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# STUDY PROGRAMME (Finance and banking)

# **MASTER THESIS**

ŽALIOJI FINTECH: FINANSAVIMO	<b>GREEN FINTECH: THE ROLE OF</b>					
VAIDMUO TVARIO EKONOMINIO	FINANCING IN SUSTAINABLE					
AUGIMO UŽTIKRINIME	ECONOMIC GROWTH					

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### INTRODUCTION

In the recent past, the Bank of England and Bank of France underlined that it is necessary and inevitable for financial systems to change to prevent climate change. Subsequently, the Bank of England made statements suggesting that the risks of financial assets subject to climate change based on the transition period to a physical and carbon neutral economy should be identified and submitted reports. On November 3<sup>rd</sup>, 2021, Andrew Bailey, the Governor of the Bank of England has made a statement that banks should reach the net-zero financial system and how their bank is helping to establish the basis for this objective (Bank of England, 2024). Climate change is a game-changer that might affect the financial market as it affects the growth as well as the stability of the economy.

As a result of rising popularity of the topic, The Network of Greening the Financial Systems (NGFS) was founded in Paris at the "One Planet Summit" in 2017. The network, which currently consists of 141 members and 21 observers since its establishment, has come together to strengthen the role of financial services in achieving capital for green low-carbon investments, and to contribute to sustainable economic growth at scale (Network for Greening the Financial System, 2024). Within the framework of this purpose, it guides financial institutions that are members or not, with exemplary practices, and provides analysis of green finance with internal or external support. The organization drives low-carbon investments and green financing as its main purpose. Having looked through the members, it can be noticed that mainly traditional banks and financial authorities of different countries constitute the body of the organization. These players do a lot to strengthen sustainable development internally, but also externally spreading the ESG values and principles across the entire world. Nevertheless, even though a conservative banking approach are seen as a positive force for improving the ESG agenda and creating a safe financial infrastructure, where established frameworks and legacy systems are considered, broader risk management and mitigation strategies are built, they might lack an innovative spirit, faster change management and sustainability adoption, and that is exactly where new market disruptors in the face of financial technology (fintech) companies, come into play. Digitization, which stands at the source of technological advancement, has raised the borders and limitations making people, businesses and institutions work in a more free and liberal manner. This might sound risky, but this is exactly what will be discussed within the scope of this thesis. We will touch upon the versatility of fintech companies and the services they provide and observe its influence on green finance, as well as juxtapose it against the conservative old-style way of financing.

The above does not mean, though, that technological companies are opposing physical banks and other types of traditional institutions. Instead, they must act in a uniform way to reach the set goals of green finance. Fintech has the potential to provide significant support on the way to these targets set by the central banks. Payment systems, investments, and data analysis, where fintech can contribute to green finance and develop applications for carbon-neutral systems and economy, are areas where they have already spread and brought solutions. The fact that consumers and financial institutions are aware of environmental and climate risks and contribute to sustainability in every transaction they carry out will have tangible and significant effects in order to prevent the global climate and environmental crisis. Fintech can also support these axes. At the beginning of the financial sector to assume the necessary balancing role in the climate and environmental crisis, it cannot be ignored that the definition and metrics of risks should be understood in a common language and a roadmap that will unite on a common denominator and be implemented globally for the control of risks. Although acting on a global scale is of course within the joint decisions of the state units that manage the economies, fintech can accelerate this change with its rational, practical, and effective methods.

Joint savings, strengthening social and environmental relations, social participation, and the ability to think long-term in value creation are the foundations of the transition to a carbon-neutral economy. Behind the fact that financial investments include sustainable and influential parameters, we can say the transition of capital to the y-generation, the global climate and environmental crisis taking the top of the agenda of the economy and markets, and the fact that a carbon-neutral future has become a global priority. Establishing green and sustainable business models is one of the most important growth factors that emerged as a result of cost-benefit analysis in the field of industry and finance. These values are not far from the foundational values of most fintech startups. Some examples can be given among fintech, which has taken important steps in these areas and set out for a carbon-neutral future.

In this thesis, we will dive into the impact of fintech startups and companies on the sustainability development and ESG objectives. The journey will consist of a detailed analysis about how fintech influence green finance. We will examine both the advantages they bring to the table and the possible risks in comparison to the traditional conservative banking approach.

This research study is highly relevant as it addresses the growing intersection between fintech innovation and global sustainability efforts. With the migration to a carbon-neutral economy becoming a worldwide priority, the financial sector plays a leading role in fostering green and

sustainable business models. Fintech startups, with their foundational values of long-term value creation, social participation, and environmental consciousness, are uniquely positioned to accelerate this transition.

The purpose of this thesis is to demonstrate how modern approaches to finance address the sustainability agenda, primarily within the financial sector, and how the financial factors generated by these approaches—distinct from traditional ones—impact sustainability metrics such as greenhouse gas emissions and related indicators in both direct and indirect ways.

To find a response to the question of fintech and their influence on sustainable finance, a SWOT analysis will be held to evaluate the strengths, weaknesses, opportunities, and threats associated with fintech solutions in the context of sustainable investing. This approach will show us in detail the factors inherent to fintech companies, startups and scale-ups that complement or instead counteract the sustainable development and ESG principles.

Moreover, to further investigate the relation between green fintech and sustainable development, we will conduct an empirical analysis. We will establish a relationship between digital finance penetration and greenhouse gas emissions, this study employs a panel data regression model using fixed effects. The dataset that is going to be used encompasses 39 developed and developing countries across multiple continents, with observations from 2014, 2017, and 2021.

As such, the level of investigation applied in this study can be categorized as descriptive, which is mainly supported by SWOT analysis and respective case studies, as well as a mix of analytical and explanatory, which is supported by the statistical fixed effects model. In case of a descriptive level, we are describing each category of the SWOT based on the findings in the existing literature, while in the second scenario we are trying to explain the relationships between variables and identifying causalities.

A limitation of this study lies in the potential bias associated with selecting case studies to represent each of the four SWOT categories, as individual case studies may not be fully representative of wider fintech landscape.

With some huge advancement of green fintech market, which is expected to rise by 22.4% in the following 6 years period, this thesis addresses a timely and novel research area, while the novelty of the topic will be presented by the comparison to the conservative banking system and approaches used therein (Meghan Neville, 2024).

# 1. THEORETICAL FOUNDATIONS OF GREEN FINANCE AND ESG PRINCIPLES AND THEORETICAL ASPECTS OF FINTECH AND ITS IMPACT ON THE SUSTAINABLE ECONOMY.

The purpose of this section is threefold. First, it aims to familiarize the reader with what is already known about green fintech innovation and sustainable development. The latter argues for the need for this work, highlighting the gap in research it fills. Third, it provides a framework to which the findings of this study can be related. Due to the lack of research on green fintech innovation and process, the section is based on a combination of general fintech innovation and ecosystem, and sustainable development goals. The chapter begins by providing an overview of previous research on the fintech innovation process. Then continues by defining green fintech innovation, which is combined with sustainable economic development research in order to obtain a definition for green fintech.

#### 1.1 Sustainability and sustainable economic growth

Before delving into sustainable finance and understanding the term "green finance", which was already used in this thesis a couple times, let's go back and sort out the terms as sustainability and sustainable development. Sustainability refers to the balance between environmental factors, economic stability and social equity (Mollenkamp, 2023). Some of these indicators are environmental dimensions such as acidity increase in the atmosphere, biodiversity, natural environmental variations, water quality, radiation, etc. The economic dimensions are gross domestic product per capita, the ratio of investments in gross domestic product, the ratio of debts to gross national product, energy consumption, renewable energy ratio, pollution reduction expenses, etc. There are factors in the social dimension such as population density and growth rates, percentage of households without electricity, rural and urban population distribution, number of telephones per thousand people, life expectancy, and child mortality rate. All 3 pillars are interdependent and need to work together to reach the set sustainable goals. Since world resources are finite, sustainable practices help to preserve these resources and establish a long-term vision for our existence and well-being.

The concept became prominent in the 1987 Brundtland Report. The importance of addressing the essential necessities of the world's poor was emphasized in that report defining the concept as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Kulik, 2024).

In the Brundtland Report, the definition of sustainable development was made, and the goals of sustainable development are also expressed. Sustainable development: aims to revive growth, increase the quality of growth, meet basic needs in employment-food-energy-water-health, create a sustainable population level, protect and enrich the resource base, re-manage technology and combine the environment and economy in the decision process.

Many classifications have been made on the indicators of sustainable development. Sustainable development indicators are categorized in environmental, economic, and social dimensions (Enel, 2024). Some of these indicators are environmental dimensions such as acidity increase in the atmosphere, biodiversity, natural environmental variations, water quality, radiation, etc. The economic dimensions are gross domestic product per capita, the ratio of investments in gross domestic product, the ratio of debts to gross national product, energy consumption, renewable energy ratio, pollution reduction expenses, etc. There are factors in the social dimension such as population density and growth rates, percentage of households without electricity, rural and urban population distribution, number of telephones per thousand people, life expectancy, and child mortality rate.

### 1.2 Sustainable development and the role of finance in it

Definition of sustainable finance refers to the accountability of financial and investment decisionmaking that might have an impact on environmental, social and governance aspects, such as climate change and biodiversity (environmental), inequality and human rights issues (social), and management relations and corporate transparency in public and private institutions (governance). (Europa.eu) The relationship between sustainable development and the financial sector with the definition of sustainable development draws attention to which is also defined as the development process in which future generations can access capital (natural and human-produced resources) at least as much as current generations.

The question is how the financial system is supposed to ease the decision-making process on the ESG principles and objectives. There are multiple routes that we can take and some of them are listed below. These are the functions of financial system that contribute to the sustainable development, that were mentioned by Levine (2005) in his book:

- Producing information beforehand on potential investments and capital allocation;
- Supervise investments and implement corporate governance post-financing;
- Simplify the efficiency of trading, diversification, and risk management;

- Consolidate and manage pool savings;
- Facilitate the transactions and exchange of goods and services.

All the functions are super-focused on sustainable development and are relevant for sustainable finance as correct allocation and control of capital and funds is the main objective of finance. Thus, these functions and objectives of one sphere match with the goals of ESG agenda and can act together to assist each other (Levine, 2005).

Since finance is an inherent and integral part of every organization, all the decisions made within businesses and projects running therein are associated with allocating funds and investments. Similarly, banks and investment funds that operate to support these companies and organizations by providing loans and investing into projects or purchasing assets can decide which route to take. Thus, by making the right decisions and building proper investment strategies can play an immense role in transitioning to a carbon-neutral, sustainable economy.

Within the economic system, the financial sector invests capital in manufacturing, logistics, and consumption, thus indirectly affecting the environment. Meanwhile, resource/energy consumption by financial enterprises will have direct environmental impacts. Indirect effects are more important than direct effects in proportion. For this reason, the importance of the role of the financial sector in sustainable development is easily understood. Governments can use financial instruments to achieve their environmental goals. For the financial sector, good environmental performance means good financial performance. For example, if banks support a pollution project, they may end up making a loss. On the contrary, if they support the anti-pollution project, they can make a profit at the end of this work as they will contribute to the environmental benefit. In this context, environmental factors have broken the traditional cost-benefit balance in financial markets. The environmental and social impacts of the financial sector appear in two ways as internal (direct-internal) and external (indirectexternal). The effects of the direct activities of financial institutions lag the indirect effects. Because institutions that benefit from the financial system have a more significant impact on the environment, it aimed to maximize the share of the partners within the framework of the traditional financial understanding, and the understanding of sustainability remains only in the criterion of sustainable profitability.

