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CHAPTER 33

Financial Sector Growth, Consolidation, and New Technologies Make It a Powerful Actor in Tackling Global Environmental Challenges

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Introduction

The role of the financial sector in the global economy has been growing steadily in the last decades, together with its size. A report by OECD demonstrates that credit by banks and other intermediaries has risen strongly in nearly all OECD countries since the 1960s, on average more than tripling relative to GDP (OECD, 2015). The stock market capitalization has also expanded considerably—from 20% of GDP in 1975 to more than 100% of GDP in 2000. It reached up to 120% of GDP shortly before the Great Financial Crisis (GFC) of 2007–2008, slightly decreasing afterward. Though the GFC and the Pandemic of 2020 led to deceleration of the financial sector expansion, the importance of finance for the global economy is likely to continue to rise in the coming years.

The tremendous growth of the global financial sector is accompanied by consolidation trends in the financial services industry and the increasing level of concentration of financial capital in major economies. More than half of all financial assets in the world are now concentrated in the United States, though China is quickly catching up with the United States, turning into global financial power (Petrov et al., 2019a, 2019b).

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The scale and impact of financial sector on the global economy define its pivotal role in tackling global environmental challenges through mobilizing financial resources, providing insurance coverage, and helping to manage and hedge risks. This idea was expressed by the President of the ECB and the former head of the IMF Christine Lagarde: "High insurance coverage and deep capital markets help mitigate the macroeconomic impact of disasters. This matters at a microeconomic level, too, where a lack of effective access to insurance and finance can lead to a disproportionately greater impact of disasters on poorer households. In the absence of insurance, households will have to rely more on precautionary saving or government transfers. Substantial investment is likely to be required to underpin the energy transition, with some estimates running to hundreds of billions of euro each year in the European Union alone. Meeting that challenge requires contributions from both the public and private sector" (Lagarde, 2020).

Therefore, one of the key questions that modern policymakers and business community have to answer is how to urge the global financial sector to provide finance of the quantity and quality that will be sufficient to tackle global environmental challenges in the most efficient way. This research aims to evaluate the role of the Industry 4.0 digital technologies as possible drivers of sustainable finance and positive global environmental changes in the coming years.

Methodology

The research is based on the analysis of reports and data provided by specialized international organizations, academic literature, official statistical data, and information from official Web sites of companies involved in sustainable finance activities.

In order to achieve environmental and other sustainable development goals, financial flows should be channeled into activities that can be considered sustainable and away from unsustainable ones. To conduct the research, we apply the approach and definitions of the European Commission. According to it, sustainable (responsible) finance can be defined as the process of taking due account of environmental, social, and governance (ESG) considerations when making investment decisions in the financial sector (European Commission, 2020). Environmental considerations can include not only climate change mitigation, but also such issues as the preservation of biodiversity, pollution prevention, and circular economy. Social considerations include the issues of inequality, human rights, investment in human capital and communities, and labor relations. Governance considerations are related to management structures, employee relations, and executive remuneration and should ensure the inclusion of social and environmental considerations in the decision-making process.

We chose to evaluate the impact of the Industry 4.0 on the development of sustainable finance and environment by considering the application of artificial

intelligence, since artificial intelligence is generally accepted as one of the most important features of the Industry 4.0.

Results

Financial instruments and mechanisms by themselves are sustainability-neutral. For investments to be directed primarily to responsible companies the latter should provide additional value to investors. The factors that create such additional value can be broadly divided into subjective (willingness to invest sustainably) and objective ones (such as impact of ESG factors on performance and risk of financial instruments).

Today the number of sustainability-aware investors is steadily growing. These fund-owners want not only to earn return on their assets, by also to make environmental and social difference, and are sometimes ready to tolerate slightly lower yields on ESG investments in comparison with other instruments that are present on the market. A survey of retail investors conducted by 2° Investing Initiative, demonstrated that two-thirds of French and German retail investors want to invest sustainably, with 64% of retail investors accepting a hypothetical −5% trade-off on their total returns(The 2° Investing Initiative, 2020).

