CHAPTER 1

The Sustainability–Financial Risk Nexus

Marco Migliorelli

Abstract This chapter gives an overview of the relationship nowadays linking sustainability-related risks (stemming from climate change, environmental degradation, social inequality, policy and technology shifts) and financial risks. Two main conclusions highlight the importance of this nexus. First, the expected consolidation of sustainability-related risks in the near future has the potential to produce a widespread impact on the financial results of both banks and insurance companies. Second, the full consideration by financial actors of sustainability-related risks may lead in some geographical areas and for some economic sectors to significant pricing adjustments and to new market failures (in terms of credit cutbacks and non-insurability of risks). The chapter concludes

The contents included in this chapter do not necessarily reflect the official opinion of the European Commission. Responsibility for the information and views expressed lies entirely with the author.

M. Migliorelli (✉)
IAE Université Paris 1 Panthéon-Sorbonne (Sorbonne Business School), Paris, France
e-mail: Marco.Migliorelli@ec.europa.eu

European Commission, Brussels, Belgium

M. Migliorelli and P. Dessertine (eds.), *Sustainability and Financial Risks*, Palgrave Studies in Impact Finance,
https://doi.org/10.1007/978-3-030-54530-7_1

by proposing a structured taxonomy systematically linking sustainability-related risks and financial risks.

Keywords Sustainability-related risks · Climate change-related risks · Physical risk · Transition risk · Financial risks · Sustainable finance

1.1 Introduction

When it comes to the discussion on the relation between sustainability and finance, the policy and academic debate has been focused thus far on the possible role of the latter to support the transition towards a climate-neutral economy and a fairer society. In this respect, concepts and frameworks such as sustainable finance, green finance or climate finance have progressively emerged.[1] These concepts and frameworks have also been consolidating within the financial industry in the form of new financial instruments (e.g. green bonds and sustainable funds), listing options (e.g. dedicated segments for sustainable securities in several stock exchanges worldwide), certification possibilities (e.g. green and climate labels for financial securities) or specific financing supporting initiatives (e.g. the World Bank or the European Investment Bank sustainability programmes). A new stream of literature is also progressively emerging dealing with these matters (e.g. Lehner 2016; Ziolo and Sergi 2019; Migliorelli and Dessertine 2019a).

Nevertheless, little attention has been given so far to the specific relationship linking sustainability and financial risks. That is, to the discussion on how factors such as climate change, environment degradation or social inequality, among others, can impact financial actors and markets. Indeed, this relationship, which is referred here as the *sustainability-financial risk nexus*, is of the utmost importance and may have systemic-wise consequences. For some observers, the failure of the various components of the financial industry to correctly integrate sustainability-related risks into financial risks frameworks may represent in the longer term a threat to the stability of the financial system as a whole (e.g. EC 2018a; BIS 2020).

[1] See for example UNEP (2016) or Berrou et al. (2019a).

To deepen the analysis on this issue, this chapter is structured as follows. First, Sect. 1.2 gives an overview of the role played nowadays by finance in fostering sustainability. To do that, the political and societal processes culminated with the adoption of the Sustainable Development Goals (SDG) and the signature of the Paris Agreement in 2015 are presented, as well as the expected contribution of finance in the resulting agendas. Then, Sect. 1.3 introduces the role of the *sustainability-financial risk nexus* within the general sustainable finance framework. In this respect, a review of the (scarce) literature dealing with this issue is also given. This dissertation is followed by Sect. 1.4, proposing a more comprehensive approach to the understanding of the relation between sustainability-related risks and financial risks. To this extent, a structured taxonomy linking the different types of risks is proposed. Finally, Sect. 1.5 concludes with a scrutiny of the key element of pricing of financial services when fully considering sustainability-related risks. Such an analysis includes the recognition of possible new market failures resulting from the progressive consolidation of these risks.

1.2 The Role of Finance in Fostering Sustainability

1.2.1 The Sustainable Development Goals (SDG) and the Paris Agreement

The concern of the sustainability of human activities have been discussed for decades (e.g. Renneboog et al. 2008; Berrou et al. 2019b). However, a significant acceleration in the political and societal debate has been observed only in the last few years. In this respect, the adoption of the Sustainable Development Goals (SDG) in September 2015 and the Paris Agreement[2] reached in December of the same year landmarked a new

[2] The Paris Agreement resulted from the United Nations Framework Convention on Climate Change (UNFCCC), an international environmental treaty that aims to limit global greenhouse gas (GHG) emissions and that is still in force today. Starting from 1995, signatories of the UNFCCC met on a yearly basis, through the Conferences of the Parties (COP). In 1997, as result of the conference held in Kyoto (COP 3), the Kyoto Protocol extended on the UNFCCC and led to the establishment of the first global legally binding obligation addressing climate change. The Paris Agreement was signed during the COP 21.

era for the fight against climate change and the transition towards a sustainable economy.[3]

The SDG are part of the "2030 Agenda for Sustainable Development" adopted by the United Nations (UN) General Assembly. The Agenda is "a plan of action for people, planet and prosperity. It also seeks to strengthen universal peace in larger freedom" (UN 2015). The SDG, to be achieved by 2030, have the merit to clearly identify the priorities of the international community in the attempt to reach a sustainable society, highlighting the importance of protecting the environment, of ensuring decent living conditions for all human beings and limiting the negative impacts of economic development. Table 1.1 reports the 17 SDG. In addition, 169 targets and 242 global indicators were also set to monitor the progress towards the realisation of the goals. In point of fact, the SDG reflect all the three distinctive dimensions of sustainable development: the economic, social and ecological dimensions. The wide acceptance of the SDG at the highest political levels represented with no doubt an important success and a significant step forward for the recognition of sustainability as one of key issues to be solved in the interest of humankind as whole.