Sustainable financial understanding necessitates investments with environmental sensitivity. In this context, the direct factors that will push financial elements to be sensitive are employees and partners raising awareness about sustainable development, indirect factors are legal regulations, the situation

of competitors, customer demands, and society's expectations. On this basis, following the United Nations Environment Program Finance Initiative Commitment signed by 177 financial institutions in 2008, it is stated the environmental factor will be considered in all financial sector activities.

### 1.3 Green finance & FinTech for Sustainable development

Simply put, green finance is financial investment, operation or mechanism that considers a better environmental outcome and support of environmentally friendly initiatives. The spectrum of financial operations include loans and debts, investment in sustainable use of natural resources, funding of renewable energy projects and so on (Wire, 2024).

In nature, the increase in CO2 emissions caused by the inefficient and uncontrolled use of resources brings some negative consequences accordingly. The melting of glaciers, the warming of seawater, and the global temperatures can now be listed as some of them. In addition, issues such as the irresponsible release of waste to nature by enterprises after production, deterioration of soil flora, degradation of petroleum by-product waste, especially plastic, and degradation of the marine ecosystem also reveal human-caused environmental destruction.

The production and consumption carried out from the manufacturing enterprises to the people who carry out their daily lives threatens the health of nature and pollutes the water and air to a serious extent in the first place. If it continues in this way, it is obvious that future generations will not be able to continue their existence in this order that will be inherited by them. Protecting the environment and minimizing the environmental destruction caused by climate change should be the primary goal of both individuals and institutions. Thus, sustainable environmental sensitivity will be created all over the world.

There are also those who fall on the financial managers and the financial sector to create the abovementioned consciousness and fulfill the target.

Looking at financial activities from a greener perspective, in other words, ensuring the environmental sensitivity of financial activities comes to the fore as the duty of both the financial sector and the managers working in this sector. With the green finance approach, it is ensured that finance and the environment are evaluated together, thus profitability and sustainability are melted in the same pot.

Green finance is a phenomenon that finance and business by combining with environmentally friendly behavior and is a new financial structure that integrates environmental protection and climate change mitigation with economic profit and regulatory help, hitting terms like "green" and "finance", two of which are controversial (Green Finance, 2023).

Green finance covers all initiatives of public or private investors to provide resources and implement and create infrastructure for projects with sustainable effects through models developed with financial instruments. Encourage the use of renewable energy sources, energy efficiency, water, sanitation, maintenance and improvement of ecosystems, transportation, and waste management and reduction of industrial pollution, the provision of adaptation to climate change, deforestation prohibitive measures, the result of the activities of a carbon footprint dioxide released into nature, reducing cities in developing climate-induced natural disasters can be given as an example of these attempts to increase resilience.

Green finance is not limited only to the financial units of private sector enterprises, managers, and companies in the financial sector. It is necessary to evaluate the financial activities carried out in the public sector from the perspective of green finance. Managers in all these areas of financial activity should review the financial instruments they use to make their activities sustainable and make them contribute to sustainability by redesigning the financial models they have developed.

Green fintech, in its place, builds on the main principles of green finance by leveraging technology to create innovative, efficient, and scalable solutions for sustainable development. Green fintech utilizes digital platforms, blockchain technology, artificial intelligence (AI), and big data analytics to integrate sustainability into financial decision-making processes.

For instance, green fintech enables individuals and businesses to track their carbon footprints using AI-powered applications, promoting behavioral change by linking financial transactions with sustainability metrics. Blockchain technology supports green finance by ensuring transparency in funding renewable energy projects and verifying the environmental impact of initiatives through immutable records. Moreover, green fintech platforms facilitate green investments by connecting investors to environmentally focused projects and sustainable businesses, reducing the transaction costs and barriers traditionally associated with green financing.

Green fintech also enhances financial inclusion, a critical factor for sustainable development. By providing digital banking and microfinancing solutions to underserved populations, green fintech empowers communities to access resources for sustainable agriculture, renewable energy adoption, and eco-friendly small businesses.

In summary, green fintech aligns with the principles of sustainable development by addressing environmental, social, and economic challenges. It not only enhances the efficiency and transparency of green finance but also broadens the reach of sustainable financial solutions, accelerating global progress toward climate resilience and environmental sustainability.

### 1.4 Fintech Innovation

With the advent of smartphones and mobile applications, consumer demands have shifted from physical products and services towards intangible ones. Same as in other niches, such as media, entertainment, retail, education, etc., which shifted into a digital world and people started to adapt, that same trend in banking and finance was inevitable. Along with the conservative banks and financial authorities, financial technology companies started to appear and disrupt the market by providing easier access to their products.

About 62% of the world's population neither use loans nor use their savings and do not benefit from traditional banking services. Approximately 38% of them don't even have a bank account. Banks tend to this segment due to high compliance and infrastructure costs and don't seem enthusiastic about serving. However, the traditional banking system providing financial services to this remote population provides depth and inclusiveness to financial markets will profit. It is stated that this can make significant contributions to global development (Lee, I. and Y.J. Shin, 2018).

Companies that offer financial services with modern and innovative technologies, fintech, mostly start-ups, reach their customers with more internet-oriented, transparent, user-friendly, and effective products. Fintech concept is a tool developed for production with "finance", which expresses the effective use of funds and "technology" words expressing information.

Fintech, which, benefits from information and communication technologies in financial services, along with innovative business models, also includes the segment that does not have a strong relationship with traditional banking started to be included in the financial system. Indeed, the Global Fintech Adaptation Index among consumers worldwide according to 2019 data while adaptation to fintech services was 16% in 2015, this rate increased to 33% in 2017 and finally it increased to 64% in 2019. With the adoption of the services provided by fintech, investment in this field is rapidly increasing. For this purpose, the total fintech investments made all over the world in 2017 is 50.8

billion while filling up. In 2018, it amounted to 111.8 billion dollars, an increase of 120% (Blackman, 2019).

Another point of interest is the fintech ecosystem, which has developed worldwide in recent years. As an indication of how the fintech concept has been in Google over the years, given in Figure 1. The indication that it has been considered to adopt fintech services more. It is observed that it coincides with the years of its inception.



Figure 1. The popularity of the search term "Fintech" at Google (Schueffel, 2016)

On the other hand, Fintech, whose framework is just starting to take shape, has been in the historical process. The literature is divided into 5 periods (InfosysBPM):

Fintech 1.0 (1886-1967) era; covers the transition period of using telegraphs and electronic transfer systems.

Fintech 2.0 (1967-2008) era; refers to the digitalization using computers and at the same time globalization process of finance.

Fintech 3.0 (2008-2014) era; from the Global Financial Crisis to the present argues that financial services have undergone a serious evolutionary transformation in the period until in progress.

Fintech 3.5 period (2014-2018), which expresses the transformation of fintech in emerging market economies, is also mentioned in the literature and covers blockchain technology and application programming interfaces.

And, lastly, Fintech 4.0 (2018-ongoing) is about the integration of such disruptive technologies as artificial intelligence and machine learning.

The relationship between technology and finance dates to the end of the 19th century, technology of that time innovations were the telegraph, transatlantic cable, steamships, and railroads. These technological opportunities have enabled the development of a financial relationship network between countries. Beginning of the Fintech 1.0 era after the first telegram was launched in 1838 the innovation, which is considered as the first, is the use of transatlantic cable in 1866 is to begin. Thus, an infrastructure system that transcends the borders of countries was established. Describing the technology-finance relationship, J.M.Keynes (1920) in "The Economic Consequences of the Peace", he described this period in his work, "London residents, in the morning, in their beds, drinking their tea while sipping, they can order many products in the world in the amount they see fit by phone and this can wait for the deliveries of the product at home. At the same time, new can benefit from the wealth created by start-ups and share them without difficulty". More Fintech 1.0 process, which continued with the use of today's credit card in 1950 with the use of first ATM (Automated Teller Machine) in 1967, it was replaced by Fintech 2.0.

This new era, which started with ATMs, developed and financial systems with online banking activities services have become more digital and global. This is an important indicator, the stock market crash in 1987 known as "Black Monday" can be taken into account. Because with this event, financial markets, through technology, how integrated they are with each other, the stock market crash in America affected the whole world. In this period, in financial markets that have become digital and global, fintech companies; different financial services such as transfer, payments, investment management, and leasing have started to be offered. As Bill Gates stated in 1994, "Banking is necessary, but Banks are not" started to be realized and while increasing the volume of financial services, a decrease was observed in the number of branches of banks. As an indicator of this situation, banks in the USA from the 90s to date, their assets have increased from \$ 3.7 trillion to \$17.4 trillion, while the branches number have fallen from 10453 to 5000. In other words, the USA has fewer but larger banks (Stulz, 2019). It can be said that the concept of fintech has transformed into today's structure with the Global Finance Crisis. New start-ups and established tech companies are trying to

offer financial services directly themselves and started to reach consumers through business circles. However, as a result of the Global Financial Crisis, the profitability and competitiveness of banks were damaged. Post-crisis on the other hand, the regulations increase the compliance costs, the other hand, brought a restriction. As a reflection of this situation, traditional fintech, which can also be considered as a challenge to the banking services initiatives those who have been left out of the system directly and at low cost, therefore it attracts attention (Arner, D.W., Barberis J., and Buckey R.P., 2016).

The rapid transformation and growth of companies providing technological services in the Fintech 3.0 era have been shaped. So much so that these companies, after the "too small to care" position, very quickly to "too big to ignore" and eventually "too big to sink" they have reached. With the Global Financial crisis in the Western World this triggered process is based on slightly different dynamics in the Eastern World. Especially in Africa and Asia, the development of fintech companies is driven by the pursuit of economic development by countries has opened.

# 1.5 Fintech Ecosystem and Perspective

The environment in which fintech enterprises operate is of great importance for developing financial technology. The elements that make up this environment, expressed as an ecosystem, can be listed as follows:

- States and their policies
- Regulations, controllers, and legal regulations
- Financial structure and Investors
- Financial institutions
- Consumers
- Request
- Entrepreneurs (Technology companies)
- New technologies
- Skilled workforce
- Universities
- Incubation centers

- Accelerators
- Organization
- Infrastructure Quality

The main players in the fintech ecosystem are states, financial institutions, and entrepreneurs. The fact that states create policies and legal regulations that will facilitate the development of the fintech ecosystem is one of the most important elements that stimulate entrepreneurial activity. For the ecosystem to function, states should create regulations such as copyright, product registration, and IPO and facilitate how they are applied. Cost advantages provided by keeping taxes and fees received low are critical for increasing ecosystem participants and maintaining their presence in the ecosystem. In addition, states should finance fintech centers by offering funds or grants and encourage investment in small businesses. The scope of state participation in developed fintech ecosystems is more limited. Service providers in these countries are mainly in the private sector. The state's role here is limited to setting policy and creating regulations. In the case of underdeveloped fintech ecosystems, the state should be included in the entire ecosystem (Diemers, 2015).

