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A review of studies on green finance of banks, research gaps and future directions

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ABSTRACT

With growing global concern for environmental protection, climate change and sustainable development, policymakers and researchers have recently focused on green finance. In this study, existing studies on green finance in the context of the banking sector have been reviewed with considerations on products and determinants of green finance. The content analysis approach has been used to critically analyse and summarize forty-six (46) relevant studies. The results found green securities, green investments, climate finance, carbon finance, green insurance, green credit and green infrastructural bonds as part of key green finance products of banks. Pertinent determinants the study found to be influencing green finance policies from banks include environmental and climate change policies, interest rates, religion, risks, social inclusion and social justice as well as banking regulations. In theory, this study provides a guide for further studies. The results of the study will assist banks on the key issues to consider in adopting, developing and granting green finance.

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Bank; content analysis; determinants; green finance; review article

1. Introduction

In recent times, the consensus for environmental protection, actions on climate change and the achievement of United Nations Sustainable Development Goals (SDGs) by 2030 (Amidjaya and Widagdo 2019; Dörry and Schulz 2018) have drawn attention to green finance. ‘Sustainable finance’ or ‘environmental finance’ or ‘climate finance’ and ‘green investment’ are variously used to refer to green finance. Green finance reached a crescendo of importance during the eleventh meeting of the G-20 nations in Hangzhou, China in 2016 (Liu et al. 2019; Schäfer 2018) where it was widely publicised and discussed. Different conceptions of green finance reflect the aspect of the concept that is of importance to the researcher, making diversities in the understandings and interest in green finance. IFC (2009) defined green finance in the confines of investment products that preserve the environment, ensure social justice and promote economic prosperity. Lindenberg (2014) explained the concept as policies from the financial institutions

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that sustain the green economy. The ‘finance’ aspect of the concept showcases the capital allocation and investment through the financial systems (Berensmann et al. 2017; Weber and ElAlfy 2019). Banks play an intermediary role in absorbing and distributing idle funds within the society to ensure economic development (Andreeva et al. 2018; Fu and Ng 2020). The ‘green’ attribute of green finance requires that the allocation of financial resources should be extended to the protection of the environment, clean energy, green building, climate change, social inclusion, and corporate governance in all sectors of the economy (Urban and Wójcik 2019; Yuan and Gallagher 2018).

In the banking sector, green finance is attaining priority due to the quest to sustain banks and society in general against unforeseeable future economic challenges (Ziolo et al. 2019) resulting from unpredictable global financial occurrences, climate crisis, social unrest and corporate scandals. Also, conventional banking paradigm is shifting towards the provision of ecofriendly products (Dikau and Volz 2020). At the Paris ‘One Planet Summit’ in December 2017, central banks and major players in the banking sector across the globe pledged their support to the promotion of ecofriendly financial products (Kim 2017). The World Bank also announced its intentions of ceasing to support corporations and nations that place less emphasis on protecting the environment (M. A. Urban and Wójcik 2019; Zhang, Zhang, and Managi 2019). Banks such as Societe Generale, Hong Kong-Shanghai Banking Corporation (HSBC), Deutsche Bank, BNP Paribas and Credit Agricole among others have reported a change in their strategic corporate policies to embrace ecofriendly products. They intend to halt financing individuals and corporate entities whose activities damage the environment (Sanchez-Roger, Oliver-Alfonso, and Sanchís-Pedregosa 2018). Some central banks like the Chinese Central Bank have developed and implemented regulations to guide green finance transactions in the banking sector (L. He et al. 2019). Interestingly, notwithstanding the importance of these commitments, a large number of banks in different parts of the world have not demonstrated the willingness to develop financial products on green finance. As a result, green finance at its current stage has not been implemented in many regions across the globe. It is faced with no common standardized regulations, high risks, limited scope and dimensions among other issues across the globe.

In addition, the scanty literature on green finance are silent on the actions taken by banks, green finance products and key determinants on green finance of banks. For instance, Sarma and Roy (2020) examined limited dimensions and keywords relating to the internal practices of banks (green banking). Zhang, Zhang, and Managi (2019) considered green finance in the general context not particularly the banking sector. Moreover, studies to synthesize, summarize and identify trends on green finance for future researches and formulation of policies in the banking sector are rare. In order to address these gaps, this study presents a systematic review of relevant studies on green finance of banks. Specific objectives to be addressed include:

- (i) *To analyse the annual publications from 1990 to 2019.*
- (ii) *To assess the active contributing journals, authors, countries and institutions to the publication to studies on green finance of banks.*
- (iii) *To examine the research methodologies and previous studies on green finance of banks*

- (iv) To identify the relevant themes in green finance of banks: dominant green finance products and determinants of green finance from banks.
- (v) To highlight the research gaps and future direction of green finance from banks.

As a systematic literature review, this study presents evidence of incoherent conceptualization of relevant themes on green finance of banks. Traditionally, banks play the major roles of creating, allocating and circulating funds in an economy but these roles are shifting with the need to implement green financial policies (Geddes, Schmidt, and Steffen 2018). A call for an urgent stakeholder engagement and development of clear-cut policies have been heightened in the banking sector (Huang, Liao, and Li 2019; Yip and Bocken 2018). Thus, the study contributes to developing green finance policies and ascertaining its key determinants in the banking sector.

The rest of the study is organized in the following regard. The next section is research methodology which outlines the procedure adopted in conducting this study: from retrieval of papers to the procedure for data analysis. In section 3, results and discussions of relevant findings are presented in line with the research objectives set in section 1. Conclusion and implications of the study are presented in section 4. The study ends at section 5 where the limitations of the study are given.

2. Research methodology

Section 2.1 details the search process engaged for the retrieval and selection of relevant research papers while Section 2.2 outlines the mechanism adopted to assess the contribution of authors on green finance of banks.

2.1. Retrieving and selection of relevant research papers

We adopted the search strategies of Carolina Rezende de Carvalho Ferreira et al. (2016) and Osei-Kyei and Chan (2015) to retrieve and select relevant research papers. The two-stage search process they outline for retrieving and selecting relevant papers (see Figure 1) was applied. The two-stage search process are (1) initial search and (2) selection and acceptance of relevant papers. This is explicated chronologically as follows.

