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AMR
ADDAS

STEFANIE
D. KIBSEY

GARY
NG1

THOMAS
WALKER

JEL: M14, H12, Q54

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TRAINING THE NEXT GENERATION OF DISASTER RISK MANAGERS THROUGH SUSTAINABILITY RESEARCH AND TEACHING

ENTRENANDO A LA PRÓXIMA GENERACIÓN DE GERENTES DEL RIESGO DE DESASTRES A TRAVÉS DE LA INVESTIGACIÓN Y ENSEÑANZA EN SOSTENIBILIDAD

AMR ADDAS[1]

STEFANIE D. KIBSEY[1]

GARY NG[1]

THOMAS WALKER[1]

JEL: M14, H12, Q54

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ABSTRACT

Disaster risk management is an integral part of sustainability, and curricula that are focused on sustainability can be broadened to include disaster risk management. The David O'Brien Centre for Sustainable Enterprise at Concordia University researches and teaches disaster risk management through involvement in a collaborative project with the United Nations' Future Earth network to develop a Sustainable Financial and Economic System Knowledge-to-Action Network (SFES-KAN). The definition of 'sustainable' in this context includes disaster risk management. The SFES-KAN aims to align the current financial system with the UN's sustainable development goals by identifying research gaps and facilitating interdisciplinary research between academics, practitioners, and policymakers to fill those gaps. Our research on such topics as risk management and sustainable investing for the SFES-KAN project has translated into research on disaster risk management and has led to curriculum development on these topics. The goal of our paper is to provide other institutions with examples and strategic information on how to translate such interdisciplinary and solution-oriented sustainability research into research and curricula on disaster risk management.

KEYWORDS

Business Education; Disaster Risk Management; Sustainable Financial System; Knowledge Co-production.

RESUMEN

La gestión del riesgo de desastres es una parte integral de la sostenibilidad, y los currículos que se enfocan en la sostenibilidad pueden ser ampliados para incluir la gestión del riesgo de desastres. El David O'Brien Centre for Sustainable Enterprise de Concordia University investiga y enseña la gestión del riesgo de desastres a través de la participación en proyectos colaborativos de la red Future Earth de la Organización de las Naciones Unidas (ONU) para el desarrollo de una Red de "Conocimiento para la Acción" para un Sistema Financiero y Económico Sostenible (SFES-KAN). SFES-KAN busca alinear el sistema financiero actual con los Objetivos de Desarrollo Sostenible de la ONU por medio de la identificación de vacíos en la investigación y la facilitación de una investigación interdisciplinaria entre los académicos, profesionales y legisladores con el fin de llenar dichos vacíos. Nuestra investigación acerca de estos temas de gestión del riesgo e inversiones sostenibles, al igual que para el proyecto SFES-KAN, se ha convertido en investigación sobre gestión del riesgo de desastres y ha conducido al desarrollo curricular de estos temas. El objetivo de este artículo es el de brindar a otras instituciones ejemplos e información estratégica acerca de cómo traducir la investigación de sostenibilidad, interdisciplinaria y orientada a las soluciones, a investigación y currículos sobre gestión del riesgo de desastres.

1 David O'Brien Centre for Sustainable Enterprise (DOCSE), John Molson School of Business, Concordia University, Montreal, Canada. Email : thomas.walker@concordia.ca http://www.concordia.ca/jmsb/faculty/thomas-walker.html

PALABRAS CLAVE
Educación de negocios; Gestión del Riesgo de Desastres; Sistema Financiero Sostenible; Coproducción de Conocimiento.

INTRODUCTION

Disaster risk management is an integral part of sustainability. While some disasters can be mitigated, others are unavoidable but must nonetheless be properly managed to reduce damages, losses, fatalities, as well as threats to communal, regional, and economic sustainability and long-term wellbeing.

The David O'Brien Centre for Sustainable Enterprise is a research centre in the John Molson School of Business at Concordia University in Montreal, Quebec, Canada which develops sustainable practices through academic research, student education, training and professional development, programs, and community outreach. The John Molson School of Business is a globally-minded business school that assumes a leadership role in making the world a more sustainable and ethical place. It currently boasts 9,222 students (including 7,768 undergraduate and 1,454 graduate students) and has over 46,600 alumni worldwide. Its faculty is known for award-winning and engaged professors, an innovative curriculum, cutting-edge research, enthusiastic alumni mentors, a unique work-study program, and more than twenty student-run community outreach initiatives.