Resulting from a parallel process, the Paris Agreement was conceived within the United Nations Framework Convention on Climate Change (UNFCCC), a global environmental treaty aiming at limiting global greenhouse gas (GHG) emissions. Starting from 1995, signatories of the UNFCCC have met on a yearly basis, through the Conferences of the Parties (COP). The Paris Agreement was signed during the COP 21,[4] when world leaders committed to strengthen the global response to the threat of climate change by "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C". To reach these ambitious objectives, appropriate mobilisation and provision of financial resources, a new technology framework and enhanced capacity-building were given specific and unprecedented attention. The agreement

[3] Among the other noteworthy initiatives on the defence of the environment, in May 2015 the Pope Francis addressed the subject of environmental degradation and climate change in a historical encyclical letter "Laudato sí" on "Care for Your Common Home".

[4] The UNFCCC had some encouraging results already before COP 21. In 1997, as result of the conference held in Kyoto (COP 3), the Kyoto Protocol led to the establishment of the first global legally binding obligation addressing climate change.

Table 1.1 Sustainable Development Goals (SDG)

#	*Sustainable Development Goal*	*Short description*
SDG 1	No poverty	End poverty in all its forms everywhere
SDG 2	Zero hunger	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
SDG 3	Good health and well-being	Ensure healthy lives and promote well-being for all at all ages
SDG 4	Quality education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
SDG 5	Gender equality	Achieve gender equality and empower all women and girls
SDG 6	Clean water and sanitation	Ensure availability and sustainable management of water and sanitation for all
SDG 7	Affordable and clean energy	Ensure access to affordable, reliable, sustainable and modern energy for all
SDG 8	Decent work and economic growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
SDG 9	Industry, innovation and infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation
SDG 10	Reduced inequalities	Reduce income inequality within and among countries
SDG 11	Sustainable cities and communities	Make cities and human settlements inclusive, safe, resilient and sustainable
SDG 12	Responsible consumption and production	Ensure sustainable consumption and production patterns
SDG 13	Climate action	Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy

(continued)

Table 1.1 (continued)

#	*Sustainable Development Goal*	*Short description*
SDG 14	Life below water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
SDG 15	Life on land	Protect, restore and promote sustainable use of terrestrial ecosystem, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
SDG 16	Peace, justice and strong institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
SDG 17	Partnerships for the goals	Strengthen the means of implementation and revitalise the global partnership for sustainable development

Source Author's elaboration based on the SDG description as given in the 2030 Agenda for Sustainable Development (UN 2015)

requires all Parties to put forward their efforts through Nationally Determined Contributions (NDC) and to report regularly on their emissions and on their implementation efforts. The Parties also bore a responsibility to meet every five years on the subject and set up a robust, transparent and accountable reporting system to track their progresses.[5] Although the global reach of the Paris Agreement is undeniable, further work is still needed to ensure its concrete impact on climate change (Berrou et al. 2019b). In fact, the agreement is only partially legally binding and there are no means of systematically verifying if the Parties are reaching their objectives.[6] Some important items were also discarded from the

[5] The objectives that were announced during the agreements will be revised in 2020, and once every five years after that initial revision. An overall assessment will be performed in 2023, and, once more, will occur every five years.

[6] In addition, in June 2017, United States President Donald Trump announced his intention to withdraw his country from the Paris Agreement. Under the agreement itself, the earliest effective date of withdrawal for the United States is November 2020.

debate, including carbon pricing and the possible discontinuation of fossil fuel extractions. Furthermore, in 2018, the Intergovernmental Panel on Climate Change (IPCC)—the United Nations body for assessing the science related to climate change—launched the alarm stating that the world needs to limit temperature increase to 1.5 °C with respect to pre-industrial levels to reduce the likelihood of extreme weather events and emphasised that GHG emissions need to be reduced with far more urgency than previously assumed (IPCC 2018).[7]

The adoption of the SDG and the Paris Agreement and the growing awareness of the civil society for sustainability issues are progressively imposing a new agenda to both governments and international institutions (e.g. EC 2019a). The changeover implies a deep reflection on the economic and social structures today in place and needs strong political commitment, ambitious technology investments, adapted regulations and likely a change in the consumption and behavioural patterns of the population (e.g. EC 2018b). In such a context, the availability of financial resources to support the transition has consolidated as an essential enabling factor.[8]

1.2.2 The Rise of Sustainable Finance

Defining precisely what it is today called sustainable finance is not an easy task. As a matter of fact, financial institutions, governments and international organisations tend to create definitions according to their underlying motivations (UNEP 2016; IFC 2017). In addition, trough time a number of possibilities to account for the connection between finance and sustainability have flourished. Among them, it should be highlighted the concern with environmental, social and corporate governance (ESG) criteria (e.g. Friede et al. 2015), the impact investing and the social responsible investing (SRI) approaches (e.g. Vandekerckhove et al. 2012; Hebb 2013), the analysis of the impact of financial development on environment degradation (e.g. Tamazian et al. 2009), the concern with climate change and human rights (e.g. Alm and Sievänen 2013), the

[7] In particular, net-zero carbon emissions at global level need to be achieved not beyond the half of this century and neutrality for all other GHG not much later.

[8] As an example, investments of around EUR520–575 billion annually have been estimated to be necessary in the EU only in order to achieve a net-zero GHG economy in the 2050 horizon (*Source* EC 2018b).

assessment of the effect of finance in terms of negative externalities (e.g. Ziolo et al. 2019), the new role of sustainable finance for financial institutions having a formal dual bottom-line approach and for which financial performance need to coexist with social goals (e.g. Migliorelli 2018).