Stage 1: Initial search for papers (articles)

The initial involves the use of an appropriate search engine to identify all journal articles on green finance from the banking industry. The Scopus search engine was deemed appropriate because: (1) it scores high performance on accuracy in retrieving journal articles (Falagas et al. 2008); (2) it contains a wider coverage of publications in different filed relevant to this study, namely finance, risk management and accounting (Díaz-García, González-Moreno, and Sáez-Martínez 2015); (3) it is the most frequently used search engine for contemporary review studies (Sarma and Roy 2020).

The search terms used are keywords on green finance are ‘sustainable finance’, ‘green finance’, ‘green financing’, ‘green loan’, ‘green credit’, ‘green securities’, and ‘green investment’. Keywords on the banking industry such as ‘banking’, ‘bank’, ‘financial institutions’, ‘finance industry’, and ‘banking sector’ were also used. The initial query brought 111 papers consisting of books, articles, conference proceedings, and reviews.

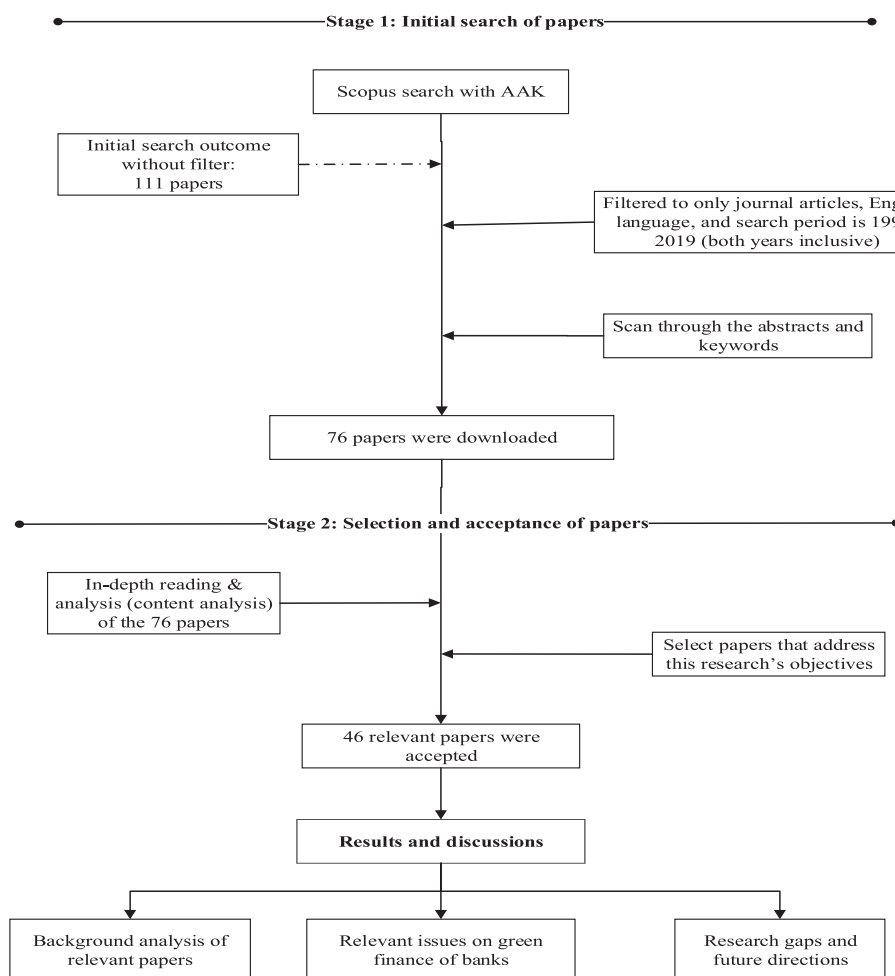


Figure 1. Research methodology process.

*Note: A/A/K = Article title/Abstract/Keyword.

Further restrictions such as (i) publication year: 1990-2019; (ii) search type: journals; (iii) document type: articles; and (iv) language: English were imposed on the results which reduced the hits to 76 journal articles. The following are the search code as of the articles:

(TITLE-ABS-KEY ('green finance' OR 'sustainable financing' OR 'sustainable finance' OR 'green financing' OR 'green loan' OR 'green securities' OR 'green credit' OR 'green investment' OR 'green insurance') AND TITLE-ABS KEY ('banking' OR 'bank' OR 'financial institutions' OR 'finance industry' OR 'banking industry' OR 'banking sector')) AND PUBYEAR > 1990 AND PUBYEAR < 2019 AND (LIMIT-TO (DOCTYPE, 'ar')) AND (LIMIT-TO (LANGUAGE, 'English')) AND (LIMIT-TO (SRCTYPE, 'j')).

Stage 2: Selection and acceptance of relevant papers

The content of the of 76 journal articles downloaded was analysed and based on the relevance of the content, 46 relevant papers were selected for data analysis and discussions. Only journal articles that address this study's objectives were selected. Although some of

the 76 papers mentioned green finance, they were not selected because they did not thoroughly address relevant issues on green finance in the banking industry. The 46 papers were categorized into three. The categorization was based on a) background of the relevant papers: annual publications, contribution of authors, journals, countries, and institutions, and research methodology adopted by previous studies, b) relevant themes on green finance of banks: types of products and determinants of green finance of banks and c) research gaps and future direction.

2.2. Assessing the contributions of authors

The contributions of the active authors on green finance of banks were assessed and ranked with a score matrix formula by Howard, Cole, and Maxwell (1987) presented as:

$$\text{Score} = \frac{1.5^{n-i}}{\sum_{i=1}^n 1.5^{i-1}} \quad (1)$$

where n denotes the contributing authors; and i = the rank of the authors. According to Howard, Cole, and Maxwell (1987), each article is given a maximum score of 1.00 (the authors share the score of 1.00 among themselves). The formula is built on the premise that the first (lead) author gets a higher score and the rest of the score share equally among other contributing authors shown (see Table 1).