Named after benefactor David O'Brien, Chairman of the Royal Bank of Canada and Encana, the David O'Brien Centre for Sustainable Enterprise (DOCSE) focuses its efforts on guiding organizations toward holistic sustainable strategies that are rooted in innovation and enterprise development. DOCSE explores issues related to sustainable enterprise, shapes curriculum development, and trains the next generation of researchers and business leaders. Its mission is to be the leader in developing business practices that support corporate social responsibility, environmental health and safety, environmental management, community, and greening activities in a holistic and systemic way.

The Centre's main goals are to advance scholarly research and develop practical solutions for creating sustainable enterprises; integrate sustainability into teaching, learning, and student activities; and to support initiatives that embed sustainability in organizations and communities. These goals are accomplished through three over-arching programs: research on sustainable enterprise, curriculum and student support, and outreach to organizations. Through these programs, DOCSE provides a variety of ways for faculty and students to participate in building and strengthening its efforts to promote sustainability at Concordia University, within the local community, and around the world.

This paper outlines the experience of DOCSE in implementing research and teaching on disaster risk management through its sustainability efforts, in particular

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its sustainability research through a collaborative project with the United Nations Future Earth initiative. The research topics and research questions that have come out of this collaborative project have been integrated by faculty members at DOCSE and the John Molson School of Business into the University's business curriculum, including course offerings in risk management and sustainability, and may also be incorporated in a developing professional certification program. DOCSE's experience can be used as a model by interested business schools and universities looking to translate sustainability research into disaster risk management research and curricula.

The remainder of this paper is organized as follows: First, we provide a brief review of our methodology. We then summarize DOCSE's research and teaching activities, and explore five of our research areas in greater detail. Next, we highlight current and future curriculum development. The final section concludes, discusses the limitations of our study, and provides suggestions for future research.

METHODOLOGY

The paper presents a comprehensive review of DOCSE's research interests as a leader and partner in collaborative research on sustainable financial and economic systems. In developing this paper, we employed the following methodology: First, we reviewed our existent business school curriculum, explored related course offerings in other (non-business) departments, and interviewed various colleagues and students to (1) explore our current course offerings in the area of sustainability and disaster risk management, and (2) identify any perceived gaps in those course offerings. Second, we reviewed the course offerings of other leading business schools in North America and around the globe, with a specific focus on any disaster risk management and sustainability-oriented course offerings and how they compare to ours. Finally, we discussed the subject area of disaster risk management with our research partners in the SFES-KAN to identify how it can be addressed through both targeted research and teaching initiatives.

Through these efforts, we were able identify both the local curriculum gaps in disaster risk management at our university and explore how disaster risk management can be framed as part of a broader global research and teaching network.

THE DAVID O'BRIEN CENTRE'S PARTICIPATION IN RESEARCH AND CURRICULUM DEVELOPMENT

SFES-KAN Research

The United Nations' Future Earth initiative seeks to encourage and facilitate collaborative, transdisciplinary research co-designed between researchers, practitioners, and policymakers in order to achieve the UN's Sustainable Development Goals (SDGs). To this end, Future Earth has created a series of 'Knowledge-to-Action Networks' (KANs) on various themes. Due to the fact that the financial and economic system underlies the ability to accomplish the SDGs (United Nations Environment

Programme (UNEP) Inquiry, 2015), a Sustainable Financial and Economic System KAN (SFES-KAN) was launched to foster co-designed research that will ultimately help align the financial and economic system with the SDGs. In 2015, the UN Sendai Framework for Disaster Risk Reduction and the UN Climate Change Conference in Paris (COP21) further highlighted the need to align the global financial and economic system with Disaster Risk Reduction (DRR) and the Post 2015 Agenda.

The SFES-KAN is currently led by the global headquarter office of the United Nations' Future Earth initiative, the regional Future Earth hub in Sweden, and DOCSE. The goal of the SFES-KAN is to address the financial and economic challenges to attaining SDGs. The KAN comprises of researchers from across various disciplines, practitioners, end-users, and stakeholders. Members identify knowledge gaps, facilitate the co-production of knowledge between disciplines, sectors, and stakeholder groups, and present co-designed solutions to sustainability challenges. Thus, the SFES-KAN requires that DOCSE collaborate with a large community of researchers and practitioners.