However, with large institutional investors being the main actors on global financial markets, the rapid development of responsible finance should still be based on objective factors, such as performance and risks.

The risks posed by ESG factors can be broadly divided into two main categories: physical risks and transition risks (Network for Greening the Financial System, 2020b):

- Physical risks. Natural calamities and environmental incidents, as well as an array of social and governance risks can lead to substantial losses of assets incurred by nations and companies. In turn, financial institutions can be affected via their exposure to sovereign and corporate borrowers. The recent rapid growth of sustainable finance, in part, has been prompted by the growing awareness that ESG factors can have a significant impact on companies and industries, while traditional pricing models usually disregard these risks due to the difficulties in the assessment of their probability and financial impact. The notion that the failure to price in ESG-related risks leads to distortion of market prices in favor of unsustainable practices and the assumption that, all risks considered, the effective yields on sustainable instruments in the long run will be higher in comparison with unsustainable ones, represents one of the key assumptions lying at the basis of sustainable finance.
- Transition risks arise from human efforts to confront ESG challenges and include changes in public policies (such as introduction of carbon-trading systems, green certificates, specialized taxes, and subsidies), technology breakthroughs, shifts in investors' preferences, and disruptive business

model innovations. The growing anxiety about negative externalities produced by some businesses and the need to tackle global problems, such as climate change, force governments to introduce ESG-related regulations and punish unsustainable practices with fines and specially designed fees. Firms that fail to meet forthcoming regulatory requirements risk to find delayed compliance increasingly expensive.

Though physical risks may seem to influence performance of portfolios more directly, a survey of financial institutions conducted by the Network for Greening the Financial System, a group of central banks and supervisors, demonstrated that in most cases the key consideration of portfolio managers was not the risk differential between green and brown assets, but rather more diffuse perception of risks (Network for Greening the Financial System, 2020a). Most banks pursued sustainable practices as part of their corporate social responsibility strategies or in an attempt to mitigate reputational, business model, and legal risks, in other words, transition risks. Only five respondents claimed to have conducted backward-looking analysis on a potential risk differential between green and brown assets, but failed to achieve robust results, which can be explained by the absence of common classifications and limitations of backward-looking analysis (historical data do not reflect future climate-related risks). Many respondents underlined the lack of standardized client data as the main obstacle for defining the greenness of an asset. At the same time, respondents noted that companies with ESG projects are expected to have a better risk profile, as they are better informed of their environment and benefit from long-term rise in profitability in case they invest in energy-efficiency projects.

The Size of the ESG Market

Sustainable finance has already become a major trend on financial markets, though it can be difficult to calculate its share in the total sum of allocated funds due to the lack of established definitions. The estimated volume of ESG-principled investing varies from US$3 to US$31 trillion, which constitutes almost one-third of global assets under management (IMF, 2019). The ESG-dedicated funds account for US$850 billion of assets (or 2% of global assets under management) and are forecasted to grow rapidly in the coming years. Equity-based ESG funds controlled US$560 billion of assets in 2019. Global green bond issuance amounted to $168.4 billion in 2018.

The largest ESG markets are located in the European Union, the United States, and Japan. While in the US and Japan the strongest growth factor is environmental, in Europe the growth is driven mainly by governance factors.

ESG-Related Instruments and Practices

Financial markets have responded to the growing demand for sustainable financial instruments by offering a new array of investment opportunities—from green bonds to ESG-dedicated funds.

The rise of sustainable investing in equities came after the release of the UN Principles of Responsible Investment in 2006 and was prompted by acknowledgment of the substantial nature and long-term character of ESG-related risks.

A breakthrough in fixed-income sustainable investment followed in 2007, when some multilateral development organizations (International Bank for Reconstruction and Development, European Investment Bank) issued green label bonds. The Green Bond Principles and the Climate Bond Initiative were later developed to set up standards for green bonds issuance.