3. Results and discussions

3.1. Background analysis of relevant papers

Annual publications

Figure 2 shows the number of publications over the sample period. The period 1990 to 2019 was chosen for this study because it is within this time frame that published studies on green finance are conspicuously available. Also, this period marks the time when the concept has gained global prominence. The results (summarized in Figure 2) show a steady rise in the publications of green finance of banks year-on-year publications from 2012 to 2019, giving evidence that the research area has been increasingly receiving strong scholarly attention with consistent increase in publication.

The sharp increase in the number of publications from 2017 with 2 papers to 2019 with 22 papers suggests that green finance in financial institutions has become topical among academics, and that the economic rationale behind this growth is the global

Table 1. Authors assessment score matrix.

Number of author(s)	Order of specific author				
	1	2	3	4	5
1	1.00				
2	0.6	0.40			
3	0.47	0.32	0.21		
4	0.42	0.28	0.18	0.12	
5	0.38	0.26	0.17	0.11	0.08

Source: Howard, Cole, and Maxwell (1987)

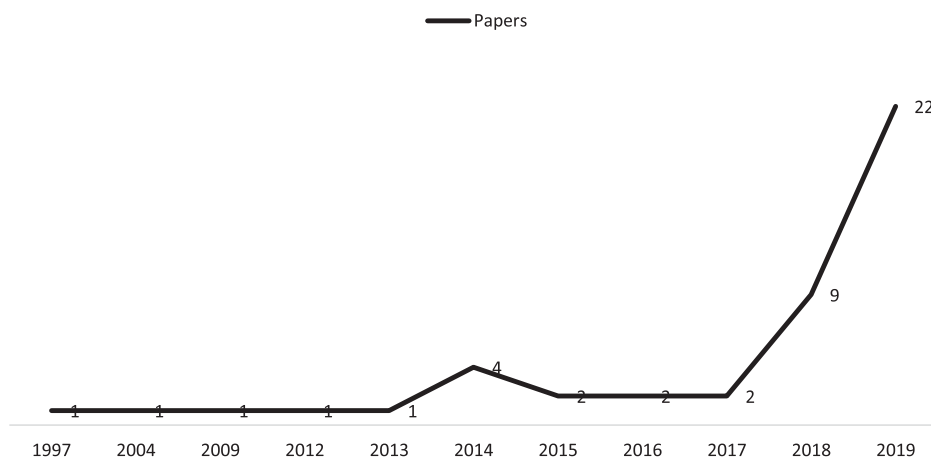


Figure 2. Annual publications on green finance.

traction of investment in green finance (He et al. 2019; Taghizadeh-Hesary and Yoshino 2019). Evidently, in 2019 green finance (sustainable debt) issued globally stood at USD465 billion, increasing by 78% from USD261 billion in 2018 (BloombergNEF 2020). Again, it is an indication of growing acceptance and commitment of financial institutions towards advancing green finance (Durrani, Rosmin, and Volz 2020). Thus, financial institutions consider the essence of environment, social, and governance (ESG) issues in designing and implementing policies on investments in relation to UN SDGs (Urban and Wójcik 2019). Moreover, the observed increase in interest may have been triggered by a call from environmental activists and accessibility of information to identify and take advantage of environmental and social opportunities (e.g. FIRST – Financial Institutions: Resources, Solutions, and Tools – for sustainability by the International Finance Corporation). On the balance, it is noteworthy to emphasize that the increasing trend of researches on green finance of banks would continue as the topic maintains relevancy status to the banking industry in several jurisdictions.

Major journals publishing green finance researches

The 46 research papers used in this study appeared in 32 journals. To identify the journals that frequently published green finance researchers, however, We selected journals that published at least two relevant articles (see summary in Figure 3). The leading journal is *Sustainability* (Switzerland), followed by the *Journal of Sustainable Finance and Investment*, *Technological Forecasting and Social Change*, *Emerging Markets Finance and Trade*, and *Humanomics* respectively. The data revealed that although these journals published a little over 40% (i.e. 19/46) of the relevant papers covered by this study, a great deal of emphasis of both theoretical and industrial practices on green finance in banks are covered by these journals.

Active contributors (authors, institutions and countries) to green finance studies

Table 2 presents the list of countries (where banks studied are situated) that contributed to research in green finance of banks during the sample period (i.e. 1990 to 2019). Besides, it shows the number of institutions, authors and score of contributions of

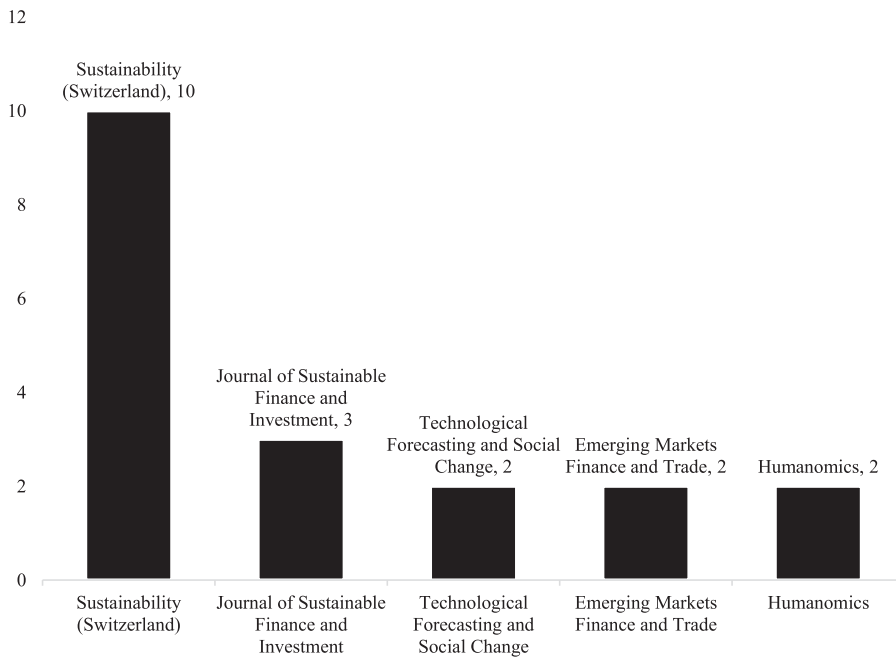


Figure 3. Major journals publishing green finance researches.