The SFES-KAN brings together researchers and practitioners from the natural sciences, social sciences, and the financial sector to research and design a more sustainable financial and economic system. A sustainable financial and economic system exists as part of a complex socio-ecological system whereby finance and economics are intricately connected to social and environmental factors. A financial and economic system is considered sustainable when it can cope with climate change, manage and reduce disaster risks, decrease vulnerability and increase resilience, solve social issues, and ultimately ensure that current and future generations have access to the same resources and healthy environment. DOCSE has taken a leadership role on the research aspects of the KAN, including outlining the importance of research on disaster risks and disaster risk management.

Ongoing research at DOCSE, the UNEP Inquiry, and other institutions has shown that a resilient economy can emerge from reforms in banking, insurance, and investing. Climate change, disasters, and other threats to sustainability can only be addressed if firms operate while managing the environmental and social consequences and risks of their business activities. Such practices benefit firms in that they help them preserve their assets and license to operate in the face of climate change, disasters, or future environmental regulations. Reconsidering disaster risks, particularly those becoming more frequent, increasingly destructive, and less predictable due to climate change, is essential.

Teaching and Curriculum Development

In addition to the research activities fostered and supported by the SFES-KAN, faculty members at DOCSE and the John Molson School of Business at Concordia University have taken important steps to make risk management and sustainability important and integral parts of the business school's curriculum. For instance, DOCSE introduced courses on risk management (including various aspects of disaster risk

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management) at the undergraduate, MBA, M.Sc., and executive MBA level in 2014 and 2015. In addition, it started offering two new courses on sustainable investing at the undergraduate and MBA level in 2016. Risk management and sustainable investing are also taught as part of M.Sc. and Ph.D. seminars and many of our graduate students have chosen to write their M.Sc. and Ph.D. theses on these topics or work on faculty-guided MBA projects in these areas.

The new courses on risk management and sustainable investing are currently offered through the school's finance department and expand and complement the school's existent course offerings provided by the management, marketing, accountancy, and supply chain departments. Those course offerings include, among other things, business ethics, corporate social responsibility, sustainable management, the shared economy, and the social economy.

While disaster risk management as well as the development of insurance tools to protect firms against large scale (so-called 1-in-100 year) risks are important parts of the instructional material conveyed by the aforementioned new risk management courses, they receive relatively little attention in other departments. To overcome this lack of course offerings, the business school allows its students to take courses on actuarial finance and actuarial mathematics offered outside the business school by the department of mathematics. These courses provide students with the theoretical background used to price both smaller as well as large scale (disastrous) risks and to understand how those risks can be transferred.

Finally, in addition to training its local student body, the John Molson School of Business (and DOCSE specifically) developed a professional certification program on sustainable investing and emerging risk management which it offers online to participants around the globe. The program, entitled the Sustainable Investment Professional Certification (SIPC) Program, instructs its participants on the different screens used to select sustainable firms, critically reviews and examines the recent trend of divesting from fossil fuels, and educates investors on newly emerging risks such as the risks arising from climate change, water and food shortages, overpopulation, corruption, cybersecurity threats, human migration, natural and man-made disasters, political instability, and armed conflict. A similar certification program on sustainable real estate development is currently in the planning/setup phase.

SFES-KAN Research & Curriculum Topics

A great number of research and curriculum topics fall under the umbrella of Sustainable Financial and Economic Systems. The climate change and disaster risk management related research questions within these themes are intended to be a guide for both the SFES-KAN and for related course offerings at the John Molson School of Business. Briefly, these include:

Sustainable Investing: An increasingly popular practice, sustainable investing includes assessing sustainability factors in the evaluation of long-term firm value and financial returns.

Climate Finance: With climate change creating material financial risk, greater standards need to be put into place to assess these risks and develop policies to manage them.

Emerging Risk Management: The emergence of risks, such as water stress and climate change-driven disasters, creates the need for a sustainable financial system that is resilient to unexpected events and unfamiliar conditions.

Stress Testing: Environmental stress tests, performed on specific financial instruments, institutions, and systems to determine robustness under different scenarios, need to incorporate environmental factors in their simulations.

Green Accounting: The value of the environmental resources and assets used by institutions needs to be properly accounted for in their financial assessments.

Islamic Banking & Ethical Finance: This unique banking structure needs to be evaluated in order to develop regulation and to determine areas that can benefit from this emerging banking alternative.

Equitable Financial Access: The green economy of the future requires the participation and willingness of the worldwide population. Of the major hurdles to overcome is the lack of equitable financial access for the poorer citizens of the world.

Sustainable Real Estate: The real estate industry needs to develop innovations that will lead to environmental gains, economic benefits, and better urban planning.