Nevertheless, the framework provided by the SDG can today be used as a new reference in the attempt to better circumscribe the perimeter of action of sustainable finance and its various components. In this respect, sustainable finance may be considered to embrace all the financial stocks and flows mobilised to achieve the SDG, irrespectively of their labelling or the technical implementation of the underlying financial instruments. Furthermore, what today is generally refereed to green finance and climate finance can be considered to be specific parts of the wider sustainable finance landscape.[9] To this extent, green finance can be referred to the financial stocks and flows aiming at supporting the achievement of the environment-related SDG,[10] while climate finance can be associated to that component of green finance focussing on climate action (in the form of climate change mitigation and climate change adaptation[11]). These relations are graphically reported in Fig. 1.1.

The various components of sustainable finance have experienced a remarkable growth in recent years, and in particular as it concerns green finance. For example, from the first issuance by the European Investment Bank in 2007, the market of green bonds has registered average annual two-digit growth, with new emissions being over USD160 billon in 2018,[12] while sustainable or green equivalents of traditional securities are today getting available for the different types of investors. In point of fact, a large part of the financial industry and several policymakers

[9] For a wider dissertation on green finance and the challenges it faces, see Migliorelli and Dessertine (2019a).

[10] For a discussion on the definition of green finance, see Berrou et al. (2019a).

[11] Climate change mitigation usually refers to efforts to reduce or prevent emission of GHG. Climate change adaptation normally concerns the adjustments in ecological, social or economic systems in response to actual or expected climatic modifications and their effects or impacts.

[12] See Berrou et al. (2019b).

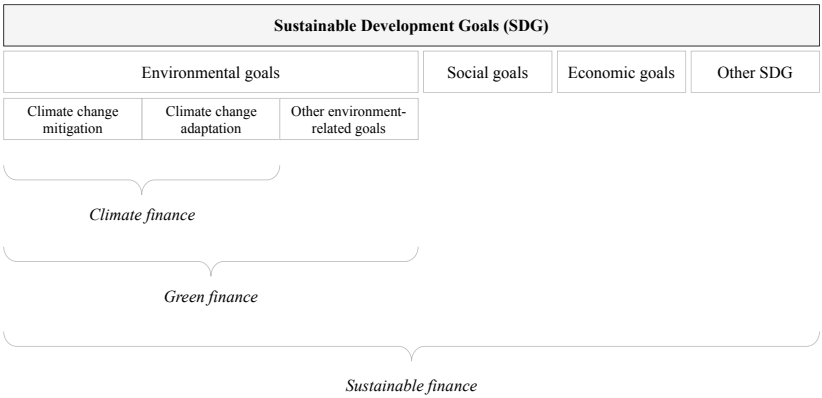

Fig. 1.1 SDG, sustainable finance and its components (*Source* Adapted from UNEP 2016)

have embraced the change and are putting in place a number of initiatives in the attempt to mainstream sustainable finance.[13,14] The European Commission's "Action Plan for financing sustainable growth" issued in 2018 and its follow-up initiatives is probably the most noteworthy example of this commitment (EC 2018a).

[13] The growth of sustainable finance in the last decade should be also related to a strong commitment of the major stock exchanges worldwide. Financial centres such as London, Paris, Luxembourg, Copenhagen, Amsterdam in Europe, Shanghai and Beijing in China, San Francisco and Los Angeles in the United States, Vancouver and Montreal in Canada have taken the lead and are progressively improving the quality and depth of their sustainable finance offer. To this extent, dedicated listings for sustainable finance and green finance securities have emerged.

[14] Nevertheless, some challenges still exist and mainstreaming sustainable finance can be considered a long-term objective. In particular, clearly identifying the sectors or activities eligible for sustainable finance, better assessing the (still unclear) financial benefits for issuers of sustainable securities, coping with the lack of incentives for market actors of entirely factoring in the sustainability-related risks in their investment decisions are some of these challenges. In addition, to effectively mainstream sustainable finance, some conditions need to be fulfilled. Namely, environmental risks are properly included in the investors' decision-making processes, market demand is effectively channelled towards sustainable investments, additionality is adequately encouraged by policymakers, the banking sector is fully engaged in the transition. For a wider discussion on these subjects, with a focus on green finance, see also Migliorelli and Dessertine (2019b).

1.3 Sustainability and Finance: A Two-Way Relationship

1.3.1 Positioning the Sustainability-Financial Risk Nexus

The policy and academic debate are consolidating around the analysis of how finance can contribute to the transition towards a sustainable society by ensuring that the necessary financial resources are available when and where needed. In this respect, the role of banks and other financial actors is a key one when simply considering their traditional function of funds intermediaries. As a matter of fact, adequate financing to the sustainability transition cannot be achieved without the full involvement of the financial industry. However, little attention has been given thus far to the possible impact of sustainability-related risks on financial actors, that is to the *sustainability-financial risk nexus*. Factors such as climate change, environmental degradation or social inequality, and others, can indeed result in direct or indirect financial risks for financial actors. An example can help illustrating this issue. Considering climate change, abounded evidence exists today demonstrating that the continuous increase in GHG emissions in the atmosphere ultimately results in a substantial increase in the frequency and magnitude of climate change-related extreme weather events such as droughts, floods or storms (e.g. IPCC 2018). Beyond the (regrettable) direct consequences on the populations and their social implications, extreme weather events may also have relevant impacts on insurance companies and banks, as unexpected and important reductions in the productivity of the economic assets typically materialise in the areas affected. For insurance companies, this can produce unexpected higher levels of payments on the previously insured risks. For banks, higher levels of impairments on outstanding credits due to higher rates of insolvency of their clients.

