of an increasingly interconnected, powerful, and resource-constrained world. Managing risks at all three levels—securities, portfolios, and systems—is an emerging approach that recognizes, and can help contend with, these complexities.

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<sup>63</sup>William Burckart, Steve Lydenberg, and Jessica Ziegler, “Tipping Points 2016: Summary of 50 Asset Owners’ and Managers’ Approaches to Investing in Global Systems,” Investment Integration Project and Investor Responsibility Research Center Institute (7 November 2016). [https://irrcinstitute.org/wp-content/uploads/2016/11/TIIP-and-IRRCi\\_State-of-Industry\\_Nov-2016.pdf](https://irrcinstitute.org/wp-content/uploads/2016/11/TIIP-and-IRRCi_State-of-Industry_Nov-2016.pdf).





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