Financial institutions provide expertise to the ecosystem. In addition, the cooperation of financial institutions with fintech initiatives increases competition quality and customer experience by encouraging financial innovations. On the other hand, entrepreneurs (technology companies) contribute to the fintech ecosystem with innovative and often disruptive technology solutions. Entrepreneurs, loans, crowdfunding, payment systems, asset management, capital market, insurance, etc. have pioneered by providing more personalized services with lower costs than traditional financial institutions in their fields. In addition, entrepreneurs act as a catalyst for producing new technologies, making them one of the most important players in the ecosystem (Lines, 2016).

Social, cultural, economic, and megatrends in demographic issues are technological developments, while technological developments are changing the financial sector. The triggering element in this interaction is the human concept. The evolution of human needs over time lead to reshaping societies, leading to a change in social, cultural, and economic structures. A need that begins as an individual in a globalizing world is quickly adopted by society and takes on a collective structure. In this direction, technological development can be defined as solutions that arise to meet the needs that have become collective.

On the other hand, technological developments shape individuals' behavior patterns and demands. Today known as Generation Y, innovative, curious, quick-consuming, impatient, very visual, self-oriented, self-confident individuals who prefer a personal thing, technology, product and service demand closely and each technological choice. As with all other businesses, banks target Millennial customers. The demands and needs of these individuals, called "consumers (users)" in the fintech ecosystem, lead to the emergence of new technologies and entrepreneurs who produce these technologies. Investors, incubation centers, accelerators, organizations and universities, other participants of the fintech ecosystem ensure the existence and development of entrepreneurs (Cockerton, 2016).

In addition, a fintech ecosystem needs to be built on a sound, reputable and reliable financial system. This ecosystem feature is one of the most important elements that increase the interest of investors. In locations where ecosystem is established financial institutions, universities, laboratories, trade organizations, data centers, and professional service providers, the presence of CO- it is a requirement for a successful ecosystem.

Another element that ensures the success of the ecosystem is the talented workforce. A skilled work force which constitutes human resources, business analysts, project managers and business development staff of the "non- technical group of engineers and software development practices interested in the "technical group" should be separated into two.

Business analysts are decisively critical in acting as a bridge between business problems and technology solutions in the emergence of a product. For the product to be developed to succeed, the business analyst must be able to analyze the sector in which the product being studied is relevant and the needs of this sector very well.

Financial technologies differ from other technologies due to their intensive use of financial and banking knowledge. In addition to the academic knowledge in economics and financial literature, the finance and banking knowledge mentioned here also includes the processes, applications, products, and services used in the sector. For this reason, fintech, unlike other technology development companies, needs business analysts with financial and banking knowledge to develop a product or service. Business analysts whose financial practices, processes, products, and services are the main condition for providing innovative products and services to the financial sector. However, it is not possible to train these personnel in fintech companies. This is made possible by transferring experienced personnel from the fintech sector after the Global Economic Crisis in 2008. The transition of experienced financial personnel to the fintech sector has contributed to the sector's development by ensuring the increase in the quality and diversity of products and services produced in this area.

On the other hand, project managers work on planning, time and cost management issues, dec ensuring coordination between project stakeholders from the beginning to the end of project. Project management is critical for improving product quality and ensuring customer satisfaction. The presence of business development personnel is important for presenting the product to the right customer in the market, directing marketing teams and achieving commercial success of the product.

The importance of a workforce experienced in software in a technical sense in the emergence of a financial technology product is undeniable. Following the analysis prepared by the business analyst, the engineer who converts the need into software code is the most important source of labor that allow the product to take its final form. The biggest advantage of fintech is its young and qualified engineering staff. Although meeting this labor force from the local ecosystem is beneficial in terms of cost and labor sustainability, employing foreign labor is important in transferring international experience to the ecosystem. At this point, the decisive factors for the inclusion of foreign labor in the ecosystem are the country' migration policies and the country's cost of living.

Finally, establishing a fintech ecosystem is difficult, given the level of constant cooperation required between all ecosystem participants. Therefore, for a fintech ecosystem to function efficiently, each participant needs to understand its role and the benefit derived from cooperation.

As we cannot imagine the future without digital transformations, financial institutions cannot avoid this factor too. The sustainable economic development program launched with the ESG and SDG roadmaps, combined with innovative green innovations with the digitization of finance and increased trust in fintech, forms the solid ground for sustainable development. Naturally, an innovation roadmap, and its process, begins with the creation of a new idea and ends with prototype testing and then implementation. Green fintech, which is still at the beginning of the road, promises full of future promises.

Green fintech's sustainability disclosures increase awareness of sectors of the economy and the capacity to address physical risks such as climate change and loss of biodiversity, as well as transition risks, reducing the physical risks that arise as economies transition. The creation of a new ecosystem for the development of green fintech will shape the steps to be taken in this regard, and by producing

green digital finance solutions, they can also be presented to a global audience of potential customers and investors. Therefore, it is crucial to understand how green digital finance can unlock its full potential and have an optimal economic and societal impact.

The ecosystem to be created should attract customers, experts, researchers, and green fintech, providing a global reach and an infrastructure that will minimize financial losses and economic risks. The map followed by the European Union countries, the knowledge, and experience they gained should be shared with other world states that are not part of this union and should be followed closely, green corruption and tackling it, and financial programs should be created to decrease potential green inflation. Thus, it can be the flagship of sustainable economic growth by creating cross-border opportunities with a green digital finance-created ecosystem that contributes to environmental goals.

In general, the experience that fintech has brought to the finance industry creates a positive hypothesis about the perspective of green fintech. In order to know more about this issue, the sector should be open to innovation, follow the technology closely, and adapt to the industry with the proper analysis. Using tools and techniques such as green fintech, blockchain and cryptocurrency, etc. Mobile phones, open banking, and extensive data analysis to be sustainable can design a perspective for development goals.

These goals are clearly to reduce poverty, reduce inequality, protect the environment and use green energy sources. The development of digital financial services and the ease of access to them have a positive impact on the environment and have the potential to contribute to the reduction of poverty. Fintech companies provide access to banking services and money transfers at a lower cost, which positively affects the reduction of poverty.

The importance of green fintech's social value is the reason why it keeps up with SDG programs because it protects the environment and is environment friendly, as well as providing low-cost access to finance to the lower class of society and its contribution to poverty reduction (Merchant and Gurgoz, 2023). Incorporating green fintech artificial intelligence, big data analytics, the internet of things (IoT), and blockchain, and other innovative technologies to reduce poverty can help increase access to finance for non-bank individuals and SMEs around the world. Another service that has emerged recently and has a significant role in developing solutions that support the SDGs is mobile banking. This is precisely what green fintech foundation is built upon (Beese, 2024).

Green fintech, which is environmentally friendly, can manage many people and use its advantages without any additional charge, with extensive data analysis, the internet of things (IoT), machine

learning, artificial intelligence, and mobile payment technologies (Fastinvest).

Green fintech companies have a variety of constructive environmental impacts by reducing CO2, helping shared vehicles, expanding, and at the same time reducing carbon consumption through the sharing economy mode. An example of green fintech is a peer-to-peer food sharing company in London that aims to prevent food production waste and green gas emissions. Green fintech also has the potential to reduce waste generation, greenhouse gas emission, and water consumption in online food distribution.

For all those stages to take place, the conceptual gaps related to green fintech, as stated in the literature, limit the research, and the researcher associates the perspective of green fintech with the results obtained from monitoring the prospectus of general fintech. In order to bridge the conceptual gaps of green fintech, fintech experts and universities, one of the most critical factors in the fintech ecosystem, need to cooperate in creating vast and comprehensive literature by filling in the gaps as a result of academic studies. Green fintech with unlimited potential needs big data and practical experience to achieve sustainable economic development goals.

### 1.6 Market players

### 1.6.1 The Network of Greening the Financial Systems (NGFS)

The Network of Greening the Financial System (NGFS), launched on 12th December 2017 at the Paris One Planet Summit, consists of 18 central banks and Auditors and five international organizations that voluntarily want to contribute to the analysis and management of climate and environmental risks.

Report on Quality Associated Financial Risks, published in March 2022 by the Network of Central Banks and Supervisors to green the financial system; made important warnings and offered policy recommendations within the environment, financial system, and macroeconomics framework. According to the reports, it should be recognized that environmental risks, including those associated with the ecosystem, can have significant macroeconomic impacts and the failure to account for mitigate and adapt to them (Elderson, 2024).

While governments are primarily responsible for addressing environmental damage such as biodiversity loss, the financial sector has an important complementary role. Governments should discourage biodiversity-harming activities and introduce policies and regulations to remove subsidies that harm the environment. Non-environmentally conscious financial flows exacerbate environmental degradation. Failure to consider environmental impacts leads not only to underestimating the financial risks associated with nature but also to magnify them. Contracts have been signed, and declarations and roadmaps published on transforming economic and financial systems and harmonizing all financial flows to support biodiversity conservation and sustainable use. Key tasks are ahead of central banks, financial supervisors, and financial institutions. These tasks are:

- Establishing a science-based framework to comprehensively and actionably evaluate the relationship between the environment, macroeconomics, and the financial system;
- To eliminate data deficiencies that may occur within the framework;
- Aligning economic policies with sustainability.

Countries should recognize biodiversity loss as a potential source of economic and financial risk and commit to developing a policy strategy to maintain financial and price stability. Skill-building programs should be conducted among the central bank, supervisory staff of financial institutions, and market participants to analyze financial risks. Central banks should help establish the necessary financial architecture for a biodiversity-positive economy, including how monetary policy operations and non-monetary portfolio management should be conducted in the context of biodiversity loss (PBL Netherlands Environmental, 2020).

# 1.6.2 Green Fintech Start-Ups

All global organizations, including the United Nations, emphasize the importance of keeping the planet intact. By embracing sustainability, fintech companies continue to do great things in terms of producing environmentally friendly financial technologies by breaking the notion that finance, and climate change are not related and proving the opposite. Within this framework, fintech is helping to create a sustainable investment ecosystem by helping customers contribute to carbon emissions, tree planting, and the launch of wooden cards. Fintech, whose primary purpose is to help businesses and consumers better manage their financial processes, also emphasize the importance of financial institutions focusing on profit and developing tools for sustainability in financial services and contributing to the environment Every fintech is green, the harbinger of strong, sustainable economic development for the future. Four factors prove the importance of finance:

Sustainability is becoming mainstream. With sustainability becoming mainstream it seems impossible to ignore the impending climate catastrophe. As people become conscious consumers, they begin to live more environmentally friendly. If the top fintech companies aim to grow and stay on track, they

must be environmentally conscious because they must align with these values to meet consumer demands.

Environmentally conscious companies outperform their unsustainable competitors. In Western countries, environmentally conscious companies outperform their non-sustainable competitors. Especially in Europe, two-thirds of customers expect banks to be environmentally friendly. The other half is ready to change the bank when they see no progress in this regard. In today's world, customers prefer socially responsible businesses.

Supervisory expectations. One of the reasons why fintech companies implement financially sustainable policies is the regulation and supervision carried out by the authorities. For example, banks in Europe are required to have ESG analytics. The main reason for this is to reduce greenwashing, that is to remove the wrong impression about how ecological a company's products are.