Table 2. Active contributors to green finance in banking industry.

Country	Institutions	Authors	Articles	Score
China	15	24	11	7.19
UK	8	11	5	6.70
Italy	12	18	4	6.40
USA	9	7	2	2.84
Malaysia	2	7	1	2.53
Netherlands	5	6	1	2.00
Spain	4	5	2	1.79
France	2	5	1	1.59
Bangladesh	3	5	3	1.47
Canada	2	4	1	1.28
Germany	2	2	3	1.00
Poland	3	3	1	1.00
Pakistan	2	2	1	1.00
Luxembourg	2	2	1	1.00

authors. This analysis is critical to the geographical distribution of studies on green finance and mirrors the degree of industry practice and improvement on the subject in explicit areas. Consequently, country-level analysis of the research on green finance in financial institutions may give useful insights into the degree of advancement in green finance in those financial ecosystems. Due to a large number of authors and countries covered, items on Table 2 are presented based on the criteria that a country should have at least a score of one (1.00) with at least two institutions, and two authors contributing to the researches on green finance of banks. With scores of 7.19, 6.70, and 6.40 respectively, China, the United Kingdom, and Italy are the top three

countries contributing to studies on green finance. In China, 24 authors from 15 institutions have contributed to investigating green finance of banks. This finding is consistent with the wider attention of the international community towards green finance taking experiences from China (He et al. 2019; Voituriez, Yao, and Larsen 2019). Besides, some countries in Asia contribute to research on green finance in financial institutions. Malaysia and Bangladesh, which obtained 2.53 and 1.47 scores respectively also contribute to the studies in the field. This result reinforces the Asian region's dominant lead on green economy (Durrani, Rosmin, and Volz 2020) and consistence with increased investment in green finance (estimated at USD2.5 trillion yearly) to fulfill the requirements of SDGs (Tracy et al. 2017).

In the United Kingdom, 11 researchers from 8 institutions have contributed to green finance in banking institutions. Though Italy had more researchers, 18 in 12 institutions, who contributed to green finance, she had a lower score of 6.4 as compared to UK's 6.7. Also, there are six more countries from Europe (i.e. the Netherlands, Spain, France, Germany, Poland, and Luxembourg) that are leading researches on green finance of banks. This observation is consistent with the European Union's role in ensuring sustainability of economies and protection of the environment (Cullen 2018). The United States is ranked fourth, with a score of 2.84 by 7 researchers from nine institutions during the period covered by the study. This statistic is consistent with the assertion that US financial institutions have a reputation for being laggards on sustainability issues when compared with their European counterparts (Krosinsky and Purdom 2016).

Furthermore, Table 3 shows the major institutions from which at least two researchers have contributed to studies on green finance. the *China University of Mining and Technology* (China) emerged as contributing the most to green finance with 6 active contributors, followed by the *Jiangsu Normal University* (China) with 4 active contributors and *University of Genoa* (Italy), *International Islamic University* (Malaysia), and *Oxford University* (UK) all with 3 active contributors. Again, the results show the dominance of institutions from both Asia and Europe. The majority of the institutions contributing to green finance-related research are based in Asia, followed by Europe while the US's Boston University is the only institution in North America contributing to relevant studies on green finance in banking institutions during the period covered by the study whiles Africa and South Africa are missing in top ranked institutions contributing to green finance.

Table 3. Major institutions contributing to green finance in banking.

Institution	Country	Authors
China University of Mining and Technology	China	6
Jiangsu Normal University	China	4
University of Genoa	Italy	3
International Islamic University (Malaysia)	Malaysia	3
Oxford University	UK	3
Guangzhou University	China	2
University of Szczecin	Poland	2
Ruhr-Universität Bochum; Institute of Economics (Italy)	Italy	2
International Islamic University	Pakistan	2
Boston University	US	2
University of Rome	Italy	2
Maastricht University	Netherlands	2

Methodologies adopted for studies on green finance

From the relevant papers analysed, five dominant research methodologies were used by existing studies on green finance. These are survey, case study (with expert opinions and interviews), literature (policy) review, robust statistical models and mixed research methods. Figure 4 shows that the statistical (or mathematical) model is the most preferred research approach in investigating green finance in financial institutions, accounting for 54% of the total number of surveyed papers. This finding appears consistent with the need for robust empirical evidence to argue the narratives and policy development on green finance and validate theoretical underpinnings of the relevance of green finance (Andreeva et al. 2018; Falcone and Sica 2019). Having been used by 20% of the surveyed papers, review of policy documents (literature) was found to be the second frequently used research approach adopted by the surveyed papers used in this study. The case study which was accompanied by interview instruments was the third preferred research methodology adopted in the surveyed papers as it was used by 11% of the total surveyed papers. This is consistent with Voituriez, Yao, and Larsen (2019) findings that case studies give detailed analyses of a phenomenon. Using a case study, they identified the differences in China's diplomatic posture a champion of green revolution. Mixed method and questionnaire survey were the least adopted research methodology on green finance representing 9% and 6% respectively.

Citation factor analysis

In Table 4, a list of the twelve (12) most cited articles on green finance from banks is presented. The number of citations of an article provides a useful measure of its scientific impact (Jiménez and Bjorvatn 2018). Moreover, the strength of an article's authority and influence is also primarily assessed in terms of its citation frequency (Chan and Liano 2009). Understanding the most cited works on green finance from banks provides a guide for future research efforts and the all times cited counts were based on all databases in GoogleScholar, Scopus and Web of Science search engines. Apart from articles

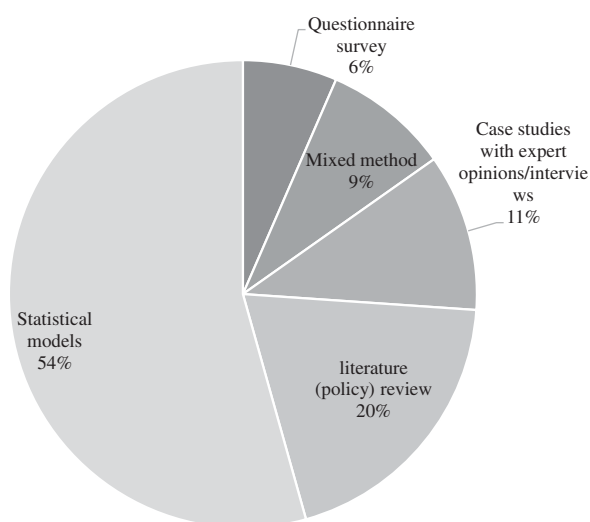


Figure 4. Research methodology adopted on green finance in banking.