Climate Change-Driven Migration: As climate change forces the dislocation of humans worldwide, often in anticipation of or in response to disasters, there are economic and financial consequences that will need to be addressed.

Synthetic Biology & Food Scarcity: Synthetic biology, if used correctly, could have a potentially positive impact on the re-design of our agricultural and food production systems. There are high risks, some known and some unknown, with the new field of bioengineering and they will need to be carefully managed.

Intergenerational Finance: The purpose of sustainability initiatives is to conserve resources and protect the planet for future generations. Intergenerational finance is aimed at ensuring the well-being of these future generations by including mechanisms that recognize obligations to respect their rights.

Research Questions

To further the above research and curriculum themes, DOCSE has highlighted several specific research questions which fall under several themes relevant to

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the SFES-KAN. These research questions represent areas of research that must be emphasized by the SFES-KAN network, including DOCSE. Addressing these research questions will help integrate sustainability and disaster risk management into both DOCSE's research activities and curriculum development. Some of the most pressing research questions identified include the following:

Sustainability: How can businesses incorporate sustainability and disaster risk reduction factors into their decision making? How can new business models be developed that are sensitive to climate change risks?

Risk Management: How can the financial sector be incentivized to identify vulnerabilities and pathways to resilience in the face of disaster risks into their risk management practices? Is regulation necessary to ensure firms apply stress testing against climate change and disaster-related scenarios?

Climate Finance: How can investments in climate finance promote projects that reduce the risk of climate change-related disasters? How can the shortfall in climate finance investments be eliminated? What are the emerging risks from climate change?

Transparency: Which regulations can promote greater business transparency and risk disclosure and how can they be implemented?

Green Infrastructure: How can a sustainable and disaster resilient infrastructure be developed? How can underdeveloped economies be restructured so that businesses can grow in a sustainable manner to reduce disaster risks and vulnerabilities in these regions?

Financial Access: How can financial access be expanded to those currently without? How can incentives be created so that financial institutions will invest in vulnerable and underserved areas? Are there lessons to be learned from alternative types of banking, such as Islamic banking, micro banks, and dwarf banks?

Development Aid: What are the strengths and weaknesses of the current official development assistance (ODA) system? How can donor countries be held accountable for their financial support pledges? How can ODA payments be better measured and tracked? How can ODA payments be better spent on public health and social issues?

Business Education: How should the education and training of the next generation of financial experts evolve so that they may integrate sustainability and disaster risk management into all their actions? What lessons can be learned from institutions that have successfully integrated sustainability and disaster risk management into their curriculum?

RESEARCH AND TEACHING AREAS IN GREATER DETAIL

In the following section, we review the research streams in which DOCSE is currently involved in more detail. The four faculty members and six postdoctoral/Ph.D. students currently affiliated with DOCSE actively engage in these and other research areas and integrate them in their course offerings. Because course offerings at the graduate level (in particular at the M.Sc. and Ph.D. level) have a strong research focus, our discussion below highlights the respective research activities at DOCSE. Course offerings at the undergraduate, MBA, and executive MBA level also cover these materials but do so more in the form of case studies, readings, and classroom discussions.

In addition, the following sections outline some of the existent current research and curriculum gaps.

Sustainable Investing

According to the World Economic Forum, Sustainable Investing (SI) is "an investment approach that integrates long-term environmental, social and governance (ESG) criteria into investment and ownership decision-making with the objective of generating superior risk-adjusted financial returns" (World Economic Forum 2011, p. 10). Recent years have seen a substantial growth in assets dedicated to investing in a "sustainable" manner. This is often referred to as ESG investing.

Factors that have driven the demand for SI include:

- Substantially increased demand for natural resources
- A general decline in both the credibility and financial capacity of governments, forcing businesses to tackle emerging issues such as climate change
- Increased stakeholder expectations for improved sustainability performance from both companies and investors
- A shift in the world's center of economic gravity toward emerging markets, where sustainability-driven risks and opportunities are greatest
- Growing threats to social and political stability, driven by income inequality and public health issues
- Rise of sovereign wealth funds, especially in Asia

None of these factors (or companies' responses to them) can be captured adequately via the traditional analysis of price/earnings ratios, balance sheets, or consensus forward earnings estimates. They are extra-financial factors that often have a major effect on a firm's bottom line (see, e.g., BP, Volkswagen, BHP Billiton).