The Future. There is a fact that we must accept as a society that global warming, loss of biodiversity, pollution, and depletion of the ozone layer are more dangerous than the harm that businesses will face. Companies that understand this are trying to contribute to fighting against climate change by making sustainability a trend in the financial sector. With this logic, companies aim to leave a better world legacy to modern and future generations to continue the road sustainably. Jim Cramer, a vital market commentator on Wall Street, comments on these developments: "Many managers have told me: We have children".

**Newday**: The company, which has started a new day in the fintech sector, is an open bank structured for users who want to direct their investments and deposits to portfolios with environmental and socially positive companies that create value for a conscious and carbon-neutral future, fintech also provides investment consultancy services (Greenmoney, 2018).

**Tomorrow**: While providing renewable energy, organic agriculture, micro- credit projects, and similar investments, it also enables its customers to use their deposits with sustainable environmental awareness.

Doconomy: Established in Sweden in 2018 by an experienced team focused on finance, technology,

and social change, the company monitors its carbon footprints via credit cards and other payments to raise awareness of its customers' consumption behaviors, simultaneously informing its customers and neutralizing the carbon footprints of each user. It opens doors to investment projects and funds they can (Doconomy Case Study).

**Trine**: Sweden-based fintech Trine is one of the innovative fintech that aims to gain customers and profit by creating social and environmental impact. Trine provides more than 2.5 million people with access to electricity with the investment of 12 thousand Trine investors. As the mechanism, after customers have determined an account with the method of work, choose a loan, and they can invest at least 25 Euros. After the loan is financed and solar products are distributed, the investments return with interest. In this way, Trine aims to pursue sustainable development by tripling customers' investments.

**Tree Card**: By focusing on the European market, fintech is proving to its European customers that it is environmentally friendly by reducing plastic and re-wooding the world. Tree Card's customers use debit cards made from recycled plastic bottles and sustainably sourced cherry wood. On the other hand, Tree Card invests 80% of its profits in tree planting projects. In addition to planting tens of thousands of trees worldwide, they are tackling the damage done by the palm oil industry in Indonesia, tackling malnutrition in Senegal, and restoring watersheds in Ethiopia.

"ESG" investments, one of the rising investment preferences of recent times, contain criteria that support strategies that prioritize Environmental, Social, and Governance values. Behind the spread of these investments, it is important to make the right definition and impact analysis of investments, as well as to provide portfolio advantage and reveal their competitive differences. Particularly, analysts' need for simultaneous data at the asset level is increasing. In this area, tools such as artificial intelligence and machine learning are introduced in the structuring of geospatial large databases. Four Twenty-Seven, a fintech that conducts financial risk analysis with climate data, was acquired by Moody's in July 2019. Combining climate science, data analysis, technology, and finance, Four Twenty-Seven supports financial institutions, government departments, asset managers, and investors in determining the current and future risks of their portfolios in the face of the climate crisis and in risk management. Four Twenty-Seven transforms real-time data from more than 2000 companies in 196 countries into financial risk parameters so that investors and regulators can implement responsible and social impact investments and guide their portfolios according to scientific data and parameters.

On the investment side, Clarity AI (Clarity AI Case Study) enables investors to make more informed decisions by analyzing the behavior and the effects of their activities. Founded by Rebecca Minguela in New York in 2017, fintech has attracted great interest in a short time with the solutions it offers. The initiative, which shows investors the environmental, social, and behavioral effects of their portfolios and preferences within the framework of financial performance, also guides investors in balancing their portfolios and optimizing their social and environmental impacts.

Green fintech aims to protect the environment and reduce its carbon footprint by providing access to finance at a low cost. Especially the digitalization of financial sector and the monitoring of the green policy on the one hand are important steps taken in this regard. Fintech has various practical implications and great potential to transform the financial sector.

### 1.7 Green Fintech Use Cases

### 1.7.1 Green Fintech Case of Switzerland

The researcher's purpose in addressing this issue in the literature is that Switzerland is more prominent in the green fintech field than other countries. As one of the most important financial centers of the world, Switzerland, which has advanced banking experience in Europe, this advantage impacts its digital transformation, and the country's development without digital finance does not seem possible. Switzerland is taking a more active approach than other developed countries by implementing 17 SDG targets and the agenda it has set for itself as a target. When we look in general, the developing innovators in the country sow seeds of sustainable development, as well as the digitalization of the finance sector, the environmental awareness of the society, the fight against the climate crisis, green finance, and the rapid adoption of sustainable fintech mechanisms to the economy.

Switzerland is among the countries anticipating climate change and crises that will result in biodiversity loss and the resulting social challenges. Evaluating the power of data and technology to accelerate global financial markets and contribute to a sustainable transition, limiting global warming to 1.5 degrees Celsius will help reduce biodiversity loss and remove social challenges. By developing green digital finance solutions, Switzerland aims to minimize these losses and become a global leader in natural, economic and environmental impact by 2030. Vision 2030 includes enabling and fostering innovation with a focus on digitization, which leads to effective contribution to global sustainability (The Green Fintech Network, 2021).

The fact that the ESG factor creates enormous opportunities for today's companies creates competitive environmental racing by strengthening the responses to global crises. Switzerland aims to drive sustainable economic growth by fostering this race with green digital finance solutions. Switzerland plans to find technological and financial solutions by collaborating with financial institutions and companies from the real economy to develop green fintech. To become the global leader in sustainable finance, Switzerland is positioning green digital finance's collaboration with Swiss green fintech as the most important center for cross-border asset management with 2'400 USD billion in client assets (Bigler, 2022). While it is expected to inherit the dollar, it provides the movement of customer demands towards digitalization and sustainability.

Hosting many green fintech houses in order to become a global technology leader, Switzerland aims to offer both solutions for corporate customers and services that appeal directly to consumers. As one of the critical points, green fintech act as a catalyst in integrating innovation and digitalization into the Swiss finance sector. In this respect, the Swiss green digital finance ecosystem has the ideal framework conditions for finding and scaling green fintech. For example, easy access to sustainability data, access to experienced venture capital funds, world-class research, a regulatory environment that encourages innovation and data security, and significant collaboration between stakeholders, especially financial institutions, working to achieve common sustainable finance goals.

Hosting international organizations and initiatives such as Switzerland's international Union for Conservation of Nature, WWF International, the Green Digital Finance Association, and the Biodiversity Finance Initiative creates cross-border opportunities to share the green digital finance ecosystem with other numbers actively. This leverage is strengthened by a clear focus on biodiversity and its link to climate change.

### 1.7.2 Collaboration between Fintech and Sustainability in Lithuania

Every country and its states aim at the development of its country and the improvement of its social and economic conditions. In line with these goals, the country's natural resources, workforce, and political conditions indicate in which direction the development, more precisely, the economy, will take. The development of countries depends on the incomes, investment, and the development of the industry.

Lithuania is a country that has rapid growth among European Union Member countries by following a sustainable policy in the fintech sector. Especially in the last five years, the country has achieved

growth in the fintech sector and has come to the fore in The Global Fintech Index. As of 2021 statistics, it has decided to be the 1<sup>st</sup> in Europe by owning 265 fintech companies, while fully portable fintech licenses have been given to 147 fintech companies. It has a large share in the growth of Lithuania's economy, as it is a large and vibrant fintech hub and provides the largest number of licensed fintech services throughout the region.

Serving more than 20 million customers, Revolut, which gained a bank license from the Bank of Lithuania in 2018, does not miss the ESG factor while planning future targets in company policies, like every innovative start- up today. Revolut aims to help in measuring and reducing the global carbon footprint by signing the Watershed program in the green return program. Revolut, which started a partnership with Watershed in the summer of 2021, is important for the company to monitor and analyze the incoming data in real-time to keep emissions under tight control. Through this partnership, Revolut aims to achieve the following goals in line with the Paris agreement goals (Cryptonomist, 2021):

- Measuring the current carbon footprint
- Carbon footprint reporting
- Modeling future carbon footprint scenarios
- Creating and implementing a strategy to reduce carbon emissions

Collaborating with organizations such as Tech Zero, open cages, WWF, and Rainforest Alliance an initiative that brings together British and Global Technology companies, Revolut helps these organizations to raise funds through Revolut Donation platform. Alan Chang, Revolut's Chief Revenue, said:

"Revolut is a global super app that enables customers around the world to get more out of their money. But as the world evolves and people's lifestyles change, more and more citizens realize that they too have a responsibility to take care of the planet and where we all live. We want to help make the shift towards a greener future a reality, so we partnered with Watershed, and we believe they will help us achieve our sustainable goals."

On the other hand, the effect of climate change on Lithuania, the country affected by the Chornobyl disaster in the past, and the brutal war going on in Ukraine, where the human tragedy is, unfortunately, taking place today, each bullet fired takes an innocent life and inflicts irreversible damages on the environment. For Lithuania, one of the countries that will be most affected by this, achieving

sustainable goals and accelerating economic development is the main goal. The biggest advantage of this path is it has a robust fintech ecosystem and has the human capital and technological resources to turn it green.

# SUMMARY

The urgent need to address climate change caused essential transformation in financial systems and affected that market significantly. Central banks and financial institutions all over the world felt the necessity of incorporating sustainable development and ESG agenda into their daily operations. Apart from that, governmental bodies have prompted companies and organizations to adhere to the new way for leading their businesses respecting sustainability and everything around this topic by imposing rules and regulations. Such communities and networks as the Network of Greening the Financial System (NGFS) highlight the pivotal impact of conservative banks and authorities in driving the sustainable development and ESG objectives. The implementation of risk management practices, robust financial security and stability by such institutions has led to improvement and promotion of green finance. Nevertheless, even though traditional approaches are reliable, they are lacking the ability to adjust rapidly to the innovation and evolving demands of our society, technology and sustainable development.

As opposed to the conservative banks, fintech companies have emerged as disruptors in this dynamic and ever-changing financial landscape. They come up with innovative technology to foster sustainable development. Their ability to utilize such technological advancements as data analytics and AI, blockchain, and digitization, as well as people's adoption of such applications and tools has created a new business on the market and positioned them as a new force for positive change in ESG agenda. However, rapid evolution and innovation carries some operational and security risks, and those have to be controlled in accordance with the rules and regulations as well.

This thesis will investigate the impact of fintech companies and their innovative approach to sustainable goals and identify how these companies affect the ESG objectives. We will also assess the strengths and weaknesses, opportunities and threats of fintech companies in relation to sustainability by conducting a SWOT analysis. This SWOT analysis will dive into how fintech start-ups and scale-ups complement and challenge traditional banks in their influence on green finance. The novelty of this research lies in the combination of qualitative approaches, such as SWOT supported by the case studies that will reflect the cutting-edge and innovative approach of fintech.

Moreover, the collected data, the controlled variables inherent to it, and the statistical model are novel and are not seen in the existing literature. This investigation will provide a clear framework for evaluating the future of financial technologies in advancing global sustainability goals in both qualitative and quantitative forms.

# 2. RESEARCH METHODOLOGY

### 2.1 Introduction to Research Methodology

Research methodology refers to the theoretical and systematic analysis of the approaches and methods applied to a field of study. It entails the concepts and techniques used in research problem

identification, data collection, its processing and final decision-making. Research methodology is a key to a well-structured and properly conducted analysis of the research problem.