Table 4. Most cited articles on green finance of banks.

Author (s)	Year	Title of Article	Citations
Wilson R.	1997	Islamic finance and ethical investment	221
Yip A.W.H., Bocken N.M.P.	2018	Sustainable business model archetypes for the banking industry	104
Missbach A.	2004	The Equator Principles: Drawing the line for socially responsible banks? An interim review from an NGO perspective	56
Mengze H., Wei L.	2015	A comparative study on environment credit risk management of commercial banks in the Asia-Pacific Region	40
Huang Z., Liao G., Li Z.	2019	Loaning scale and government subsidy for promoting green innovation	38
Bai Y., Faure M., Liu J.	2013	The role of china's banking sector in providing green finance	35
D'Orazio P., Popoyan L.	2019	Fostering green investments and tackling climate-related financial risks: Which role for macroprudential policies?	34
Cui Y., Geobey S., Weber O., Lin H.	2018	The impact of green lending on credit risk in China	32
Rayman-Bacchus L., Relano F., Paulet E.	2012	Corporate responsibility in the banking sector: A proposed typology for the German case	27
Falcone P.M., Sica E.	2019	Assessing the opportunities and challenges of green finance in Italy: An analysis of the biomass production sector	26
Glomsrød S., Wei T.	2018	Business as unusual: The implications of fossil divestment and green bonds for financial flows, economic growth and energy market	25
Raberto M., Ozel B., Ponta L., Teglio A., Cincotti S.	2019	From financial instability to green finance: the role of banking and credit market regulation in the Eurace model	23

written by Wilson (1997) and Yip and Bocken (2018) which had more than 100 citations, most of the papers have less than 50 citations indicating the paucity of literature on this topic. It is also an indication of the newness of the green finance product to banks which scholars and practitioners are developing all over the world. The last three studies (Falcone and Sica 2019; Glomsrød and Wei 2018; Raberto et al. 2019) on the Table 4 support this claim as these studies were conducted less than three (3) years ago.

3.2. Relevant themes on green finance of banks

1. Green finance products of banks

A host of green finance products are emerging in the banking industry and they come with different brands, and terms and conditions. Strategically, banks identify and sell relevant green finance products that position them ahead of their competitors in the industry (Raberto et al. 2019). These products are influenced by a number of factors (see Table 6) in the context of the banking sector (Mengze and Wei 2015). In Table 5, the commonly found green finance products from banks are presented taking a cue from the 46 papers selected for this study.

The green finance products identified from the banks include:

Green loan (credit)

Green loan or credit is a special short to medium-term financial support from banks to start-ups, small businesses and multinational corporations to research and develop innovative products (Díaz-García, González-Moreno, and Sáez-Martínez 2015; Islam et al. 2014). Specifically, it provides start-up funds for green innovation, making them competitive, particularly among high-tech companies (Chen et al. 2019). Also, green loans strengthen the capital structure of small businesses to sustain them from financial distress offered to small businesses at low-interest rates. Cullen (2018) pointed out the

Table 5. Most reported green finance products of banks.

Green finance products	References (*)
Green credit/loan	1, 3, 8, 15, 19, 20, 21, 22, 23, 24, 25, 27, 28, 29, 30, 34, 36, 43, 44
Green long-term investment account	1, 8, 11, 12, 14, 18, 21, 28, 29, 34, 39
Carbon finance	1, 2, 8, 12, 13, 14, 17, 24
Climate finance	11, 12, 18, 23, 26, 43
Green traded stocks and bonds	1, 8, 15, 23, 24
Green bancassurance	1, 8, 24, 35
Green infrastructural finance	16, 23

NB: (*) – Check references from the appendix

tremendous effects of green credits on the success of businesses. Additionally, in providing loans to small firms, banks assent to the equator principles which ensure preferential treatment for environmentally friendly projects. The equator principles require these banks to increase the amount of loans to be disbursed, reduce the interest on these loans as well as extend the repayment period (Verma 2012). These practices are intended to enhance the interest of firms in pursuing environmentally friendly projects.

Green long-term investment account

Also termed as sustainable investment account, green long-term investment accounts is a product from the banks which allows customers to save enough funds to support environmentally-inclined long-term investment activities in agriculture and other aspects of the economy (He et al. 2019). Recent evidence suggest that renewable energy investment is increasing and banks make this possible by opening up to firms and individuals to invest in this project (He et al. 2019). Another aspect of green long-term investment from banks is to make sure sponsoring programs have adequate finance to tackle the economic challenges among the minorities, accompanying old age (pension), to ensure social cohesion and integration, sound corporate governance and improve labor relations (Julia, Rahman, and Kassim 2016).

Carbon finance

The banking finance relates to financing biogas plants, solar panels, waste disposal plants, energy treatment plants (ETPs), and installation of tunnel and zigzag kiln among others (Da et al. 2019; Esposito, Mastromatteo, and Molocchi 2019). This banking product is essential for reducing carbon emissions from fossil fuel, industrial wastes and pollutants from manufacturing plants leading to the reduction of greenhouse gases. It assists in recycling wastes, improving cooking, and supplying safe and clean water (Raberto et al. 2019). Many banks in coal-exporting nations are issuing more carbon finance and less of traditional loans on fossil fuel (coal) to reduce the negative impacts of carbon emissions on the environment (Ganda 2018; Glomsrød and Wei 2018).

Climate finance

The climate finance from banks aims at creating funds to address the climate crisis such as greenhouse gas emissions from industry and all human activities to ensure the resilience of weather, and the wellbeing of humanity (D’Orazio and Popoyan 2019; D’Orazio and Valente 2019). Moreover, the product is to support programs, institutions and pressure groups focused on mitigating the negative fluctuations in the weather conditions (M. A. Urban and Wójcik 2019). Diverse interpretations exist on climate finance from banks making it broad and multifaceted (Buchner et al. 2014). The current debate on

climate finance from financial institutions is much focused on annual reporting of banks with the quest to meet the Paris Agreement in 2015 and UN's SDGs.