Underestimating the impact of sustainability-related risks on financial actors may have two main drawbacks. Firstly, it can result in a flowed assessment of the commitment and the capacity of the financial industry to support sustainable investments, in particular in the areas expected to be more affected by sustainability-related risks. Situations in which banks or insurance companies refuse to take-in additional financial risk when highly dependent of sustainable-related risks can eventually materialise. This would be for example the case of banks limiting credit to farmers in regions hit by increasing desertification, as considered to be less

productive in the mid-term. Or of insurance companies refusing to insure households living in areas subject to increasing risk of floods. On the other side, a systematic underestimation by banks and insurance companies of the long-term impact of sustainability-related risks on their core businesses could bring to a situation in which financial stability[15] can be undermined. As little historical data (and knowledge) is today available for financial actors as concerns the possible incidence of sustainability-related risks, and the occurrence of these risks is expected to grow in future both in terms of frequency and magnitude (so that past experience cannot be used to predict the future), eventually very little information is today available as concerns the financial actors' assets under the risk of climate change or other sustainability-related risks (e.g. ECB 2019).[16]

Hence, the *sustainability-financial risk nexus* merits today a throughout attention and it should be considered as a crucial element of the sustainable finance framework.[17] Clearly, solving the *sustainability-financial risk nexus* implies two separate dimensions of analysis. On the one hand, the assessment of the possibilities of reducing the magnitude of sustainability-related risks. This can be done through policy and societal actions aiming at fostering a climate-neutral economy and a fairer society.

[15] Financial stability can be defined as a condition in which the financial system—which comprises financial intermediaries, markets and market infrastructures—is capable of withstanding shocks and the unravelling of financial imbalances. This mitigates the likelihood of disruptions in the financial intermediation process that are systemic, that is, severe enough to trigger a material contraction of real economic activity (ECB website, consultable here: https://www.ecb.europa.eu/pub/financial-stability/fsr/html/ecb.fsr201911~facad0251f.en.html#toc1).

[16] Based on EC (2019b), weather-related disasters caused a record EUR 283 billion in economic damages in 2017 and could affect up to two-thirds of the European population by 2100 compared with 5% today.

[17] In this respect, a noteworthy initiative is the establishment of the Network for Greening the Financial System (NGFS), launched at the One Planet Summit in Paris in December 2017 under the initiative of the Banque de France. Composed by more than 30 central banks and supervisory bodies (including Banco de España, Bank of England, Bank of Finland, Banque Centrale du Luxembourg, Deutsche Bundesbank, European Banking Authority, European Central Bank, Japan FSA, National Bank of Belgium, Oesterreichische National Bank, the People's Bank of China, the Reserve Bank of Australia, Reserve Bank of New Zealand), it aims on a voluntary basis to exchange experiences and best practices, to contribute to the development of environment and climate risk management in the financial sector, and to mobilise mainstream finance to support the transition towards a sustainable economy. In 2019, the NGFS issued the first comprehensive report on climate change as source of financial risk (NGFS 2019).

As a matter of fact, the development of sustainable finance securities, products and services can be embedded in this dimension. On the other hand, the consideration of the *sustainability-financial risks nexus* triggers the need of controlling for the impact of the key sustainability-related risks on financial actors. In this respect, an assessment of the existing risk management frameworks should be systematically carried out to test for their capacity to take into account these new risks.

1.3.2 Sustainability-Related Risks and Observed Channels of Transmission to the Financial Markets

Limited literature exists dealing with the *sustainability-financial risk nexus*. In this section the main references to date are reported as concerns the impact of climate change (in the form of physical risk, transition risk and liability risk), distressed commodity markets, environmental degradation and social inequality.[18]

1.3.2.1 Climate Change: Physical Risk, Transition Risk and Liability Risk

Central banks have been among the first actors to recognise that even though significant macroeconomic effects from climate change may occur in a somehow distant future, some impacts are already beginning to be felt (ECB 2019). As a consequence, in the last few years, and in line with their activity of supervision and control of systemic risks, they have started to identify some specific financial risks linked to climate change (BoE 2015; TCFD 2017; ACPR 2019; ECB 2019). Namely:

- Physical risks, defined as the impacts today on insurance liabilities and the value of financial assets that arise from climate and weather-related events that may damage property or disrupt trade.[19]

[18] Even if not linked to financial risks, sustainability-related risks have nevertheless recently started to be considered as crucial factors in the development of modern society. Extreme weather events, failure of managing climate change mitigation and adaptation, natural disasters, man-made environmental disasters, large-scale involuntary migration, biodiversity loss and ecosystem collapse, water crises, occupy seven positions in a top ten of risks by likelihood by the World Economic Forum (WEF 2019).

[19] The United Nations Environmental Programme Finance Initiative (UNEP FI) provides a methodology for assessing physical risk (UNEP FI 2018). It recommends

- Transition risks, that is the financial risks that could result from the process of adjustment towards a low-carbon economy, such as changes in policy, technology and physical risks that could prompt a reassessment of the value of a large range of assets as costs and opportunities become apparent (the case of stranded assets).
- Liability risks, that is the impacts that could arise tomorrow if parties who have suffered losses or damages from the effects of climate change seek compensation from those they hold responsible (such claims could come decades in the future, but have the potential to hit carbon extractors and emitters and, if they have liability cover, their insurers).

Nevertheless, the limitation to climate change and a substantial lack of data to properly assess the impact of these risks make this recognition still a marginal improvement in the understanding the relationship between sustainability-related risks and financial risks.[20]

considering both changes in average weather conditions and the more frequent occurrence of extreme events. To implement these exercises, it would be necessary to improve the available data, in particular on the geographical location of borrowers, to improve macroeconomic models that integrate the impact of climate change and to anticipate difficulties that the insurance sector could experience.