# 2.1.1 Key Components of Research Methodology

### 1. Research Design:

Research design is the high-level and conceptual strategy that is used within a field of study. It is
needed to effectively tackle the identified problem and contribute to the research topic. There are
multiple ways in which research design can be laid out. Some of them are descriptive, correlational,
experimental, analytical, etc. It serves as a blueprint for steps ranging from data collection, its
processing and applied techniques or models.

### 2. Research Methods:

- While research design stays above water and provides more of an overview on the applied approaches and techniques, research methods are more specific and deeper as these are the actual techniques and methods applied to tackle the research question. Generic research methods are the following:
- Qualitative Methods: These are exploratory methodologies involving non- or low-numeric data gathered from expert interviews, company reports and publications, textual content analysis, etc.
- Quantitative Methods: These are methodologies requiring the data collection and analysis through scraping, surveys, questionnaires, statistical analysis and experiments with an objective of identifying patterns and correlation.
- Mixed Methods: These are the combination of both qualitative and quantitative methodologies. They
  might involve data collection and analysis steps through interviews and case studies, as well as the
  application of statistical models on financial figures or transactions of the company.

We will dive deeper into each type of research methods in the chapter 2.2.

### 3. Data Collection:

 Data collection step is about different techniques implemented to gather data for the purpose of answering a research question. These techniques can be primary (scraping, surveys) and secondary (available data sources, literature reviews). The chosen data collection technique depends on the research questions, determined design method and resources available in the literature.

### 4. Data Analysis:

After the data collection is completed, that data needs to be cleaned (depending on its state), processed and analyzed to draw meaningful insights and conclusions. Data analysis steps and methods depend on whether the collected data is qualitative or quantitative and the identified research design. Qualitative data analysis typically involves using textual content analysis and identifying patterns based on case studies and interviews, while quantitative data may be analyzed applying statistical models with the help of coding and programming languages. The ultimate goal of both data analysis methods is to determine patterns and correlations between dependent and independent variables.

### 5. Validity, Novelty and Reliability:

- Validity refers to the extent to which the research truly measures what it intends to measure. It
  measures the accuracy of the findings within the scope of the project and the possibility of
  generalizing to other industries, niches, contexts.
- Novelty of the research problem and the contribution to the existing literature is also an important factor as the study should provide value and differentiate itself from the currently available research studies introducing better grounds for future projects.
- Reliability of the research study is also essential as it identifies the consistency of the held analysis which should be re-creatable and unchanging under similar conditions.

# 2.1.2 Importance of Research Methodology

Systematic and structured manner for conducting research is essential for the purposes of scientific projects and research methodology is responsible for creating guidelines for adoption of those. Researchers are then able to accurately choose fitting research design and techniques, ensuring that the research is valid, novel and reliable. Moreover, well-structured research methodology facilitates the process of analysis re-generation, results testing and its application in future research studies.

To conclude, research methodology is a foundation of every research study which ensures objective, systematic and reliable output that contributes to the knowledge base.

### 2.2 Research Methods

As mentioned earlier, there are 3 essential methods for conducting academic research. These are quantitative, qualitative and mixed-methods approaches. All 3 can be sub-divided into multiple analysis techniques. Let's have a closer look into some of these techniques that can be used in the field of finance and sustainability:

### **Quantitative Analysis:**

- Financial Ratio Analysis: Financial ratios provide insights into the company's financial health and performance. Profitability ratios (e.g., return on equity, gross profit margin), liquidity ratios (e.g., current ratio, quick ratio), solvency ratios (e.g., debt-to-equity ratio, interest coverage ratio) are some of the most essential and effective performance metrics that can show how effectively a company manages its financial resources and how stable it is. These metrics are also very relevant to the field of sustainability. Looking at profitability ratios such as Return on Investment (ROI), it is possible to deduce if the company providing green loans or investment products is making higher returns. Moreover, having analyzed the sustainable products and offerings of the company and its cash flow can also lead to a better understand of liquidity within the company. Thus, researchers can compare these ratios across multiple companies over years and see how sustainable practices affect their financial situation and stability on the market.
- Valuation Models: Discounted cash flow (DCF) analysis and relative valuation models (e.g. P/E ratio) can be applied with the objective of deriving the actual value of the company. This approach is widely and frequently used in all studies associated with financial research and its influence on the dependent variable. In our case, similar to the financial ratios analysis, a company with strong ESG practices and sustainable offerings can be valued higher than its peers due to the fact that sustainable products are trending and are in high demand, therefore involving less risks and creating potential for long-term growth prospects.
- Regression Analysis: Regression models are statistical analysis tools that help to derive correlation between different variables. Regression models often require a high volume of historical data to derive the relationship between independent and dependent variables. For instance, by analyzing the ESG scores and other sustainability indicators of the company and testing how that affects its stock prices and financial performance can be indicative of ESG efforts implemented by the company and its outcome on the business.

### **Qualitative Analysis:**

• Case Studies: Case studies provide an in-depth and practical assessment of a specific event or a response to a research question. Due to the high volumes of data, quantitative research and statistical models might overlook certain contextual insights, while a relatable case study can be used to gain a deeper understanding into the research question. For our research problem, case studies will be used

as a supporting mechanism for each element of the SWOT category by analyzing the successes, challenges and overall impact of sustainable products and services on the company's performance.

- Expert Interviews: Company representatives, experts and business analysts can be interviewed to gain a deeper insight into the company performance, market trends and dynamics. Specifically in the intersection between finance and sustainability, experts can provide a nuanced and detailed explanation of every outcome and market trend occurring due to the change in regulatory practice or a new sustainable offering.
- Content Analysis: Company blogposts and articles, reports and other textual and visual data can be
  utilized to derive patterns, formulate hypotheses, describe events and strategies. Every year
  established companies around the world release annual sustainability reports that describe their
  approaches and results towards ESG goals. These reports can be used to provide insights into how
  green fintech is represented in the public discourse and how companies articulate their sustainability
  and ESG commitments. Frequently, this method is used in combination with other research methods
  as it is mostly descriptive and hardly provides enough novelty into the existing literature, even though
  it is valid and reliable.

#### **Mixed-Methods Approach:**

The combination of both quantitative and qualitative methods is also quite popular in academic research. For instance, researchers can use numeric data for determining the company value using financial metrics and ratios, while also conducting interviews with industry experts and company employees to assess the outcome of the applied model and its influence on the non-financial factors, like operations, marketing, logistics, and so on. Here are some common methods of mixed-methods approaches:

#### **Comparative Analysis:**

Comparative analysis refers to a systematic juxtaposition of two or more entities, their operations, processes and figures to identify similarities, differences and patterns. Researchers can compare the ESG performance of fintech companies with that of conservative banks and organizations. In the context of this research study, conventional approaches utilized by traditional financial institutions and their impact on sustainability will be compared to the innovative fintech way of processes and activities in the ESG direction.

### **Event Study Analysis:**

In the financial world, such events as mergers and acquisitions, regulatory adjustments, market changes and developments, financial announcements and reports have a great impact on the market dynamics. Therefore, these events can be analyzed in detail to discover patterns and relations affecting a wide variety of fields and sustainability is not an exception. In this context, cryptocurrency can be provided as an example of a market shift towards digital and intangible currencies that have affected the social and economic situation, renewable energy, energy consumption and regulations. These can be both positive and negative patterns, but the impact can't be neglected. In fact, event studies can also be analyzed vice versa, such that an event happening on the sustainable market can influence the financial situation of companies and organizations and is subject to even study analysis too.

#### **Surveys and Questionnaires:**

Surveys or questionnaires can be arranged to collect numeric or textual data about the company directly from internal or external stakeholders. A survey can be conducted amongst employees or consumers of the fintech application to gather opinions and identify trends and gaps in the market. In case the volume of data collected via a survey is quite high, it can be statistically analyzed by discovering correlations and factors influencing the success or failure of green fintech in reaching the ESG objectives.

This research study utilizes a set of qualitative approaches, integrating SWOT analysis and case studies to explore the role of green fintech in promoting sustainable economic growth, as well as a quantitative approach represented by a Fixed Effects regression model. The choice of these methodologies is driven by the necessity to cover each element of SWOT categories, that was already performed in the previous studies and articles, but also to support the findings with concrete use cases and real-world scenarios. At the same time, we will contribute to the existing literature byrunning an empirirationalecal analysis testing the impact of fintech and digital finance on greenhouse gas emissions to provide a measurable and observable evidence.

### 2.3 Rationale for Methodology Selection

The selection of SWOT analysis, supported by case studies and regression analysis, is grounded in the specific characteristics of the research topic. Green fintech is a relatively new and rapidly evolving field, characterized by a high degree of innovation and a strong focus on sustainability. Given the dynamic nature of this field, an elastic yet structured approach is necessary to cover various components of fintech's impact on sustainable development. SWOT analysis is specifically well-fitted to this task as it allows for a comprehensive assessment of both intrinsic and extrinsic factors that

influence green fintech. By segregating these factors into strengths, weaknesses, opportunities, and threats, the SWOT framework provides a clear and organized structure for analyzing the sophisticated relationship between fintech innovations and sustainability objectives.

Case studies are an invaluable tool in this research as they offer detailed insights into specific instances of green fintech implementation. These real-world examples help to ground the theoretical aspects of the research in practical, observable phenomena. By evaluating how various fintech companies navigate the challenges and opportunities of sustainable finance, the case studies provide a deeper understanding of the factors that contribute to or hinder the success of green fintech initiatives.

Other research methods, such as questionnaires or interviews, while valuable, may not be as comprehensive. These methods usually provide insights into specific companies, individual perspectives and might have a small focus groups, which might not give the broad industry view you're aiming for and might not be generalized to the entire industry. They can be time-consuming and may not capture the full range of factors influencing green fintech's role in sustainable economic growth. By using SWOT analysis and case studies, a more detailed understanding of how fintech is influencing sustainable finance across the whole industry, while also offering concrete examples of its application.

Lastly, the selection of regression models for this study, and specifically the Fixed Effects model, is grounded in their ability to provide robust and understandable insights into the complex relationships between digital finance adoption, sustainability practices, and economic outcomes. Regression analysis adds a powerful statistical value that aligns well with the goals of this study.

The panel structure of our dataset, which includes data across a variety of countries and years, is particularly well-suited to regression analysis. Panel data regression techniques, such as the fixed effects model we have chosen, can account for unobserved heterogeneity across countries and time periods. This capability is critical for isolating the true effects of digital finance adoption on gas emissions, controlling for country-specific characteristics and global trends that might otherwise confound the analysis.

### 2.4 Research Design Framework

The research design for this study pursues both qualitative and quantitative approaches, which are well-suited herein due to the constitution of the research questions. This approach is designed to provide a deep, contextual understanding of the role of green fintech in sustainable development, focusing both on quantifiable and non-quantifiable metrics. Thus, the research is built around three main components: SWOT analysis, case studies, challenging each SWOT component and a statistical analysis of Digital Finance Impact on Greenhouse Gas Emissions.

The exploratory stage of the research concerns an extensive literature review to establish a foundational understanding of the current state of green fintech and its relationship with sustainable development and ESG goals. This phase is pivotal for pinpointing gaps in the existing literature, which in turn informs the development of the research questions and hypotheses. The literature review also helps to contextualize the research within the broader academic discourse on sustainability and financial innovation, providing a theoretical framework that guides the subsequent stages of the study.