The growth of this field should not be too surprising, considering that investors dislike risk but seek higher returns. In 2009, Goldman Sachs wrote in a report on climate change, "we believe the equity market is only beginning to recognize the magnitude of impact the transition to a low-carbon economy will have on companies' competitive positions and long-term valuations" (Goldman Sachs, 2009, p.2).

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The main question that many investors ask is whether there are any trade-offs to sustainable investing, whether in terms of underperformance or higher risk. Increasingly, the evidence shows that there are none. In fact, investing in sustainability often exceeds the performance of comparable traditional investments.

The main focus of interested parties at this stage is data, or rather the lack thereof. The Governor of the Bank of England, Mark Carney, recently recognized this in a widely quoted speech when he stated that "the challenges currently posed by climate change pale in significance compared to what might come. [...] Once climate change becomes a defining issue for financial stability, it may already be too late" (Bank of England, 2015). He went on to suggest setting up a "climate disclosure task force" to create a voluntary standard for the information companies producing or emitting carbon should disclose. Such information would provide investors with a better idea of potential risks at a time when scientific evidence was showing that eventually climate change will threaten financial resilience and longer term prosperity.

The key word here is risk. Investors can cope with risk but intensely dislike uncertainty. The difference is subtle but critical. Risk can be modelled, mitigated, and managed. Uncertainty leaves investors blind and unable to deploy effective risk management tools or make credible long term plans. Efforts should therefore be directed towards developing ESG metrics that enhance disclosure and assist investors in managing their ESG risk exposures.

Climate Finance

Climate finance is attracting ever-growing amounts of attention. Climate finance flows rose from $97 billion in 2010 to $331 billion in 2013 (Climate Policy Initiative, 2014). Measuring and tracking these flows is challenging. Data is gathered from two primary sources: 1) existing databases, tracking initiatives, and studies compiled by various organizations; and 2) third-party expertise, when official numbers are lacking or do not appropriately portray the related flow. Often, researchers make their own estimates when no satisfactory official or third-party numbers are available.

The Climate Policy Initiative (Venice) releases annual reports on the landscape of climate finance. To support policy debates, these reports map the magnitude and nature of finance flows – the sources of finance, intermediaries involved in distribution, financial instruments, and final uses. The 2011 report notes that a large portion of the $100 billion promised to climate finance in the Copenhagen Accord was already allocated prior to the Summit. With the majority of climate finance used for mitigation measures, only a very small share goes to adaptation and disaster resilience efforts. In addition, the proportion of funds earmarked for climate change adaptation has only slightly increased over the 2011-2014 period (Climate Policy Initiative, 2014).

A 2012 OECD report highlights key issues and questions that may be taken into consideration with regards to how the international community counts both public and private financial flows towards the $100 billion commitment and how to track

these flows. The report makes four key recommendations to move forward on developing a robust climate finance tracking system (Clapp et al., 2012):

- Increasing transparency and setting clear definitions for climate finance under the UNFCCC framework
- Making decisions about what institutions or actors should be tracking and reporting, and with what frequency
- Exploring various avenues of tracking climate finance within a more comprehensive system under UNFCCC
- Moving towards more robust tracking and reporting on public and private sector flows

Stadelmann et al. (2013) note that existing data on private climate finance are limited and of very poor quality: definitions of 'private climate finance' are missing and data are hardly verified. They conclude that policy makers will first have to clearly define 'private climate finance' and develop systems for measuring, reporting, and verifying private finance numbers before they are used in international climate agreements. Similarly, a common understanding of key climate finance terminology is needed by knowledge producers, users, and other stakeholders to improve ongoing discussions on how best to track climate finance, clarify efforts to measure its effectiveness, and help identify where public sector interventions can best affect the scale-up of climate finance (Falconer & Stadelmann, 2014).

The IIED (International Institute for Environment and Development) lists eight unmet promises in climate finance funding. These broken promises include the lack of transparency, the unfairness of contributions, the imbalance of funding towards mitigation instead of adaptation, the lack of central coordination through the United Nations, the double-counting of promised funding, and the failure to live up to promised funding (Ciplet et al., 2012).

Barrett (2013) also finds evidence of inequity in climate finance noting that climate change creates an inverse distribution of risk and responsibility. Developed countries are responsible for the majority of emissions that cause climate change, but are forecasted to confront only moderate adverse effects. Least developed states, on the other hand, are much more vulnerable to the effects of climate change and related disasters and face significant threats to their livelihoods, assets, and security. There are many calls for a more equitable system that supports developing countries in climate change mitigation and, especially, adaptation climate finance (see Pittel and Rübbelke, 2013).