[20] Some first structured attempts to specifically analyse the incidence of these risks has been indeed made in Europe by the British Prudential Regulation Authority (PRA) in 2018 and by the French Autorité de contrôle prudentiel et de resolution (ACPR) in 2019. The PRA surveyed a number of UK banks on the possible incidence of climate change-related risks (PRA 2018). Relevant conclusions included: (i) for banks, the financial risks from climate change have tended to be beyond their planning horizons (for 90% of the UK banking sector these horizons averaged four years—before risks would be expected to be fully realised and prior to stringent climate policies taking effect); (ii) the majority of banks are beginning to treat the risks from climate change like other financial risks rather than viewing them simply as a corporate social responsibility issue; such banks start to oversight the financial risks from climate change and assign the overall responsibilities for setting the strategy, targets and risk appetite relating to these risks (including at board level); (iii) banks have begun considering the most immediate physical risks to their business models and have started to assess exposures to transition risks where government policy is already pulling forward the adjustment (this latter includes exposures to carbon-intensive sectors, consumer loans secured on diesel vehicles, and buy-to-let lending given new energy efficiency requirements). Similarly, the ACPR surveyed the main French banking groups (ACPR 2019). The main conclusions stemming from the survey were: (i) banking groups appear to have relatively little exposure to physical risk on the basis of currently available scenarios and expected impacts are mainly concentrated in low-vulnerability geographical areas (nevertheless, the industry seems to be aware that

1.3.2.2 Distressed Commodity Markets

Rising temperatures and changing patterns of precipitation can be expected to have direct impacts in particular on agriculture and fisheries (e.g. ECB 2019), even though with uneven influence between the different regions worldwide. In this respect, some regions are already substantially affected by both global climate variations and commodity price fluctuations.[21] This is valid also when considering that the impact of changing weather conditions on commodities' production and yields are strongly dependent of technology availability and sophistication (Brown and Funk 2008).

Today, financialisation of commodity markets can be considered a structural trend. In this respect, it can also be argued that commodities-driven fund management have become a proper investment style for many institutional investors (e.g. Adams and Glück 2015). This means that, as those institutional investors continue to target their managed funds into commodities, spillovers effects between commodities markets and financial markets will probably increase. Hence, higher volatility in the commodity markets can be considered today a specific source of concerns for fund managers, including when triggered by climate change.

1.3.2.3 Environmental Degradation and Social Inequality

Abundant and substantially unanimous literature today exists demonstrating the detrimental effect on the environment of the traditional model of economic development, in particular due to resources depletion and negative externalities (e.g. Tamazian et al. 2009; IPCC 2018). Land degradation, land erosion, waters and air pollution, deforestation are among the most visible signs of this pattern. In this vein, the behaviour of companies in terms of environmental and social consideration has

the full risk is not necessarily and fully transferable to the insurance sector); (ii) achieved progress in the area of transition risks was the most significant as banking institutions consider themselves being more directly exposed to this risk (in the mid-term), even though this trend is unevenly distributed across banking groups (institutions underlined that the horizon for transition risk is much closer to the one underlying their strategic thinking); (iii) most of respondents consider not to be exposed to liability risk in a material manner, even though the number of litigations is increasing at the international level and institutions are encouraged to seize this topic.

[21] For example, it has been observed that warming in the Indian Ocean and an increasingly concentrate precipitations (as in the case of hurricanes) could reduce main-season precipitation across vast parts of the Americas, Africa and Asia (Brown and Funk 2008).

been mostly studied in the framework of the analysis of the relationship between environmental, social and governance (ESG) performances and economic and financial performances. The large majority of studies show positive relationship of ESG performances on economic and financial performances, with the impact appearing to be stable over time (e.g. Friede et al. 2015). Nevertheless, the aspect of how environmental degradation or social inequality can negatively impact economic development and eventually financial markets and actors have thus far not been explored in depth.

1.4 A Wider Look at the *Sustainability-Financial Risk Nexus*

A more comprehensive approach to the study of the *sustainability-financial risk nexus* can be proposed. In this respect, Table 1.2 suggests a taxonomy linking sustainability-related factors and risks to the corresponding risks for business, banks and insurance companies.[22] The relationship portrayed are assumed and not backed by data. Nevertheless, such taxonomy can help identifying potential indirect and direct financial risks for banks and insurance companies stemming from sustainability-related factors. In this respect, indirect risks for financial intermediaries have to be considered the ones coming from the exposure to sustainability-related factors by the clients (businesses) they serve.

Four main sustainability-related factors are considered: climate change, environmental degradation, social inequality, policy and technology shifts. To these main factors, specific sustainability-related risks potentially affecting businesses and financial actors are linked. For example, to climate change are associated risks of increase in the frequency and magnitude of floods, droughts and storms, of distressed commodity markets, of permanent change in climate conditions, of increase in the level of seas and of accusation from citizens to polluting businesses to cause climate change. These sustainability-related risks can be associated to concrete risks for businesses (hence also indirectly triggering risks for banks and insurance companies). For instance, the increase in the frequency and magnitude of floods, droughts and storms can result for businesses in loss of production, in a reduction in assets' value or in the disruption in

[22] For a similar exercise, limited to climate change, see TCFD (2017, pp. 10 and 11).

Table 1.2 A taxonomy for sustainability-related risks and financial risks

Sustainability-related factor	*Sustainability-related risk*	*Risk for businesses*	*Risk for banks*	*Risk for insurance companies*
Climate change	Increase in the frequency and magnitude of floods, droughts and storms	Loss of production [operational risk-related]	Increase in clients' insolvency risk [credit risk-related]	Higher payments on insured risks [physical risk and liquidity risk-related]
		Reduction in assets' value [operational risk-related]	– Reduction in the value of guarantees [credit risk-related] – Increase in clients' insolvency risk [credit risk-related]	Higher payments on insured risks [physical risk and liquidity risk-related]
		Disruption in the supply chain or in the operations [operational risk-related]	Increase in clients' insolvency risk [credit risk-related]	–
		–	Disruption in the operational activities [operational risk-related]	–
		–	–	Disruption in the operational activities [operational risk-related]
	Distressed commodity markets	Higher costs of production and/or cost of hedging	Increase in clients' insolvency risk [credit risk-related]	–