Following the exploratory phase, the research design shifts to a descriptive approach, with the aim of providing detailed, context-rich descriptions of green fintech initiatives. This is where the case studies play a central role. By focusing on specific companies and their approaches to sustainable finance, the descriptive phase of the research allows for a close examination of how theoretical concepts are applied in practice. The case studies are selected based on their relevance to the research questions and their ability to illustrate different aspects of the green fintech landscape.

The ultimate component of this study is the regression analysis technique. The wide acceptance of regression techniques in economic and financial research enhances the credibility and comparability of the results. By using these established methods, we ensure that our findings can be readily interpreted and integrated into the existing body of literature on fintech and sustainability.

### 2.5 Qualitative Research Methods

### 2.5.1 Application of SWOT Analysis

SWOT analysis is a strategic planning tool that is used to evaluate an organization's ability to achieve its objectives. It is widely used in business and management studies to evaluate different strategies and approaches. In this thesis, SWOT analysis is applied to evaluate the role of green fintech in promoting sustainable development and ESG goals. The swot framework can be divided into 4 categories: strengths, weaknesses, opportunities, and threats.

The strengths category focuses on determining the inherent advantages of green fintech, such as capacity for innovation, agility in adapting to new market conditions, and alignment with sustainability goals. These strengths can be evaluated from the perspective of their contribution to sustainable economic growth, both in terms of direct impact on environment, such as carbon offsetting

and emissions, and wider contributions to the ESG topic.

On the other hand, weaknesses category involves factors inherent to fintech companies that may undermine or diminish the impact on the growth of sustainable economy. These can be both internal factors, like scalability issues due to misguided management or operations, and external one, like regulatory changes, like bans applied by the government on cryptocurrencies. This category is essential for understanding to avoid potential challenges and barriers to the growth and impact of fintech innovation. Therefore, it should be processed in detail to derive areas where companies and organizations need to be cautious to fully realize their potential in advancing sustainability.

The opportunities category investigates factors, predominantly external, that could improve the role of green fintech in ESG agenda. Nowadays, technological advancements and digitization can be seen as one of the biggest factors creating opportunity for fintech companies. Amongst other examples, consumer behavior changes, artificial intelligence and ever-changing regulations can be the sources for new opportunities. We will try to identify and analyze some major sources of these opportunities that have the potential of generating a positive impact on the sustainable development by green fintech.

Finally, the threats category involves factors inherent to fintech companies that may hinder sustainable growth and create risks for its development. These may include competition from the conventional banks and institutions, economic crisis and government limitations. By foreseeing these threats, the SWOT analysis provides a comprehensive view of the challenges that fintech companies face in their efforts to contribute to sustainable development.

#### 2.5.2 Case Study Methodology

While SWOT analysis can generate a solid foundation for discussions around green fintech and its impact on sustainability, case studies will provide in-depth, practical and real-world examples in that direction. Case study methodology is well-suited to this research problem as it adopts a detailed examination of the complex phenomena of fintech and its role in sustainable development involving an interaction between at least three different components, like finance, technology and sustainability.

Case studies that are selected for this study are guided by the research questions. Representative examples of fintech companies and organizations need to be introduced. The selected use cases will span across a wide variety of companies in different niches, products, geographical locations, and scopes of efforts towards sustainable economic growth. The objective of provided samples will be to

showcase their advantages and disadvantages in relation to the ESG goals and how these companies contribute to them, which can be both positive and negative.

Case study data can be gathered from a wide range of sources, such as company reports, articles, interviews with employees and consumers, publications and so on. Such a multi-source approach ensures the validity and reliability of this research study. Moreover, it provides a broader and more comprehensive picture of the company's efforts towards sustainable goals.

As mentioned, the case study analysis and samples will be provided in conjunction with the four SWOT categories. Each case will be analyzed for a detailed discovery of how certain companies utilize their strength, deal with their weaknesses, capitalize on opportunities, and mitigate threats.

### 2.6 Quantitative Research Methods

### 2.6.1 Quantitative Analysis of Digital Finance Impact on Greenhouse Gas Emissions

To empirically investigate the relationship between digital finance penetration and greenhouse gas emissions, this study employs a panel data regression model using fixed effects. The dataset encompasses 39 developed and developing countries, with observations from 2014, 2017, and 2021 (Baltagi, 2021; Wooldridge, 2010).

Due to the nature of gathered data which encompasses the information about the use of digital mobile applications and financial operations across different countries through years, panel data regression analysis is one of the most relevant quantitative methods to be applied on the cross-sectional and time-series data. This method enable us to research hoe digital finance penetration affects greenhouse gas emission over time.

This quantitative analysis will provide empirical evidence on the relationship between digital finance penetration and greenhouse gas emissions, complementing the theoretical framework and qualitative insights presented in earlier chapters.

### 2.6.2 Hypothesis Testing

The null hypothesis for each independent variable is that it has no effect on greenhouse gas emissions. We will test these hypotheses using t-tests for individual coefficients and an F-test for joint significance (Hsiao, 2014).

#### 2.6.3 Data Sources and Variables

The independent variables, sourced from the World Bank Findex database, include:

- Percentage of population that made a digital payment
- Percentage of population that received a digital payment
- Percentage of population that made a utility payment using a mobile phone
- Percentage of population with a mobile money account
- Percentage of population that received wages through a mobile phone
- Percentage of population that received public sector wages through a mobile phone
- Percentage of population that received government payments

The dependent variable, annual greenhouse gas emissions per country, is measured in metric tons of CO2 equivalent (Stock & Watson, 2020).

# 2.6.4 Model Specification

The fixed effects model is specified as follows (Greene, 2018):

```
Yit=\beta0+\beta1X1it+\beta2X2it+...+\beta7X7it+\alpha i+\lambda t+\epsilon it
```

Where:

- Yit is the greenhouse gas emissions for country i in year t
- X1itX1it to represent the seven digital finance penetration variables
- αi captures country-specific fixed effects
- λt represents time fixed effects
- *ɛit is the error term*

This model allows us to control for unobserved heterogeneity across countries and time periods, providing more robust estimates of the relationship between digital finance penetration and greenhouse gas emissions (Cameron & Trivedi, 2005).

# 2.6.5 Estimation Procedure

The model will be estimated using the least squares dummy variable (LSDV) approach, which is equivalent to including dummy variables for each country and year. To address potential heteroskedasticity and autocorrelation, robust standard errors will be computed (Wooldridge, 2002).

To verify the robustness of our findings, we will estimate the model using alternative specifications such as pooled OLS. (Angrist & Pischke, 2008)

### 2.7 Data Collection Methods

Data collection is a crucial part of this research study as it provides the fundament for SWOT analysis, case studies and regression analysis ensuring the validity and reliability of the findings. For this, this research employs a mix of primary and secondary data sources.

Primary data sources mainly involve direct observations of fintech practices and examples based on the existing literature and real-world use cases. Moreover, we will collect the information through interviews with industry experts and surveys of fintech consumers extracting that information directly from the company employees or indirectly through market analyses and publications. Primary data collection provides the most important insights into the role of green fintech in achieving sustainable economic growth.

Secondary data is collected from existing financial reports, regulatory documents, and other publications that serve as a supporting resource to validate the findings from the primary data. This method provides a broader context to the topic of fintech companies and their impact.

For the quantitative research, specifically the fixed effects regression model, data was gathered from two essential secondary sources. The controlled variables, which measure digital finance penetration across various dimensions, were obtained from the World Bank's Global Findex database. Having filtered on relevant independent variables, this extensive dataset provides information on how adults in 39 countries save, borrow, make payments and get salaries in a digital manner. The data covers the years 2014, 2017, and 2021, offering a longitudinal perspective on digital finance adoption. The response variable, greenhouse gas emissions, was sourced from the Greenhouse Gas Emissions Dataset available on European Commision website (European Comission, 2024). This dataset provides annual greenhouse gas emissions data for the same countries and time periods as the Findex data, allowing for a matched panel dataset. The use of these established and reliable data sources ensures the reliability and validity of our quantitative analysis.

The combination of both primary and secondary data ensures that the study is based on reliable and robust evidence, and it provides a clear understanding of green fintech phenomena.

Ethical considerations of this research must be outlined too as they are an important part of the data collection process. It must be highlighted that an informed consent was obtained from interviewees

and the confidentiality of sensitive information is maintained. Thus, the research study maintains its integrity and ensures that the outcome of the interviews and other information sources is trustworthy and valid.

### 2.8 Data Analysis Techniques

Qualitative data analysis techniques are the main methods of how the collected data is analyzed in this research study. The analysis is targeted on determining insights, trends, and patterns that tackle the research problem and contribute to the overall understanding of the role of green fintech in sustainable development.

SWOT analysis is the foremost tool for organizing and clarifying gathered data. The data is categorized into the four SWOT categories (strengths, weaknesses, opportunities, and threats) in structured manner and analyzed to identify key themes and recurring patterns. This analysis provides a systematic framework for understanding the intrinsic and extrinsic aspects that have an impact on the effectiveness of green fintech in promoting sustainability.

The case study data is analyzed and provided as supporting samples along with the SWOT analysis, with each case inspected in reference to the SWOT elements. This approach allows for a detailed exploration of how specific companies implement sustainable practices, and how these practices align with the broader trends identified in the SWOT analysis. The knowledge obtained from the case studies is then incorporated into the broader analysis, providing specific examples that support the overall research findings.

For the quantitative analysis, panel data regression models are used to test the relationship between digital finance penetration and greenhouse gas emissions in a set of countries. The analysis employs a fixed effects model to control for unobserved heterogeneity across countries and time periods. The model is estimated using the least squares dummy variable (LSDV) approach.

We will conduct a Hausman test to ensure the validity of the regression results and confirm the appropriateness of fixed effects over random effects. Hypothesis testing is performed using t-tests for individual coefficients and an F-test for joint significance.

The combination of qualitative and quantitative analysis techniques provides a multi-faceted approach to understanding the complex relationship between green fintech and sustainable economic growth. This mixed-methods approach allows for a more comprehensive and nuanced exploration of the research questions, enhancing the validity and reliability of the study's findings.

# **3 RESULTS**

### 3.1 SWOT Analysis and Case Studies

#### 3.1.1 Strengths

Green fintech has shown prominent strengths in developing sustainability and reaching sustainable goals. These strengths are backed by the ability of modern technologies to foster innovations, which helps to address environmental challenges and promote sustainable agenda within the financial sector. When juxtaposed against the traditional banking approaches, green fintech often exhibits greater agility, innovation, and direct engagement with sustainability goals.

#### 1. Enhanced Accessibility and Financial Inclusion

One of the most essential strengths of green fintech is its ability to enhance accessibility to sustainable financial products and services. By leveraging digital platforms and mobile technologies, green fintech solutions can reach a broader audience, including underserved populations and remote areas.

Ant Forest, a project by Ant Financial and a platform built on top of China's giant Alipay, provide strong grounds for this strength. The application reduces the carbon footprint in a gamified manner, allowing consumers to earn "green energy" points for environmentally friendly behaviors. These points can then be used to plant real trees, effectively combining financial technology with environmental conservation. Users of the platform are supposed to accumulate points by performing green activities, such as getting electronic invoices instead of paper ones or using sustainable packaging when making their orders. Even number of steps made during the day can be converted into points. This nurtures a responsible lifestyle and green attitude towards sustainable development. In the age of digitization and high penetration of smartphones and mobile applications, such an approach appears to be useful in creating awareness about sustainability (Chen and Cai., 2019).