Pickering et al. (2015) note an absence of coordination. While reflecting on reasonable differences over what constitutes a 'fair share', the authors conclude that an intermediate degree of coordination may reduce shortfalls in overall funding.

Just as important as the climate finance flows, comprehensive policy incentives such as carbon pricing, standards and regulation, and dedicated funding instruments such as policy banks or funds are needed at the national and international levels (Spencer et al., 2015). The Institute for Sustainable Development and Interna-

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tional Relations (IDDRI) finds a need to mobilize and redirect about a trillion USD of investment annually over the next 15 years to finance low-carbon, climate-resilient development consistent with the 2°C goal.

Further research efforts are required to establish a universal definition for climate finance, identify new climate finance sources, establish climate finance best practices, make donor countries pay out promised contributions, introduce fairness and proportionality into climate finance funding, and reduce the funding gap in climate finance, obtaining more climate finance funding from private sources.

Emerging Risks

Emerging risks are risks caused by unexpected events or unfamiliar conditions that affect firms, companies, and organizations, leading to increased volatility and uncertainty (Oliver Wyman, n.d.). Some of these risks are new or developing (e.g., cybersecurity risks), while others have been known for some time but are quickly evolving and becoming increasingly complex and interconnected (e.g., environmental risks). Emerging risks and their potential consequences are usually poorly understood, making them difficult to quantify. These dangers are not only increasingly likely to occur, but their potential impact is also growing.

Water stress and climate change are two examples of important and interconnected emerging environmental risks that present a material threat to financial systems. Climate change can result in changing precipitation and evaporation patterns, meaning some water-dependent industries may face water stress that could lead to increased operational, regulatory, and reputational risks. A sustainable financial system should be capable of addressing these issues and be resilient to emerging risks.

For example, a report of the Risky Business project (Risky Business, 2014), chaired by Michael Bloomberg (former mayor of NYC and founder of Bloomberg), Hank Paulson (former U.S. Treasury Secretary) and Tom Steyer (founder of hedge fund Farallon Capital Management), demonstrated the material risks posed by water and climate change. The report identified short-term climate threats to coastal property and infrastructure, agriculture, and energy which would significantly increase the cost of coastal storms, increase coastal property and infrastructure losses, reduce crop yields, and increase energy costs.

There are several key questions that need to be addressed both by researchers and in the classroom. For example, future research should identify which emerging risks present the most material impacts and how emerging risks are interconnected, improve our understanding of financial system vulnerabilities to emerging risks and how to improve resiliency through improved risk management practices, and identify methods and tools for reducing uncertainty around emerging risks.

Environmental Risk Management

Environmental credit risk management involves the consideration of environmental risk factors in banks' lending decisions, with the purpose of making better informed

lending decisions. Weber et al. (2010) show that the integration of a debtor's environmental performance as a decision criterion improves the predictive validity of the credit rating process and also the predicted financial performance of the borrowing firm. Weber et al. (2015) replicate these findings in a study of Bangladeshi banks.

Hu and Li (2015) conduct a comparative study on the usage of environmental credit risk management of banks in 12 countries of the Asia-pacific region. They group banks into three groups: the best performers (Canadian, American, and Japanese), average performers (Australian, South Korean, Chinese, and Thai), and the worst performers. Weber (2012) finds that Canadian banks are proactive in environmental credit risk management and are best-of-class globally. Basah and Yusuf (2013) study Malaysian banks and their managers to determine how environmental risk factors are treated differently according to bank and bank manager parameters. Their study finds a significant relationship between bank managers' racial groups, religious affiliations, bank types, and bank nationality towards credit evaluation. Weber et al. (2008) observes that European banks integrate environmental risk management in only the rating phase but not in other phases of the credit management process.

Environmental risk management practices also affect firms' cost of borrowing and debt financing. Bauer and Hann (2010) investigate their effect on the cost of borrowing using bonds. They find that firms with greater environmental issues have a higher cost of debt financing and lower credit. Conversely, firms with proactive environmental practices have a lower cost of debt. Sharfman and Fernado (2008) reach a similar conclusion noting that improved environmental risk management is associated with a lower cost of capital. In addition, they observe a noticeable shift from equity to debt financing for environmentally active firms. Clarkson et al. (2013) obtain contradictory results by finding that voluntary environmental disclosures do not lower the cost of capital borrowing but enhance firm value.