Green traded stocks and bonds

Green securities generally refer to securities from banks that are mainly used to support green industry projects, including green indices and green fund traded on the exchanges (D'Orazio and Popoyan 2019; D'Orazio and Valente 2019; Ziolo et al. 2019). The development of green stocks and bonds are conducive to the function of optimizing the allocation of resources in the capital market and serving the real economy (Yuan and Gallagher 2018). Stock markets and banks in Asia especially China play leading roles in promoting green securities to support innovation and development of listed companies (Taghizadeh-Hesary and Yoshino 2019). Stock markets emphasize developing green bonds, accelerating the innovation of green index products, and deepening international cooperation in green finance. In June 2017, the stock markets in Shanghai, China and Luxembourg introduced a Green Bond Index (Bielński and Mosionek-Schweda 2018) with a Green Bond Channel.

Green bancassurance

Risks are inevitable to everyone and one way to manage these risks is through insurance. Green bancassurance offers carbon-neutral underwriting coverages for green buildings, cars and other insurable assets or liabilities (Wang et al. 2017). The product has a positive direct impact on the planet, people and animals. In collaboration with insurers, banks help to promote sustainable practices by offering eco-friendly policies which include options such as premium discounts for carbon-neutral cars, certified green homes (building) and properties to homeowners, car-owners etc. (Green et al. 2016; Wang et al. 2017). Green bancassurance stimulates green innovation providing efficient means to avoid insurable risks (Mills 2012). From the country level, the results indicate that banks in India and China have employed green bancassurance to provide economic incentives to policyholders at an affordable cost (Soundarrajan and Vivek 2016; Zhou and Huang 2016) and to reduce carbon-emissions (Mills 2012).

Green infrastructural finance

As an innovative financing option, green infrastructural finance support and promote ecological civilization in development projects. It implements sustainable financing options to build mega infrastructural projects such as roads, schools, railway and hospitals (Falcone and Sica 2019; La Rocca and Baietti 2012). The green infrastructure support is often long-term nature which gives a wide range of flexibility to borrowers to repay. A typical example is the first green bond issued in North America to finance Public-Private Partnership (PPP) hospital project in Canada (Thomas 2014). The bond had a maturity period of 32 years and CAD 231.5 million value. This bond was oversubscribed due to its green label. The bond has been used to finance North Island hospitals. Banks serving as private partners to public-private partnerships (Hwang, Shan, and Supa'at 2017) with the public sector have ensured the projects have been successful. From the perspective of Gianfrate and Peri (2019), green infrastructure bonds with labels impact strongly on the subscription price. This attracts private investors and special purpose vehicles to access to finance infrastructure. These bonds are averagely sold on premium making it convenient for borrowers. Also, Tolliver, Keeley, and Managi (2020) indicate that

green infrastructure finance has produced infrastructures with positive environmental outcomes globally. This promotes global climate and sustainable development. Finally, Flaherty et al. (2017) conclude that issuing green infrastructural finance has the potential to mitigate climatic conditions caused by public buildings, encouraging more investment in environmentally friendly projects.

2. Determinants of green finance of banks

The following are results of the analysis of the key factors influencing decisions, investments and products on green finance from banks. An overview of the analysis is in Table 6.

Global action on environmental protection and climate change

The willingness of banks to take action on external pressures and demands to be environmentally responsible largely stem from increased global and regional policies and agreements on the environment and climate change (Esposito, Mastromatteo, and Molocchi 2019). The pressure on banks to implement environmental protection and climate change has risen after the Paris Climate Agreement was signed in 2015 (Chen 2018). Global and regional bodies such as United Nations, World Bank, IMF, European Union, and G20 are increasingly mounting pressure on their members and trading partners to implement green finance policies in their finance systems (Campiglio et al. 2018). Also, international pressure groups on climate change and environmentalists (Jung et al. 2020) such Greta Thunberg are pushing for a change in banking policies to reflect the current climate and environmental crisis, and the need to abandon or reconsider refinancing fossil fuel (carbon emissions). Due to these pressures, banks are accepting environmentally-focused reforms everywhere in the world (Dikau and Volz 2020).

Table 6. Identified determinants of green finance of banks.

#No.	Determinants of green finance of banks	References (*)	Papers
1	Global action on environmental protection and climate change	2, 8, 9, 14, 15, 19, 20, 21, 22, 23, 28, 29, 30, 32, 34, 40, 43, 45, 46	19
2	Banking sector regulations	8, 9, 12, 14, 15, 16, 17, 18, 23, 37, 43	11
3	Internal practices and ethics of banks	1, 8, 12, 14, 15, 16, 17, 18, 23, 43	10
4	Risks	8, 11, 12, 14, 15, 16, 17, 19, 34, 36	10
5	Social justice and social inclusion	1, 2, 8, 9, 11, 15, 32, 38, 43, 45	10
6	Interest rates	3, 9, 14, 15, 19, 21, 35	7
7	Religion	18, 19, 34, 35, 40, 44, 46	7
8	Bank (company) size	1, 3, 7, 8, 9, 12, 15	7
9	Technology and innovation	3, 9, 10, 19, 20, 31	6
10	Financial literacy & consumer awareness	4, 19, 33, 34	4
11	Sound corporate governance and disclosures	8, 19, 20, 45	4
12	GDP growth rate (economic growth)	12, 14, 21, 23	4
13	Reliable data on green finance	1, 4, 8, 15	4
14	Profitability (returns) on green finance	1, 15, 40	3
15	Bank credit policies	29, 33, 36	3
16	Level of consumer demand and expectation	1, 8, 37	3
17	Age of a bank	1, 15	2
18	Leverage (solvency)	1, 18	2
19	Financial access (inclusion)	8, 33	2
20	Global financial crisis & unpredictable events	8, 25	2
21	Employee awareness and training	19, 34	2
22	Taxes	14, 28	2
23	Inflation	23, 27	2

NB: (*)- Check references from the appendix

Banking sector regulations

Central banks and national banking regulatory bodies in many nations have accepted the need to develop and implement green finance policies (Durrani, Rosmin, and Volz 2020). Central banks have begun to require banks to attain green certifications, green credit scores, environmental innovation, and social inclusion (Chen et al. 2019; Julia and Kassim 2019). Competitively, banks that adhere to these requirements on green finance enjoy tax holidays and other incentives from the central banks. Also, intense competition to gain an advantage over others are driving banks to come under intense mimetic pressure in banking sectors (Campiglio et al. 2018) resulting in the growth of green finance.