Traditional banks often struggle to reach certain layers of populations due to the steep costs associated with the maintenance of physical branches and sophisticated regulations. Green fintech solutions, being mainly digital, can overcome these challenges more easily. For instance, while a traditional bank might require customers to visit a branch to open an account or apply for a green loan, fintech platforms can often complete these processes entirely online, making sustainable financial products more accessible to a wider audience.

### 2. Enhanced Transparency, Accountability and Cost Reduction

Green fintech solutions often lead to increased efficiency and reduced costs in sustainable finance operations. By automating processes and utilizing advanced data analytics, these technologies can streamline sustainable investment decisions and reduce operational expenses. An example can be provided in multiple pilot use cases within the supply chain industry, where the blockhain technology substituted the hard-to-verify paper documents. Green fintech platforms often incorporate blockchain and other distributed ledger technologies, which can significantly enhance transparency and accountability in sustainable finance (Tapscott and Tapscott, 2016). The global trade has become easier to track as every transaction was digitally "documented" and could not be hidden therefore. The global leader in shipping industry, Maersk, based in Denmark, and IBM have supported the technology with the purpose of reducing inefficiencies and corruption (Nassiry, 2018).

Conservative financial institutions often possess legacy systems and procedures that can be quite slow and costly to update. This can create barriers for them to adapt to new sustainability requirements faster or offer innovative green financial services and products. In contrast, green fintech companies, built on innovative tool stack, can integrate sustainability metrics into their operations and product offerings easier. For example, while a traditional bank might take months to develop and launch a new green investment product, a fintech company might be able to do so in weeks.

### 3. Innovative Sustainable Financial Products

Green fintech enables the foundation of non-existing financial products and services that support sustainability objectives. These products can vary from green bonds to carbon offset credits, all made more accessible through digital platforms.

Bocken et al. focuses on 3 main business model strategies that exist to tackle unsustainability: defensive, accommodative and proactive. Defensive mechanisms are mainly aimed at protecting current business models focusing on risk and cost reduction often driven by the need for compliance. This should primarily be associated with traditional banks and institutions. Accommodative strategies are alterations of internal activities and include some consideration of environmental or social objectives. Proactive strategies concern full integration and the redesign of the fundamental business logic of the company to tackle sustainable development. Despite the fact that all business model innovations that deliver sustainability are welcomed, proactive innovation strategies appear most impactful (Bocken et al., 2014).

Examples of platforms associated with proactive strategy are platforms that sell so called "NFTrees". Coorest, a company that operates in this sector, creates forests by planting trees around the world and sells NFTs, which are tied to a physical tree. This creates an opportunity for its buyers, like people and companies to compensate their CO2 carbon emission. The objective of a platform is to mitigate human activities and help buyers balance out their carbon offset (Coorest Case Study).

While traditional banks have begun offering green financial products, they are often limited in scope due to regulatory constraints and risk-averse corporate cultures. Thus, they can be primarily associated with defensive and accommodative strategies from the business model innovation perspective. Green fintech companies are more flexible and can experiment with innovative products that directly link financial activities with environmental outcomes. For instance, while a traditional bank might offer a standard green savings account, a fintech company might provide a savings account where the interest rate is tied to the customer's carbon footprint reduction.

### 4. Data-Driven Sustainability Insights

Green fintech companies excel at leveraging big data and advanced analytics to provide detailed sustainability insights. This capability allows for more informed decision-making in sustainable investments and personal environmental impact.

Cogo uses transaction data to calculate users' carbon footprints and provides personalized suggestions for reducing environmental impact. This level of granular insight is typically beyond the capabilities of traditional banking systems (Cogo Case Study).

Traditional banks often lack the sophisticated data analytics capabilities of fintech companies. While they may have vast amounts of customer data, they often struggle to turn this into actionable sustainability insights. Green fintech companies can provide customers with detailed breakdowns of their environmental impact based on their financial activities (Puschmann et al., 2020).

# 5. Rapid Adaptation to Sustainability Trends

The agile nature of green fintech allows for quick adaptation to emerging sustainability trends and regulatory changes. This flexibility enables these companies to stay at the forefront of sustainable finance innovation (Lee and Shin, 2018).

Treecard (Treecard Case Study) quickly capitalized on the growing trend of sustainable consumerism by launching a wooden debit card that uses merchant fees to fund reforestation projects. This rapid response exemplifies the agility of green fintech.

Traditional banks often struggle with quick adaptation due to complex organizational structures and legacy systems. The process of developing new products or services can be slow compared to green fintech companies that can pivot quickly to address new sustainability challenges or opportunities as they arise.

# 3.1.2 Weaknesses

Green fintech, a core of financial technology and sustainable development, has modified traditional financial practices, promoting sustainability aims. However, there are weaknesses that impede its potential to support sustainability in an effective manner. This section outlines key weaknesses, supported by real-world use cases, in the context of green fintech's impact on sustainability.

# 1. Regulatory Challenges and Ethical Concerns

Green fintech works in a dynamic but fragmented regulatory setting. Regulatory frameworks often stay behind technological advancements, which in its turn leads to inconsistencies and discrepancies.

For instance, considering the fact that current global regulations on blockchain and AI are scarce, a number of hurdles are faced by the green fintech startups offering blockchain-enabled carbon credit trading platforms. A case in point is ClimateTrade (ClimateTrade Case Study), a platform allowing companies to offset carbon emissions through blockchain. While innovative, it has encountered challenges in scaling due to differing regional laws on blockchain applications and carbon credit standards (Merchant and Gurgoz, 2023).

Ethical concerns and issues around the usage and security of data are also prevalent in green fintech. For example, Doconomy (Doconomy Case Study), a fintech that tracks carbon emissions looking through consumer operations and transactions, has faced questions about data ownership and privacy. While its app empowers users to understand and reduce their carbon footprints, some argue that the extensive data collection might pose risks to individual privacy, especially if such data is mishandled or sold without consent (Elderson, 2024).

### 2. Overdependence on Technology and Workforce

High dependence on technology and digitization creates risks like cyberattacks, breaches of personal and enterprise data, and operational disruptions. For instance, **Ethereum**, a world-wide popular blockchain platform that supports a large number of green fintech projects, has been criticized for its high energy consumption. This inefficiency led to the Ethereum network's gradual transition to a proof-of-stake model, showcasing the struggle to balance technological innovation with environmental goals (Greenmoney, 2018).

Moreover, despite the hype of technology and digitization in the 21st century, the development occurs faster than the supply of workforce in that area. The green fintech sector struggles with a scarcity of skilled employees in both fintech and sustainability. For example, **Trine**, a Sweden-based fintech company that invests in green and renewable energy projects, has found it challenging to recruit data engineers and scientists who also have expertise in environmental science. This skills gap has slowed down the development of robust analytics for tracking the impact of investments on sustainability goals (Cockerton, 2016).

### 3. High Initial Investment Costs and Focus on short-term profitability

The development of green fintech solutions entails substantial initial costs, deterring smaller companies and startups. Start-ups and scale-ups nowadays often go through funding rounds where they try to attract investments from private equity and venture capitals to be able to sustain their

operations and expenses. Moreover, despite their alignment with sustainability goals, lots of green fintech firms prioritize short-term financial gains over long-term environmental impact to prove their business and operating models to investors. For instance, Altruistiq (Altruistiq Case Study), a startup that offers carbon accounting software for enterprises, faced significant challenges in securing initial funding due to the high costs of building scalable, compliance-ready infrastructure. Many investors hesitated due to uncertainties around long-term returns in the sustainability-focused fintech sector (Lee and Shin, 2018).

### 3.1.3 Opportunities

The green fintech industry, positioned in the center of finance, technology, and sustainability, focuses on harnessing several opportunities that can promote sustainability and accelerate the migration towards a green economy. This section explores key opportunities, supported by real-world use cases, that green fintech can leverage to potentially extend its impact on sustainability.

### 1. Growing Consumer Demand and Expansion into Underserved Markets

The increasing awareness of environmental issues among consumers has led to growing demand for sustainable financial products and services. Green fintech companies can capitalize on this trend by offering innovative solutions that cater to environmentally conscious individuals. For instance, Tomorrow, a German green neo-bank, allows users to track the carbon footprint of their expenses and assures that their deposits and savings are used only for green projects. By following this strategy, Tomorrow has attracted a substantial base of customers who are aware and interested in eco-friendliness and is paving the way for mainstream adoption of sustainable banking (Beese, 2024).

Green fintech can cover financial gaps in underserved regions by providing access to affordable and sustainable financial services. For example, M-KOPA (M-KOPA Case Study), operating in East Africa, offers solar-powered home systems through a pay-as-you-go model facilitated by mobile payments. This model has brought clean energy to millions of households that previously lacked access to electricity, demonstrating how green fintech can empower communities while driving sustainability (Beese, 2024).

### 2. Advancements in Technology and Big Data

The speedy development of technologies such as blockchain, artificial intelligence (AI), and big data analytics creates firm grounds for transformative opportunities. These advancements enable more effective tracking, reporting, analytics, decision-making and management of sustainability metrics

and indicators. For instance, ClimateTrade (ClimateTrade Case Study), mentioned already in this thesis, uses blockchain technology to streamline carbon offset transactions. Its platform allows businesses to purchase verified carbon credits transparently, reducing operational inefficiencies and ensuring accountability. This demonstrates how emerging technologies can strengthen the role of green fintech in achieving global sustainability goals (Blackman, 2019).

As mentioned above, the ability to process and analyze large sets of data offers green fintech businesses a unique advantage in managing climate risks. For instance, Four Twenty-Seven, a climate data and analytics company, helps financial institutions in providing assessments of climate-related risks to their assets. By providing actionable insights, Four Twenty-Seven supports the financial sector in making informed decisions that mitigate environmental risks, contributing to a more elastic and resilient global economy (Merchant and Gurgoz, 2023).

### 3. Development of Green Financial Products and Circular Economies

The foundation of new green financial products, such as green bonds, carbon credits, and sustainable investment funds, represents a growing market segment. For example, Clarity AI (Clarity AI Case Study), a green fintech platform, provides tools for evaluating the environmental, social, and governance (ESG) impacts of investment portfolios. It enables investors to align their portfolios with sustainability objectives, driving demand for green financial products (Blackman, 2019).

Green fintech can play a pivotal role in enabling circular economies, where waste is minimized, and resources are reused or recycled. For example, OLIO (OLIO Case Study), a peer-to-peer food-sharing app, combines fintech and sustainability principles to reduce food waste. Users can exchange surplus food locally, promoting resource efficiency and reducing greenhouse gas emissions associated with food production. By supporting such initiatives, green fintech can foster sustainable consumption and production patterns, aligning with the United Nations' Sustainable Development Goals (Merchant and Gurgoz, 2023).

### 4. Policy and Regulatory Support

Governments and regulatory bodies worldwide are increasingly promoting sustainability initiatives, creating opportunities for green fintech to expand. Policies such as the European Green Deal and tax incentives for green investments encourage the development of innovative solutions. For example, Switzerland's Green Fintech Network has established frameworks and support mechanisms to attract

green fintech startups. This proactive regulatory environment enables startups to flourish and address sustainability challenges effectively.