Institutional investors adopt ESG principles by subscribing to international ESG standards. The leading international organization in the field of developing such standards is the United Nations Environment Programme Finance Initiative (UNEP FI), a partnership between UNEP and the global financial sector that aims to mobilize private sector finance for sustainable development. UNEP FI has established or co-created Principles for Responsible Banking (PRB) (subscribed by more than 130 banks with the total sum of assets amounting to US$47 trillion, or one-third of the global banking sector), Principles for Sustainable Insurance (PSI) (applied by insurers that account for 25% of the world premium) and Principles for Responsible Investment (PRI) (applied by half the world's institutional investors with US$83 trillion in assets). It also supports Sustainable Stock Exchanges Initiative (SSEI) that today involves 90 stock exchanges representing almost all publicly listed capital markets (UNEP Finance Initiative, 2020).

The leading world banks have already subscribed to the Equator principles, undertaking to promote sustainable practices and to deny financing to unsustainable businesses.

Rating agencies develop specialized indices of sustainable businesses and assets (such as Dow Jones Sustainability Index, FTSE Global Climate Index Series, FTSE ESG Index Series, S&P Green Bond Select Index). In addition, they start to accompany their credit risk assessment reports with nonfinancial information arising from sustainability considerations.

The VanEck Vectors Green Bond ETF has become the first US-listed fixed income ETF for US and foreign green bonds, tracking the performance and yield characteristics of the S&P Green Bond Select Index.

Approaches to Incorporation of ESG Principles into Business Models

Financial institutions can choose different ways to incorporate ESG considerations into their investment decisions. Some of the most commonly used methods include:

- Negative screening, the most widely applied practice, which implies excluding from portfolios companies or entire sectors on ethical or religious grounds (such as tobacco, alcohol, and munitions) or based on environmental considerations (coal mining and coal-fired plants, sand oil, Arctic oil, and gas activities);
- Positive screening, developed later than negative screening, favors companies that comply with certain minimum ESG standards or norms (norm-based screening), or sectors and firms that are considered sustainable (sustainability-themed investments);
- ESG scoring uses a set of metrics to evaluate a company's performance across a number of ESG factors. The scores can further be used to compose sustainability rankings or be incorporated into broader credit scores;
- Limiting exposure to risk sectors as percentage of total financing and setting targets for exposure to positive impact activities are commonly used by financial institutions as part of their sustainability strategies.

Barriers to the Development of ESG Investing

Despite the growing demand from investors and clients, investment managers face significant impediments when trying to implement ESG principles into their investment decisions.

To start with, the unified global criteria for what can be considered ESG investment have not yet been developed. The same can be said about consistent methodologies and reporting standards.

The existing corporate ESG reporting is largely voluntary and inconsistent, as a result, only a small proportion of enterprises now publish ESG reports. Therefore, anyone trying to estimate ESG performance of a company has to deal with the lack of reliable and consistent information. In addition, some companies involve in so-called greenwashing (providing unrealistically positive reporting on implementation of ESG principles in their operations), attributing themselves responsible corporate behavior that they in fact do not pursue.

The G20 identifies such barriers to scaling and deploying sustainable finance as: information asymmetries; limited analytical capabilities (including difficulty in fully identifying, assessing, and pricing risks associated with unsustainable investments as well as upside opportunities of sustainable financing); maturity mismatches (lack of long-term funding required for sustainable projects); lack of internalizing environmental and social externalities (Sustainable Finance Study Group, 2018).

Performing ESG assessment in the absence of specialized disclosure implies processing vast amounts of unstructured and incompatible data from various sources. Hiring a team of analysts to conduct a specialized research would

imply disproportionately high costs for an investor. On the other hand, companies, especially small businesses, can view ESG disclosure as an unnecessary expense.

Overall, high costs related to ESG disclosure may be considered a factor that drives both borrowers and lenders away from responsible financing. Therefore, digital solutions that would assess a company's ESG performance at a tolerable price could significantly accelerate the growth of responsible investing and, as a result, contribute to sustainable development.