Internal practices and ethics of banks

The essence of integrating green banking practices by top management make banks responsible environmental actors (Forcadell, Aracil, and Úbeda 2019). Adopting green banking practices requires top management and employees to be committed to daily environment friendly operations (Cui et al. 2018). The sufficient focus of senior management to develop and internalize green programs in banking operations. Key issues influencing green banking is the demands of customers and the quest to ensure social legitimacy (Mengze and Wei 2015).

Risks

Risks and control measures on risks implemented by banks influence the decisions made on green credit. Credit managers must know the extent of risks associated with green finance, and the essence of the application of green credit risk models in issuing green finance (Krosinsky and Purdom 2016). Traditional finance risk models such as Credit Exposure Analysis (CEA) could be used to assess the green finance by considering the benchmarks used in calculating the economic capital with the support of Basel II for banks and borrowers as national regulatory guidelines (Green et al. 2016). Green loans are typically supported by less-demanding collateral whose value changes are based on the amount contracted and time (Huang, Liao, and Li 2019). Credit insurance and credit derivatives could be used to manage green credits of banks while diversifying the risks (Elliott and Zhang 2019).

Social inclusion and social justice

Social integration and equality have become relevant in determining the relationships between banks and communities especially in the twenty-first century (Missbach 2004). Acceptance of banks in communities is increasingly being determined by how banks take action on social happenings such as racism, diversity, human rights, minorities rights, and consumer protection (Voituriez, Yao, and Larsen 2019). These social issues influence the performance of banks in the areas of customer loyalty, attracting new customers and improved corporate image.

Interest rates

The interest charges associated with green finance is usually low. This prevents the scarcity of green credit and increase green investment (Wang et al. 2019). The capital intensity of green finance influences the interest charges. Comparatively, interest charges on green finance has been found to be high on infrastructural bonds compared to green credit given to small businesses (Julia and Kassim 2019; Yusof et al. 2016).

Religion

Historically, religion has influenced perceptions of people, regulations and demand for financial products (Yip and Bocken 2018). Religion-inspired biases and ideologies should be checked when designing sustainable finance products. Banks built on ideologies of the Islamic Religion (that is, Islamic banks) are keen to develop sustainable practices into their banking practices with the tenets of the Islamic religion. They are likely to embrace and issue green finance to customers with Islamic religious beliefs which discourages charging interest on credits (Islam et al. 2014). Moreover, studies have found strong relationships between religions and socially responsible finance (Julia and Kassim 2019). Religious folks in Western countries, a society largely built on Judeo-Christian beliefs (Julia, Rahman, and Kassim 2016) are likely to accept socially responsible credits to help the needy and empower the weak. However, recent events have shown that large chunk of religious conservatives in the Western society are likely to reject climate and carbon finance based on climate change being a hoax, and denying its existential threat to humanity (Taghizadeh-Hesary and Yoshino 2019).

Bank (company) size

The size of a bank is seen as the total assets of a bank (Dietrich and Wanzenried 2011). A bank's size influences the amount of green credits the bank can issue to borrowers considering the long-term risks. Diversification of risks on total assets of bank determine the capitalization of green finance (Hwang, Shan, and Supa'at 2017). Green investment is perceived as riskier and banks must have enough asset base to contain their fallout from default when granted to borrowers (Babihuga and Spaltro 2014).

Technology and innovation

Financial literacy and awareness of green finance has grown due to technology (Azhgaliyeva and Liddle 2020; Chen et al. 2019). New techniques designed on green finance products could make the accessibility of data easier to credit analysts and monitoring of the performance of the green loan. There is also a continuous effort to build a broad-based database on climate change with the aid of hi-tech data capturing and storage mechanism. Moreover, technology-inclined businesses demand safe and low-interest finance to drive their growth (Amidjaya and Widagdo 2019). Also, human capital development is done through technology. For instance, farmers are driven to be interested in green finance and increase productivity when they are presented with alternative, low-interest finance packages.

3.3. Research gaps and future research direction*Regulations and policies*

Barbu and Boitan (2019) posited that a gap exists between a country's position taken on international agreements on environmental protection, and national regulations on green finance. These disparities must be addressed and drawn into the regulatory framework of banks. For instance, countries in Africa and South America can be praised for adopting the Paris Climate Accord. However, these nations have failed to inculcate the relevant issues in the integral parts of the banking sector. Also, banks are drifting from financing coals and fossil fuels nonetheless it still stands that majority of banks still sponsor fossil fuel in countries such as United States and Australia. Banks approach

green finance policies distinctively due to no standardized policies on green finance in many banking sectors across the globe.

Risk management

In general, green finance is accompanied by potential losses (Barbu and Boitan 2019; Chen et al. 2019). The extent of uncertainties of these losses is difficult from the start so when deciding, banks should consider the high risks associated with the green finance products in the short and long term. Industry and internal bank credit risk policies on green finance should include measures to control risks, and stimulating discourse on green finance (Siri and Zhu 2019). The challenge on controlling risks on green finance has been largely attributed to limited common risk management models, standards for classification, or labeling of relevant risks on green finance (Falcone and Sica 2019; Huang, Liao, and Li 2019). Future studies and framing of policies in the banking industry must turn to the robustness of the risk mitigation models embracing a more responsible financial conduct with societal and environmental viewpoint.

Performance and disclosures

Although some measures have been taken to assess the performance of green finance such as China's Green Credit Key Performance Indicators, it falls short because it only applies to China, and it may not apply to other parts of the world. Thus, the global indicators on the performance and disclosures on green finance are not well-defined in the context of banks (Gallagher and Yuan 2017). Further research addressing performance indicators and disclosures and their implications are needed.