Sustainability-related factor	*Sustainability-related risk*	*Risk for businesses*	*Risk for banks*	*Risk for insurance companies*
		–	Increase in the volatility of the value of the investment portfolios [market risk-related]	–
		–	–	Increase in the volatility of the value of the investment portfolios [market risk-related]
	Permanent change in climate conditions	Loss in assets and land productivity	– Increase in clients' insolvency risk [credit risk-related] – Reduction in the value of guarantees [credit risk-related]	–
		Emerging adaptation costs	Increase in clients' insolvency risk [credit risk-related]	–
	Increase in the level of seas	Permanent loss of assets and land	– Increase in clients' insolvency risk [credit risk-related] – Loss of the value of guarantees [credit risk-related]	Higher payments on insured risks [physical risk and liquidity risk-related]

(continued)

Table 1.2 (continued)

Sustainability-related factor	*Sustainability-related risk*	*Risk for businesses*	*Risk for banks*	*Risk for insurance companies*
	Accusation from citizens to polluting businesses to cause climate change	Reputational risk	– Reputational risk due to accusation of financing polluting businesses – Increase in clients' insolvency risk [credit risk-related]	–
		Loss of clients	Increase in clients' insolvency risk [credit risk-related]	–
Environmental degradation	Soil, air or waters pollution	Production disruption or interruption	Increase in clients' insolvency risk [credit risk-related]	–
	Deforestation	*Increase in other risks linked to climate change, environmental degradation, social inequality, policy and technology shifts*		
	Loss of biodiversity	*Increase in other risks linked to climate change, environmental degradation, social inequality, policy and technology shifts*		
	Increase in the frequency and magnitude of epidemics or pandemics	Reduction in market demand or stop of production following containment measures	– Increase in clients' insolvency risk [credit risk-related] – Increase in the volatility of the value of the investment portfolios [market risk-related]	Increase in the volatility of the value of the investment portfolios [market risk-related]

Sustainability-related factor	*Sustainability-related risk*	*Risk for businesses*	*Risk for banks*	*Risk for insurance companies*
	Judiciary actions from affected population towards polluters	Compensation due to proven responsibility [liability risk]	– Increase in clients' insolvency risk [credit risk-related]	Higher payments on insured risks [liquidity risk-related]
			– Compensation due to possible joint responsibility [liability risk]	
		Reputational risk	Increase in clients' insolvency risk [credit risk-related]	–
	Accusation from citizens to polluting businesses to cause environmental degradation	Reputational risk	– Reputational risk due to accusation of financing polluting businesses	–
			– Increase in clients' insolvency risk [credit risk-related]	
		Loss of clients	Increase in clients' insolvency risk [credit risk-related]	–

(continued)

Table 1.2 (continued)

Sustainability-related factor	*Sustainability-related risk*	*Risk for businesses*	*Risk for banks*	*Risk for insurance companies*
Social inequality	Unfair treatment of workers	Reputational risk	– Reputational risk due to accusation of financing unfair businesses practices – Increase in clients' insolvency risk [credit risk-related]	–
		Compensation due to proven responsibility [liability risk]	Increase in clients' insolvency risk [credit risk-related]	–
		–	Reputational risk Compensation due to proven responsibility [liability risk]	–
		–	–	Reputational risk Compensation due to proven responsibility [liability risk]
	Discriminatory treatment of women	Reputational risk	– Reputational risk due to accusation of financing unfair businesses practices – Increase in clients' insolvency risk [credit risk-related]	–

Sustainability-related factor	*Sustainability-related risk*	*Risk for businesses*	*Risk for banks*	*Risk for insurance companies*
		Compensation due to proven responsibility [liability risk]	Increase in clients' insolvency risk [credit risk-related]	–
		–	Reputational risk Compensation due to proven responsibility [liability risk]	–
		–	–	Reputational risk Compensation due to proven responsibility [liability risk]
	Discriminatory treatment of minorities	Reputational risk	– Reputational risk due to accusation of financing unfair businesses practices – Increase in clients' insolvency risk [credit risk-related	–
		Compensation due to proven responsibility [liability risk]	Increase in clients' insolvency risk [credit risk-related]	–
		–	Reputational risk Compensation due to proven responsibility [liability risk]	–

(continued)

Table 1.2 (continued)

Sustainability-related factor	*Sustainability-related risk*	*Risk for businesses*	*Risk for banks*	*Risk for insurance companies*
		–	–	Reputational risk Compensation due to proven responsibility [liability risk]
	Social dumping (employees treated differently in different jurisdictions to save on costs)	Reputational risk	– Reputational risk due to accusation of financing unfair businesses practices – Increase in clients' insolvency risk [credit risk-related]	–
		–	Reputational risk	–
		–	–	Reputational risk
Policy and technology shifts	Reduction in public financing/policy-driven higher cost of financing for polluting assets	Higher cost of financing	Increase in clients' insolvency risk [credit risk-related]	–
	More stringent regulatory requirements in order to promote sustainability	Stranded assets [transition risk]	– Increase in clients' insolvency risk [credit risk-related] – Loss of the value of guarantees [credit risk-related]	–

Sustainability-related factor	*Sustainability-related risk*	*Risk for businesses*	*Risk for banks*	*Risk for insurance companies*
		Obsolete business lines	– Increase in clients' insolvency risk [credit risk-related] – Loss of the value of guarantees [credit risk-related]	–
		–	Reduction in the value of the stocks of non-sustainable industries in the investment portfolios [market risk-related]	–
		–	–	Reduction in the value of the stocks of non-sustainable industries in the investment portfolios [market risk-related]
	Technology improvements causing obsolescence of polluting assets	Stranded assets [transition risk]	– Increase in clients' insolvency risk [credit risk-related] – Loss of the value of guarantees [credit risk-related]	–
		–	Reduction in the value of the stocks of non-sustainable industries in the investment portfolios [market risk-related]	–