Despite the growing body of literature highlighting the benefits of environmental risk management, many industries are still resisting its usage. Clarvis et al. (2014) investigate the lack of integration of environmental risk into investment decision-making in the sovereign bond market. They present a framework, made in collaboration with partners such as the United Nations Environment Program Finance Initiative, that they hope will improve the financial rationale for considering environmental risk in the sovereign bond market. Similarly, Campbell and Slack (2011) find that U.K. sell-side brokerage analysts are extremely skeptical of the benefits of information contained in annual corporate environmental reports. The analysts rarely consider environmental risk in making their recommendations.

Environmental risk management also entails the need of environmental insurance for both bank lenders and firm borrowers. Katzman (1988) notes the need for pollution liability insurance in response to the environmental catastrophes of the time. Tol (1998) recognizes early-on the effects of climate change and the need for climate insurance. He points out that initially it will be difficult to insure for climate change because the associated damages will be hard to quantify. As time goes on, the need for such insurance will increase and insurance companies will shift the risk

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to the insured. Gollier (2005) bemoans the lack of insurance for catastrophic environmental risks in the market and offers possible remedies. He cites ambiguity aversion as one reason when insurers overestimate the risk of catastrophic events thus pricing the premiums beyond what consumers are willing to pay for coverage. Possible solutions would be a redesign of the incentives for underwriters or as a last resort, a system of government-backed insurance similar in form to that of social security. Botzen and van den Bergh (2008) conduct a multi-national study of environmental insurance and conclude that there is an insufficient amount of insurance coverage against climate change and other environmental risks in the Netherlands. They note that the problem is twofold: not enough insurance is bought and not enough is sold. Botzen and van den Bergh (2009) look at climate change insurance for individuals and conclude that a profitable environmental insurance market could exist in the Netherlands. Schroder (2013) regards environmental insurance as a useful risk management tool in the real estate industry. She notes that conventional risk management tools do not address the environmental risks carried by buyers and sellers. Environmental insurance would transfer all the risk to a third-party insurer, thus removing it from the real estate transaction. She argues that all parties would see this as a positive assurance against environmental risks. Finally, Liedtke et al. (2014) sees an opportunity for insurers to make a contribution to managing climate change. Insurance policy-makers could make it mandatory for building owners to make their properties environmentally-certified. They could also require stricter environmental risk disclosures from those seeking coverage.

The disclosure of needed information for proper environmental risk management is generally lacking and researchers often disagree about its utility. Thompson and Cowton (2004) find an unfulfilled demand for environmental information and point out that banks rely heavily on annual corporate environmental reports as their main source of information for environmental risks. At the same time, Lajili and Zeghal (2005) argue that annual reports have limited usefulness in a Canadian context because of the lack of uniformity, clarity, and quantification, which makes comparisons difficult. Mol et al. (2011) examine the effect of new information disclosure policies in China. They note that even though the Chinese government enacted the Environment Information Disclosure Decree, national and provincial environmental protection bureaus are slow to comply with the new legislation. The researchers conclude that the situation is improving but that implementation is often incomplete or ineffective. Liu and Lin (2014) report a more positive situation for environmental disclosures in Chinese commercial banks. They find that improvements in the banks' environmental risk management behaviors are driven by external pressure from the community and non-governmental organizations.

Stress Testing

Stress tests are performed on specific financial instruments, institutions, and systems to determine robustness under different scenarios, though very few incorporate environmental factors into the simulations. Ally Financial subjects their investment

portfolios to market risk and counterparty credit risk. They use a variety of different models to project changes in market values due to changes in interest rates, credit spreads, and volatility (Ally Financial Inc., 2015). A typical bank-wide stress test applies unfavorable scenarios to determine the effects on variables such as its net income, balance sheet, risk-weighted assets, and capital adequacy (U.S. Bancorp, 2014). The U.S. Bancorp stress test is also limited in the types of risk investigated: credit risk, operational risk, interest rate risk, market risk, reputation risk, and liquidity risk. Regulators are interested in testing the performance of entire systems such as the banking system. The staff at the U.S. Federal Reserve regularly analyze the banking institutions under its jurisdiction (Flannery et al., 2015).

Many question the validity of these stress tests. Ong and Pazarbasioglu (2014) discuss the lack of credibility in many stress tests and the need for tougher testing scenarios. Borio et al. (2014) doubt the value of macro stress tests as early warning devices, i.e. as tools for identifying vulnerabilities during seemingly tranquil times and for triggering remedial action. Doumpos et al. (2015) find that the stress tests performed by the European Banking Authority on European banks have much room for improvement. Similarly, Bookstaber et al. (2013) identify shortcomings in current stress testing and offer a research agenda for their improvement. However, none of the recommendations involve the use of environmental variables in testing scenarios.