The Promise of Data Science

Linking specific sustainable digital finance practices to the evidence of their impact demonstrates that digital finance that includes the use of such Industry 4.0 technologies as big data, artificial intelligence (AI), machine learning, blockchain and IoT in the financial sphere, contributes to achieving 13 out of 17 sustainable development goals (G20 Sustainable Finance Study Group, 2018). More specifically, digital finance accelerates the development of sustainable finance.

The potential of artificial intelligence, machine learning, and fintech in promoting responsible investment has been recognized on the highest level. In November 2019, the Monetary Authority of Singapore (MAS) announced the Green Finance Action Plan to promote a more sustainable financial system, which identifies harnessing technology to enable trusted and efficient sustainable finance flows as one of the four key thrusts. In June 2020, the Swiss Federal Council issued a report and guidelines on sustainability in the financial sector, stressing the key role of green fintechs as innovation drivers, and conducted the 2020 Green FinTech Survey to reveal obstacles and opportunities for fintechs to deliver positive environmental impact that transcends Switzerland's borders.

The processes that are expected to be facilitated by data science technologies include:

- Gathering and initial processing of standardized information. Algorithms, that would automatically collect accurate, consistent, and timely ESG relevant data, such as information represented in corporate ESG reports, are expected to accelerate and to lower the cost of ESG compliance assessment. This could be particularly useful when updating ESG indices. It has been estimated that applying algorithms to perform repetitive and high-frequency tasks can reduce operation costs of businesses by 50–70% (EY, 2016);
- Identifying patterns, references, and links across vast amounts of unstructured data. Development of such technologies can be considered a complex and difficult task, however, they could significantly enhance the effectiveness of decision making, risk pricing, and capital allocation;
- Detecting and eliminating inconsistencies to improve data quality;

- Measurement of ESG factors and their incorporation in pricing and decision making. The losses caused by ESG risks, such as climate change, are large, nonlinear, and hard to estimate. They can be incurred by particular companies or affect broader economic conditions, affecting volatility of financial markets and economic growth. Applying artificial intelligence to model these effects can help to better estimate their scale and identify the transmission channels, which can be used both by businesses (such as insurance firms to better assess risks and calculate premiums) and governments (to effectively internalize negative externalities by charging taxes and fines);
- Increasing transparency. Automatic processing of ESG data by artificial intelligence would ensure reliable and real-time disclosure, facilitate comparisons and eliminate greenwashing;
- Automatization of credit approvals;
- Facilitating regulatory compliance;
- Tailoring portfolios to investors' preferences;
- Other. Digital technologies can supply the financial industry with completely new tools. For example, a research conducted by Sony CSL for Japan's Government Pension Investment Fund found that AI can successfully define fund managers' styles and drifts by analyzing trading behavior data, and can therefore help to appoint managers, whose values and trading patterns are consistent with the goals and investment strategy of the fund (Sasaki et al., 2018).

The process of incorporating digital technologies into sustainable finance can be prompted by the fact that the already existing machine learning models and quantitative methods, used in other thematic and non-thematic portfolios, can be applied to EGS-financing as well, without the need to develop specific approaches.

The Examples of Companies Offering AI Solutions for Sustainable Finance

The first sustainable finance digital solutions have already found their way onto the market.

- One example of a company that applies AI to provide alternative ESG data insights to institutional investors is Truvalue Labs, which sells its services to the UK's £30 billion Brunel Pension Partnership and Government Pension Investment Fund. With the help of natural language processing and machine learning, it mines data from more than 100,000 non-company sources to help investors identify sustainable investments in accordance with their preferences;