(continued)

Table 1.2 (continued)

Sustainability-related factor	*Sustainability-related risk*	*Risk for businesses*	*Risk for banks*	*Risk for insurance companies*
		–	–	Reduction in the value of the stocks of non-sustainable industries in the investment portfolios [market risk-related]

Notes The table shows the effects of sustainability-related risk events on the different economic actors. In particular, it links the risks for businesses with the consequent risks for banks and insurance companies. Nevertheless, some of the sustainability-related risk events can also impact directly banks and insurance companies. This is in particular the case for distressed commodity markets due to climate change, for social inequality-related risks and policy and technology shifts. Blank cells mean no risk for that actor (and hence no relation with the risks for the other actors shown in same line)
Source Author's elaboration

the supply chain or in the operations. These risks for businesses can be hence analysed with respect to corresponding risks for banks and insurance companies. To this extent, the reduction in assets' value of their clients can cause, for banks, a reduction in the value of the real guarantees (e.g. covering a loan) or an increase in clients' insolvency risk. As a matter of fact, both these risks are credit risk-related. For insurance companies, this can translate in higher payments on insured risks. This implies an exposure to liquidity risk and physical risk.

In addition to indirect risks, financial actors can also be impacted directly by sustainability-related risks. As an example, distressed commodity markets can result for both banks and insurance companies in a specific market risk due to the increase in the volatility of the value of the investment portfolios (when they are invested, at least in part, in commodities or in financial instruments having commodities as underlying assets). Similarly, possible unfair treatment of workers, discriminatory treatment of women or minorities (linked to social inequality as main sustainability-related factor) can rise a reputational risk and possibly the need of compensation due to proven responsibility (that is, in this latter case, a liability risk).

As it is shown in the taxonomy, sustainability-related risks typically result for banks and insurance companies in an increase in the risks already under management, such as credit risk, market risk, liquidity risk, liability risk, operational risk or reputational risk. This conclusion can have indeed significant consequences in terms of risk management practices for financial intermediaries. In fact, a strong argument can be made according to the idea that the correct management of the sustainability-related risks in the financial industry has to derive from a proper refinement of the existing frameworks, more than a complete change in paradigm.[23] In this respect, it seems nevertheless necessary to develop specific forward-looking approaches and methodologies able to cope with the lack of data and information on the specific relationship between sustainability-related and financial risks.[24]

The structure offered by the taxonomy in categorising sustainability-related risks and their impact on financial risks is likely a first-of-a-kind.

[23] Similar conclusions seem to emerge from the recent studies of the British Prudential Regulation Authority, PRA, and by the French Autorité de contrôle prudentiel et de resolution, ACPR (see PRA 2018 and ACPR 2019).

[24] For a wider discussion on this issue, see Chapter 4.

It suffers some limitations due to the lack of data on the significance and strength of the relations proposed and it is limited in scope, not including, inter alia, the role of households and of financial actors other than banks and insurance companies (e.g. investment funds). In this respect, we should be conscious of the fact that for a framework to be useful, it must have clear testable implications, so that the proposed patterns may be supported or refuted by data. Further empirical research will hence be needed to test the effectiveness on the ground. Nevertheless, the taxonomy can be considered a limited but concrete first step in better framing the *sustainability-financial risk nexus*.

1.5 Pricing the Sustainability-Related Risks and New Market Failures

As mentioned, the need for financial actors to systematically take into account sustainability-related risks in their core business is progressively becoming material. Nevertheless, this desirable new attention could also engender some negative side effects. When relevant, the full consideration of the sustainability-related risks by financial intermediaries in their risk management frameworks may have two possible outcomes: an adjustment in the pricing components of financial services (in particular as concerns credits and insurance services) and a reassessment of their risk-taking strategies. The effects of these outcomes on the real economy will probably be uneven between geographies or economic sectors and, also depending on the progressive development and sophistication of the risk management practices, may be concentrated in the areas more affected (or expected to be more affected) by sustainability-related risks.

On the one hand, the pricing outcome may result in an increase in the cost of accessing financial services for economic agents in (some) proportion to their exposure to sustainability-related risks. This may be the case for example of companies operating in regions under increasing risk of hurricanes, which may need to face an escalation in the cost of insurance. Or for oil companies that may experience a substantial increase in the cost of accessing external financing due to limitations in availability of funds following policy decisions to discourage the use of fossil fuels. However, correctly pricing the incidence of sustainability-related risks on their financial risks is probably the most effective way for financial actors to be shielded from unexpected financial and economic losses. In addition, such a possible development would be in compliance with the principles and

structures of existing prudential regulations and hence the one likely to be encouraged by policymakers in the years to come.

On the other hand, pricing adjustment may not be effective in the case of sustainability-related risks of significant magnitude. Following a reassessment of their risk-taking strategies, financial actors could eventually refuse to keep providing credit or insurance services to some of their existing and potential clients, in consideration of the high impact of sustainability-related risks on the financial risks they would need to bear. As a matter of fact, a number of sustainability-related risks may become uninsurable and a number of banks' clients may lose their creditworthiness due to sustainability-related factors. This can be the example of businesses located in areas increasingly hit by floods and hence subject to substantial degradation of their economic potential or households living in islands under the threat of the rise of sea level. New market failures can hence materialise in future as following a deeper assessment of the impact of sustainability-related risks on the different economic agents.