Very few papers actually address environmental factors in stress testing. Schoenmaker et al. (2015) incorporate an ecological dimension into the macroprudential policy framework of stress testing and applies this in the example of carbon emissions. Here, higher risk weights are set for carbon intensive and dependent sectors (transport, mining, energy) and carbon intensive and dependent companies within these sectors.

There is an increasing acknowledgement that environmental factors affect the global financial system. In 2011, Mercer released a report examining the strategic asset allocation implications of climate change so that investors capture risk more effectively, gain insights, and integrate them into their current investment processes. KPMG International (2012) converts 22 environmental impacts into financial value, drawing upon current environmental economic research to achieve a total environmental cost value. Robins (2014) reports that HSBC and other financial institutions have started to analyze the valuation implications of the low-carbon transition. The fifth theme of the One Bank Research Agenda involves the development of the Bank of England's response to fundamental technological, institutional, societal, and environmental change (Bank of England, 2015). There is a growing consensus that aggregate economic losses accelerate with increasing temperature and these future changes in climate will lead to significant reductions in global economic output. Physical risks, such as catastrophic weather events, could affect economic growth, particularly in developing countries, translating directly into financial losses through an increase in insurance claims (Lloyds of London, 2014).

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CURRICULUM DEVELOPMENT IN LIGHT OF SFES-KAN RESEARCH

The SFES-KAN provides an excellent platform through which both research and curriculum development in the area of sustainability and disaster risk management can be fostered. The KAN comprises academics, practitioners, policy makers, and consultants who work in the area of sustainability, risk management, insurance, and policy development. DOCSE has hosted panel discussions with these parties at a UN-PRI conference in Montreal in September 2014, the *Our Common Future under Climate Change* conference in Paris in July 2015, and via a series of local corporate workshops that it organizes twice per year. The participants of these workshops have also been invited as guest lecturers to related courses offered by the John Molson School of Business at Concordia University.

Through these interactions, DOCSE has been in an excellent position to establish a transdisciplinary team of experts with which it undertakes and leads the aforementioned research activities. In addition, these experts have been instrumental in establishing (and ultimately teaching in) the Sustainable Investment Professional Certification (SIPC) program provided online through the university and play an active role in the creation of a new professional certification program on sustainable real estate which DOCSE plans to launch in the near future.

In addition to incorporating the aforementioned research topics into its curriculum and developing new undergraduate and graduate-level courses (as has been one of the main missions of DOCSE and its faculty in the past), we envision the creation of another professional certification program that builds upon the highly successful SIPC program developed by DOCSE and now administered through Concordia's Executive Business Office as well as the Sustainable Real Estate program currently under development. Similar to these programs, the new program would draw upon the expertise of prominent experts in this field (many of which have already joined the SFES-KAN), would be offered online to a world-wide audience, and would teach both the theoretical underpinnings and practical implications of a sustainable financial and economic system, including disaster risk management.

CONCLUSIONS

DOCSE's participation in collaborative projects around building a more sustainability-oriented financial system has led to increased research in the field of sustainability and the development of sustainability curriculum at Concordia University's John Molson School of Business. Both DOCSE's sustainability research and the sustainability curriculum at the Business School have included disaster risk management as an integral part of sustainability.

More specifically, as part of the UN Future Earth SFES-KAN project, DOCSE's researchers are investigating a wide array of topics that fall under the 'sustainability umbrella', including sustainable investing, climate finance, emerging risks, environmental risk management, and stress testing. These research topics have become in-

corporated in courses offerings at the undergraduate, MBA, and executive MBA levels. DOCSE continues to expand these course offerings by introducing new courses and developing new certification programs.

Of course, sustainability is a broad theme and there are several relevant topic areas under the aforementioned umbrella that DOCSE has not yet explored. Furthermore, DOCSE's primary focus has been on managing risks that threaten sustainability and not simply disaster risk management. Future research at DOCSE may need to emphasize questions around deepening our understanding of disaster risks specifically and refining disaster risk management best practices so that Concordia may further develop its disaster risk management curriculum, including DOCSE's plan to develop a professional certificate or program around SFES research that would incorporate disaster risk management. Both DOCSE and the John Molson School of Business may benefit by learning lessons from peers who have also developed research and curricula on disaster risk management through sustainability-themed research and curriculum.

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