- JP Morgan, an investment bank, applies AI-based Themebot to screen keywords in patent filings in order to find companies linked to new low-carbon technology;
- In 2014 Deep Knowledge Ventures, a venture capital firm, appointed an algorithm called VITAL (Validating Investment Tool for Advancing Life Sciences) to its boardroom. The algorithm proved useful when assessing future performance of biotech start-ups by detecting red flags that increased the probability of their failure;
- Sensefolio applies Machine Learning and NLP techniques to provide ratings on ESG performance of over 20,000 companies, claiming to derive data from more than 100,000 sources of information, including news, reports, social media posts, company reviews, etc. and mapping scores to 50 ESG subcategories;
- A similar service is provided by Sustainalytics, a Morningstar company, which compounds corporate ESG risk ratings. Sustainalytics also provides predictive analytics for smart climate investing and cheaper incorporation of ESG considerations into investment decision making;
- Ping An Group, a Chinese financial services conglomerate, aims to combine artificial intelligence with ESG to provide Ping An analysts with ESG-related investment suggestions, depending on their specific needs. AI is expected to automatically attribute about 500 ESG-related labels to investment projects based on their policy papers and principles; besides, the algorithm helps to reveal when and how investment decisions failed to comply with ESG principles, thus strengthening performance management of ESG;
- In Switzerland, a fintech platform yourSRI.com screens approximately €15 trillion of assets under management every day, enabling investors to create ESG ratings, receive key performance indicators and discretionary investment mandates for mutual funds and ETFs with one click. The platform combines traditional financial data (Thomsom Reuters/Lipper) with ESG data (MSCI ESG Research) and carbon data (ISS-Ethix) to automatically calculate environmental and social score of a fund as well as its carbon footprint;
- FTSE Russel in the UK created a new smart Global Climate Index that uses data from the FTSE Green Revenues data model to hedge climate-related risks and detect the upside opportunities from the transition to a low-carbon economy;
- Similarly, Deutsche Bank in cooperation with Solactive announced the launch of the Solactive Sustainability Index Europe, based on the S-Ray platform, a data-driven machine learning investment tool, to track the performance of environmentally and socially responsible European firms;
- Big data, machine learning, and AI have already transformed alternative lending platforms that started to offer loans to a broader base of customers and a new class of investment opportunities to savers. For example, Mercado Crédito in Argentina evaluates 400 variables when

providing loans to small enterprises in order to unlock innovation for social impact;
- A number of alternative finance platforms use artificial intelligence to find optimal investment opportunities for their customers. For example, CleanTek Market in Australia uses algorithms to match organizations active in the cleantech sector with each other, evaluate the quality of the deal and aggregate small projects into larger deals;
- A partnership between CréditAgricole Assurance and Airbus utilizes satellite imagery to enable precise calculation of losses incurred by grassland owners and farmers due to climate variations, which facilitates the development of innovative insurance products;

Risks

While giving a promise of tremendous benefits when it comes to evaluating and preventing ESG-related risks, artificial intelligence can itself become an ESG risk for societies and companies that aim to implement it into their operations.

- For one thing, the use of artificial intelligence could create a significant negative environmental impact, as the technology requires large amounts of computing power and can be considered highly energy-consuming. Mining of metals used to produce hardware can add to ecological degradation;
- Besides, like in any other sphere, artificial intelligence in finance aims to replace people when it comes to routine intellectual operations, such as gathering of information and its initial analysis. This, in turn, raises the question of possible layoffs and can add to social inequality and instability—the risks that AI is meant to help to mitigate. A 2018 report by OECD states that thought the worries about "massive technological unemployment" are exaggerated, automation in certain industries may lead to further polarization of the labor market;
- More detailed risk assessment in insurance increases the chances that some people or social groups become uninsurable. In sectors other than insurance, bias in algorithms can give rise to financial exclusion of disadvantaged groups;
- While the application of AI to make ESG-related investment decisions can improve the image of a company, the questions of ethics and privacy when collecting and processing information, including large amounts of highly personal data that especially financial institutions have access to, may act to the opposite;
- Another concern voiced by researches in the field of AI states that algorithms may replicate existing problems in society if the datasets that are used to teach the machine are themselves biased;

- The backward-looking character of data that algorithms analyze defines limits to what AI can do in finance;
- AI cannot be considered a reliable tool for predicting and estimating regulatory risks;
- Some other impacts of excessive use of artificial intelligence may be difficult to anticipate, such as its possible effects on democracy, the rule of law or on the human mind itself.

Taking the possible risks related to artificial intelligence into account, the United Nations suggested that AI algorithms should be subjected to special auditing to ensure that they benefit to the UN Sustainable Development Goals (Truby, 2020). The auditing should not, however, be so burdensome that it prevents innovation.