Scope and dimensions

As a developing concept, green finance of banks is limited in the scope of issues covered and the dimensions of study. It remains unclear the relevant issues on green finance products relating to the banking industry in the broader green finance spectrum. Also, there is an overlap of the issues relating to the products and concepts surrounding green finance where scholars and practitioners are not clear about these issues. Perhaps, this can be attributed to green finance being an emerging product in the banking industry across the globe. Moreover, only two themes were presented in this study: products of green finance and determinants of green finance of banks. Existing studies have shown and discuss a limited number of issues (social, environmental, legal, technological, and others) that affect the green finance of banks. These issues remain distinctively presented and analysed with unclear themes. Another area of concern is the ambiguity and unexplored issues surrounding the dimensional approaches of green finance of banks. Future studies are encouraged to clarify and conduct in-depth analysis of these issues and dimensions. Scanty studies on green finance especially developing economies should be considered in further studies clarifying the conceptualizing and theorizing the green finance in banking in the global south.

Data and models

It is not easily accessible to get data on green finance of banks (Cui et al. 2018). Specific credit score techniques on green finance with expansive data has not been developed. It could be attributed to the lack of centralized database in the banking sector on green finance. Most models on traditional finance do not apply to green finance. Researchers must build practical models on and institutionalize reliable data on green finance.

4. Conclusions and implications

This study is a meta-analysis of studies on green finance. Environmental protection, climate change, social inclusion and sustainability continue to receive attention in the world, and in recent years, the interest in these issues have heightened in the banking industry. A systematic review of 46 relevant papers on green finance in the banking industry accompanied by the content analysis methods served as the methodology of this study. Two themes emerged from the method used: green finance products of banks and determinants of green finance of banks. The results revealed seven prominent green finance products of banks which are green loan/bonds, green investment, climate finance, green infrastructural bonds, green insurance, green securities, and carbon finance. The study also identified 21 key determinants of green finance of banks with the 9 topmost determinants being: risks, banking sector regulations, bank size, environmental policies and climate change, internal practices and ethics, technology and innovation, religion, interest rates, social inclusion and social justice. Furthermore, research and policy gaps which need to be addressed by researchers and policymakers in the banking industry on green finance are in the context of regulations, dimensions of research, risk management, data and models. Specifically, the results revealed that the majority of existing studies were conducted in Asia and Europe leaving other continents like Oceania, South America and Africa as sites where little to no research studies have been conducted on the banking sector. This study has implications for banks and banking regulations. Managers and employees of banks will understand the essence of promoting green finance to gain a competitive edge in the banking industry. The corporate sustainability, corporate image and financial performance of banks will be enhanced. Banks could strengthen financial inclusion and add to innovative finance products and strengthen corporate sustainability. Finally, from a policy formulation perspective, the analysis in this study could assist regulators and managers to frame policies which embrace the needs of stakeholders, simultaneously positioning banks to have a competitive edge in the banking industry.

5. Limitations of the study

Although this study provides significant and relevant findings on green finance, it comes with some limitations. Firstly, conference papers, reviews, abstracts and articles were excluded from the selection of the papers for this study. These studies were not published in peer-reviewed journals. Also, studies which were not published in English were not considered. These exclusions have bearings on the findings of the study making it skewed to journal articles and English language. That is, the exclusion of non-peer-reviewed and non-empirical sources from this review paper may have introduced sampling bias. However, these sources were not significant to limit the findings as similar studies (Carolina Rezende de Carvalho Ferreira et al. 2016; Sarma and Roy 2020) have used similar approaches to conduct researches on green finance. Secondly, green finance has been a concept for centuries. Therefore, the time specified (1990 to 2019) could pose a bias by excluding preceding years. However, it is within this time frame that studies were available for review. Also, this study focused on two thematic topics on green finance: products and determinants excluding numerous issues on green finance of banks. Thus, generalization and interpretation of the results should be done with caution since it is not covering all issues on green finance. Moreover, few studies have been published on this subject, especially on green finance of banks.

However, it is understandable since green finance in the banking industry is still a developing concept, and this demand much researches in future.

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Appendix: Relevant papers on green finance of banks

#Reference	Author(s) and Year
1	He et al. (2019)
2	Voituriez, Yao, and Larsen (2019)
3	Chen et al. (2019)
4	Siri and Zhu (2019)
5	Barbu and Boitan (2019)
6	Vazquez and Chin (2019)
7	Contreras, Bos, and Kleimeier (2019)
8	Ziolo et al. (2019)
9	Huang, Liao, and Li (2019)
10	Forcadell, Aracil, and Úbeda (2019)
11	D'Orazio and Popoyan (2019)
12	D'Orazio and Valente (2019)
13	Da et al. (2019)
14	Raberto et al. (2019)
15	Wang et al. (2019)
16	Falcone and Sica (2019)
17	Esposito, Mastromatteo, and Molocchi (2019)
18	Urban and Wójcik (2019)
19	Julia and Kassim (2019)
20	Amidjaya and Widagdo (2019)
21	Majeed and Mazhar (2019)
22	Elliott and Zhang (2019)
23	Yuan and Gallagher (2018)
24	Cullen (2018)
25	Sanchez-Roger, Oliver-Alfonso, and Sanchís-Pedregosa (2018)
26	Dörny and Schulz (2018)
27	Celik and Ogus Binatli (2018)
28	He and Liu (2018)
29	Cui et al. (2018)
30	Glomsrød and Wei (2018)
31	Yip and Bocken (2018)
32	Gallagher and Yuan (2017)
33	Saviano, Nenci, and Caputo (2017)
34	Julia, Rahman, and Kassim (2016)
35	Yusof et al. (2016)
36	Mengze and Wei (2015)
37	Zeidan and Spitzack (2015)
38	Benijts (2014)
39	Clark (2014)
40	Abdel-Baki and Leone Scibolazza (2014)
41	Islam et al. (2014)
42	Bai, Faure, and Liu (2013)
43	Rayman-Bacchus, Relano, and Paulet (2012)
44	Hassan (2009)
45	Missbach (2004)
46	Wilson (1997)