Even though it can be expected that pricing adjustments and market failures will be in many cases relatively small or even absent, this will still build a case for the need of periodically assessing the social impact of the management of sustainability-related risks by financial actors. In this respect, the problem could be exacerbated by the substantial lack of data and reliable information on the specific relationship linking sustainability-related and financial risks and the possible adoption, in particular in the short-term, of excessively precautionary approaches. Eventually, a specific policy intervention may also become necessary. This may be in the form of price control or cost support for the access to key financial services, promotion of ad hoc reinsurance schemes, more favourable fiscal treatment for stranded assets. As a matter of fact, these measures, which are limited to easing the possible impact of the side effects of the full consideration of sustainability-related risks on financial risks, can only supplement the wider policy strategies to foster a more sustainable society. In this respect, they may be considered by policymakers within the broad category of transition measures.

References

Adams, Z., & Glück, T. (2015). Financialization in commodity markets: A passing trend or the new normal? *Journal of Banking & Finance, 60,* 93–111.

Alm, K., & Sievänen, R. (2013). Institutional investors, climate change and human rights. *Journal of Sustainable Finance and Investment, 3*(3), 177–183.

Autorité de contrôle prudentiel et de résolution (ACPR). (2019). *French banking groups facing climate change-related risks*. Paris.

Bank for International Settlements (BIS). (2020). *The green swan. Central banking and financial stability in the age of climate change*. Basel.

Bank of England (BoE). (2015, September). *Breaking the tragedy of the horizon—Climate change and stability*. Speech given by Mark Carney Governor of the Bank of England.

Berrou R., Ciampoli N., & Marini V. (2019a). Defining green finance: Existing standards and main challenges. In M. Migliorelli & P. Dessertine (Eds.), *The rise of green finance in Europe. Opportunities and challenges for issuers, investors and marketplaces*. Cham: Palgrave Macmillan.

Berrou, R., Dessertine, P., & Migliorelli M. (2019b). An overview of green finance. In M. Migliorelli & P. Dessertine (Eds.), *The rise of green finance in Europe. Opportunities and challenges for issuers, investors and marketplaces*. Cham: Palgrave Macmillan.

Brown, M. E., & Funk, C. C. (2008). Food security under climate change. *Science, 319*(5863), 580–581.

European Central Bank (ECB). (2019, May). *Climate change and financial stability*.

European Commission (EC). (2018a). *Action plan: Financing sustainable growth*. COM(2018) 97 final, Brussels.

European Commission (EC). (2018b). *A Clean Planet for all. A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy*. COM(2018) 773 final, Brussels.

European Commission (EC). (2019a). *The European Green Deal*. COM(2019) 640 final, Brussels.

European Commission (EC). (2019b). *Guidelines on non-financial reporting: Supplement on reporting climate-related information*. 2019/C 209/01, Brussels.

Friede, G., Busch, T., & Bassen, A. (2015). ESG and financial performance: Aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance and Investment, 5*(4), 210–233.

Hebb, T. (2013). Impact investing and responsible investing: What does it mean. *Journal of Sustainable Finance and Investment, 3*(2), 71–74.

Intergovernmental Panel on Climate Change (IPCC). (2018). *Special report. Global warning of 1.5 °C*.

International Finance Corporation (IFC). (2017). *Green finance. A bottom-up approach to track existing flows*. Washington, DC.

Lehner, O. M. (Ed.). (2016). *Routledge handbook of social and sustainable finance*. Abingdon: Routledge International Handbooks.

Migliorelli, M. (2018). Cooperative banking in Europe today: Conclusions. In M. Migliorelli (Ed.), *New cooperative banking in Europe. Strategies for adapting the business model post-crisis*. Cham: Palgrave Macmillan.

Migliorelli, M., & Dessertine, D. (Eds.). (2019a). *The rise of green finance in Europe. Opportunities and challenges for issuers, investors and marketplaces*. Cham: Palgrave Macmillan.

Migliorelli, M., & Dessertine, D. (2019b). From transaction-based to mainstream green finance. In M. Migliorelli & P. Dessertine (Eds.), *The rise of green finance in Europe. Opportunities and challenges for issuers, investors and marketplaces*. Cham: Palgrave Macmillan.

Network of Central Banks and Supervisors for Greening the Financial System (NGFS). (2019, April). *A call for action. Climate change as a source of financial risk*.

Prudential Regulation Authority (PRA). (2018, September). *Transition in thinking: The impact of climate change on the UK banking sector*.

Renneboog, L., ter Horst, J., & Zhang, C. (2008). Socially responsible investments: Institutional aspects, performance, and investor behaviour. *Journal of Banking & Finance, 32*(9), 1723–1742.

Tamazian, A., Chousa, J. P., & Vadlamannati, C. (2009). Does higher economic and financial development lead to environmental degradation: Evidence from the BRIC countries. *Energy Policy, 37,* 246–253.

Task Force on Climate-related Financial Disclosures (TCFD). (2017). *Recommendations of the Task Force on Climate-related Financial Disclosures*. Basel.

United Nations (UN). (2015). *Transforming our world: The 2030 agenda for sustainable development*.

United Nations Environment Programme (UNEP). (2016, September). *Definitions and concepts. Background note* (Inquiry Working Paper 16/13).

United Nations Environmental Programme Finance Initiative (UNEP FI). (2018, July). *Navigating a new climate: Assessing credit risk and opportunity in a changing climate*.

Vandekerckhove, W., Leys, J., Alm, K., Scholtens, B., Signori, S., & Schäfer, H. (Eds.). (2012). *Responsible investment in times of turmoil*. Dordrecht: Springer.

World Economic Forum (WEF). (2019). *The global risks report 2019*.

Ziolo, M., Filipiak, B. Z., Bąk, I., Cheba, K., Tîrca, D. M., & Novo-Corti, I. (2019). Finance, sustainability and negative externalities. An overview of the European context. *Sustainability, 11*(15), 4249.

Ziolo, M., & Sergi, B. S. (Eds.). (2019). *Financing sustainable development. Key challenges and prospects*. Cham: Palgrave Macmillan.