European Commission responded to the ethical and sustainability risks posed by artificial intelligence by developing Ethic guidelines for trustworthy AI. The report states that AI can be considered trustworthy if it displays three main characteristics: It should be lawful, ethical, and robust. The framework also outlines the seven key requirements that AI systems should meet in order to be deemed trustworthy: human oversight; technical robustness and safety; privacy and data governance; transparency; diversity, non-discrimination, and fairness; societal and environmental well-being for all human beings, including future generations; accountability.

General Data Protection Regulation, introduced by the EU in 2018, stipulates that any company can be required by the European Union to explain a decision made by one of its algorithms.

Policy Implications

Governments can and should play a leading role in encouraging wider use of digital technologies in sustainable finance by:

- Raising awareness about the potential, opportunities, and threats connected with utilization of digital technologies in sustainable finance;
- Providing risk assessment and disseminating knowledge about new sustainable digital finance solutions;
- Developing standards, methodologies, and legal frameworks in the field of sustainable finance;
- Hosting multistakeholder platforms to initiate discussion and serve as centers of gravity for action on sustainability;
- Introducing financial and other stimulus to promote sustainable investment;
- Improving digital and financial infrastructure;
- Integrating sustainability elements into the existing financial system.

Despite the bright prospects for the application of AI to evaluate corporate ESG performance, introduction of policymaker actions that would standardize and incentivize disclosure can significantly accelerate the growth of sustainable finance. Governments can not only improve reporting standards, but also guide companies in data analysis and risk analytics, developing methodologies that would efficiently price in externalities, evaluate and mitigate risks and turn long-term benefits from sustainability into today's performance. More and better data can reveal the spheres where market mechanisms fail to take negative externalities into account and therefore some policy action is needed. Finally, governments can introduce incentives to foster the development of sustainable finance markets.

Multilateral cooperation of countries in the field of ESG-related standards and supervision can help to overcome the lack of supervisory capacity and to avoid fragmentation of sustainable asset markets.

Artificial intelligence can be applied when developing the mentioned standards and regulations to define the most crucial ESG factors and to develop techniques of negative externalities internalization.

Conclusion

The research has identified two possible sources of growth for sustainable finance: the increasing willingness of ecologically and socially aware individuals to invest sustainably, even if at lower yields, and the assumption that, should ESG-related risks be properly reflected in the prices of financial instruments, sustainable investments would demonstrate better long-term performance-risk ratios in comparison with unsustainable ones. Though the second factor holds far greater potential, as it automatically increases the attractiveness of responsible investments for all market participants, until now financial institutions have struggled to develop methodology and instruments to effectively price in ESG-related risks. However, investors' demand for sustainable instruments, complemented by policy shifts toward sustainability in some countries, has turned out sufficient to instigate the development of a wide array of ESG-related instruments and has led to the emergence of noticeable and dynamic sustainability sector on the financial markets.

Still, it can be expected that further development of sustainable finance will be founded on pricing in risks and negative externalities associated with unsustainable business practices. Today financial intermediaries face numerous obstacles when trying to create ESG profile of a business. Some of the widely recognized impediments include the lack of standardized definitions of sustainable activities and instruments; the voluntary and inconsistent nature of corporate ESG disclosure; the complex and long-term character of ESG-related risks.

The further analysis has revealed that such Industry 4.0 technologies, as big data and artificial intelligence, can in a large part eliminate these barriers by speeding up and reducing the cost of collecting and processing vast amounts

of unstructured ESG-related data and, consequently, accelerate the rise of responsible investment.

However, as the industry is still in the process of formation, active governmental supervision is required to ensure efficient and orderly development of sustainable finance. Financial authorities are expected to promote responsible investment by developing legal frameworks and guidance for financial institution as well as introducing regulations to internalize ESG-related externalities (such as quota trading systems, ESG-related fines, and fees). Besides, specialized supervision and regulations should be implemented in order to minimize the ESG-related and privacy risks accompanying the use of digital technologies in finance.

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