### 5. Education and Advocacy

Green fintech possesses a great potential for educating consumers and enterprises about sustainability. It also fosters environmentally-friendly practices by integrating educational elements into their platforms.

For example, Doconomy (Doconomy Case Study), a Swedish green fintech, leverages its digital platforms to analyze daily financial decisions of application users with a purpose of educating them and increasing their awareness of environmental impact. The app uses their transationIts app tracks users' carbon footprints based on their transaction history, offering personalized insights into how their spending contributes to CO2 emissions. Doconomy goes further by suggesting actionable steps, such as choosing eco-friendly alternatives or offsetting emissions through carbon credits. This educative approach ensures users are not only informed but actively engaged in reducing their environmental footprint (Elderson, 2024).

Green fintech companies are also helping raise awareness at higher levels, like within big businesses and governments. For instance, Clarity AI (Clarity AI Case Study) provides tools that show the environmental and social effects of investments. This helps not only individual investors but also companies looking to make their strategies more sustainable. By offering clear data on ESG (Environmental, Social, and Governance) performance, Clarity AI encourages businesses to align their goals with environmental responsibility (Blackman, 2019).

Green fintech is also a bridge between research and real-world action. For example, Altruistiq (Altruistiq Case Study), which offers carbon tracking tools for companies, includes educational materials explaining how carbon tracking works and why it's important for meeting regulations. This transparency helps businesses build trust and better understand their environmental responsibilities.

By combining technology with education and advocacy, green fintech companies not only achieve their business goals but also help create a more informed and environmentally aware society. Their role in educating people and pushing for change at all levels makes them key players in the fight for a sustainable future.

### 3.1.4 Threats

Green fintech has a lot of potential, but it faces several challenges that could slow its growth and reduce its impact. These challenges come from issues with regulations, technology weaknesses, and outside economic factors.

### 1. Regulatory and Legal Uncertainty

One major challenge for green fintech is the lack of clear and supportive regulations. Inconsistent rules and sudden changes in laws can make it hard for companies to grow or innovate. For example, platforms like Binance, which combines blockchain with green projects, have faced regulatory issues in several countries, affecting their operations and trust. Similarly, legal uncertainties around blockchain-based carbon credits can scare off investors because they're unsure about their legitimacy or value. Without clear regulations, green fintech companies struggle to gain momentum, especially in international markets (Merchant and Gurgoz, 2023).

Another issue is the risk of greenwashing, where some green fintech companies exaggerate their environmental benefits to attract customers. This can damage the sector's reputation when these claims are proven false. For instance, Aspiration, a fintech company offering sustainable banking, faced criticism for allegedly misleading claims. Such incidents not only hurt individual companies but also create doubt about green fintech solutions as a whole (Blackman, 2019).

#### 2. Technological Risks and Barriers

Green fintech relies heavily on technology, which brings its own challenges. Cyberattacks and data breaches can damage user trust and cause financial losses. For instance, SolarCoin (SolarCoin Case Study), a blockchain-based rewards platform, had security issues, showing the risks of depending on digital systems. Implementing and scaling technologies like blockchain and AI also require significant resources, making it tough for smaller companies to compete.

Even successful platforms like Power Ledger (Power Ledger Case Study) have faced difficulties with scalability when trying to expand globally. These challenges not only slow down adoption but also increase operational costs. Additionally, some technologies used in green fintech, such as blockchain, have been criticized for their high energy consumption, which can conflict with sustainability goals.

### 3. Economic Instability and Resource Constraints

Economic downturns and limited resources create significant challenges for green fintech companies. During financial uncertainty, investors and consumers might prioritize other services over those focused on sustainability. For example, during the COVID-19 pandemic, green fintech startups like Newday Impact Investing saw reduced funding as investors looked for safer investments. Market volatility adds to these difficulties, as seen with CarbonX (CarbonX Case Study), a carbon credit trading platform that faced issues due to fluctuating credit prices.

Startups, in particular, struggle with resource limitations, making it hard to compete with larger companies or invest in expanding their solutions. Altruistiq (Altruistiq Case Study), which offers carbon accounting tools, had trouble securing enough funding to grow its operations amid increasing competition. These constraints hinder innovation and limit the ability of green fintech to tackle larger sustainability challenges (Beese, 2024).

### 4. Consumer Reluctance and Competition from Traditional Institutions

Despite growing awareness, many consumers remain hesitant to adopt green fintech solutions due to a lack of trust or understanding. For instance, TreeCard (Treecard Case Study), which uses its profits to fund tree-planting projects, has faced challenges in convincing mainstream consumers of its value. Without widespread consumer buy-in, green fintech firms may struggle to scale their operations or make a significant impact.

In addition to consumer reluctance, traditional financial institutions are emerging as strong competitors. Established banks like HSBC and Citi are launching their own green finance programs, leveraging their extensive resources and customer bases to challenge smaller fintech firms. These institutions often have the advantage of greater regulatory expertise and access to capital, which allows them to scale solutions more effectively than green fintech startups (Elderson, 2024).

#### 5. Ethical Concerns and Market Volatility

Ethical concerns about data use are a big challenge for green fintech. Many companies gather a lot of personal data to track sustainability indicators and metrics, which raises questions about privacy and security. For example, as mentioned earlier in this research study, while Doconomy (Doconomy Case Study) helps its users understand their carbon impact, some people worry about the data storage and potential misuse or breaches that might occur. These concerns can hurt consumer trust and slow down the adoption of green fintech solutions.

Green fintech firms also rely immensely on unstable markets like carbon credits and renewable energy investments. Price fluctuations in these markets can make it hard for companies to stay profitable and stable. For instance, CarbonX (CarbonX Case Study) faced significant challenges when carbon credit prices were low, highlighting the risks of depending on such volatile markets.

### 6. Risk of Greenwashing

The rise in popularity of sustainability has also led to the exploitation of the "green" label for marketing purposes without substantive efforts toward environmental goals. For example, Aspiration, a fintech company promoting sustainable banking, faced criticism when investigations revealed discrepancies in its claims about the environmental impact of its debit cards and banking services. This tarnished its reputation and highlighted the risk of greenwashing in the sector (Blackman, 2019).

# 3.2 Results of Fixed Effects Regression Model on Panel Data

Due to the panel nature of data, it was decided to proceed with the fixed effects regression model within the scope of this research study.

# 3.2.1 Statistical Indicators

There are several statistical indicators that are used in this study to evaluate the overall fit of the predictors on to the dependent variable.

# 1. R-squared Values

R-squared indicates the level of the variation in the dependent variable (emissions) that is explained by the independent variables in the model. For panel data, there are three types:

- **Overall R-squared** looks at how well the model explains the data as a whole.
- Within R-squared measures how well the model explains the variation within each entity (like a country or firm) after accounting for fixed effects.
- Between R-squared shows how well the model explains differences between entities.

If R-squared results in a high number, it means the model fits well, but it doesn't always mean there's a cause-and-effect relationship.

### 2. F-statistic and P-value

The F-statistic checks whether the independent variables, as a group, have any real effect on the dependent variable. Its p-value tells us how likely it is that we'd get these results by random chance if the independent variables had no effect. If the p-value is low (less than 0.05), we'd say at least one variable matters.

# 3. Parameter Estimates (Coefficients)

The coefficients demonstrates how much the dependent variable (emissions) changes when an independent variable increases by one unit, assuming everything else is constant and stays the same.

- A positive coefficient means the variable increases emissions, while a negative one means it decreases emissions.
- Whether a coefficient is significant or not depends on its t-statistic and p-value.

# 4. Standard Errors

Standard errors show the precision and accuracy of the coefficient estimates. Smaller standard errors mean the estimates are more reliable. If standard errors are big compared to the coefficients, it could potentially mean there's an issue like multicollinearity or not enough data variation.

# 6. Confidence Intervals (CI)

Confidence intervals provide a range of values where the true coefficient likely falls. For example, a 95% confidence interval means the results are true with a confidence of 95%. If the intervals are really wide, it suggests the estimates aren't very precise. This could happen because of high standard errors or data limitations, such as its volume or inaccuracy.

# 7. P-values for Coefficients

P-values test if a coefficient is likely to be zero (meaning the variable doesn't really affect the outcome).

If the p-value is less than a set threshold (usually 0.05), we can say the variable has a significant effect on the dependent variable. Otherwise, it's not considered important.

# 8. F-test for Poolability

This test examines if combining all the data into one big dataset (pooling) is valid or if we need to use fixed or random effects to account for differences between entities. For the purposes of this study, it was decided to use fixed effects, however we also decided to test if this was the right decision.

A low p-value (below 0.05) means pooling is not relevant, and a fixed or random-effects model should we utilized that accounts for entity-level differences.

# 3.2.2 Results of Fixed Effects Regression Model on Panel Data

This study applies a fixed-effects panel data regression model to analyze the relationship between various indicators of financial and digital inclusion and emissions. By controlling for unobserved, time-invariant differences at the entity level, the model ensures the results are robust and account for factors that do not vary over time across entities.

The results of the model fitting are presented below:

- Dep. Variable: Emissions
- R-squared: **0.3576**
- Estimator: PanelOLS
- R-squared (Between): -0.0892
- No. Observations: 114
- R-squared (Within): **0.3576**
- R-squared (Overall): -0.0874
- Log-likelihood: -714.05
- Cov. Estimator: Unadjusted

# **F-statistic**

- F-statistic: **4.7311**
- P-value: **0.0001**
- Distribution: F(8,68)

Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
const	571.82	-1.5869	0.1172	-1290.9	147.23
Made a digital payment (% age 15+)	-8.7535	-1.1413	0.2578	-24.059	6.5517
Made a utility payment: using a mobile phone (% age 15+)	-6.8762	-3.3294	0.0014	-10.998	-2.755
Made or received a digital payment (% age 15+)	27.528	2.4508	0.0168	5.1144	49.942
Received digital payments (% age 15+)	-0.2575	-0.0833	0.9338	-6.4225	5.9075
Received government payments: through a mobile phone (% age 15+)	41.422	1.6481	0.1039	-8.7302	91.575
Received private sector wages: through a mobile phone (% age 15+)	3342.5	-0.5087	0.6126	-1.65E+04	9769.9
Received public sector wages: through a mobile phone (% age 15+)	-3310.8	-0.5039	0.616	-1.64E+04	9800.5
Received wages: through a mobile phone (% age 15+)	3292.8	0.5011	0.6179	-9818.6	1.64E+04

The overall R-squared value of 0.3576 indicates that the independent variables explain about 36% of the variance in emissions. While this demonstrates a moderate level of explanatory power, it also reflects the complexity of emissions, which are influenced by numerous factors not captured within the scope of this model.

As mentioned above the study utilizes 8 independent variables and their impact on the dependent one,

i.e. "Emissions". The independent variables are:

- Made a digital payment (% age 15+)
- Made a utility payment: using a mobile phone (% who paid utility bills, age 15+)
- Made or received a digital payment (% age 15+)
- Received digital payments (% age 15+)
- Received private sector wages: through a mobile phone (% age 15+)
- Received wages: through a mobile phone (% age 15+)
- Received government payments: through a mobile phone (% age 15+)

- Received public sector wages: through a mobile phone (% age 15+)
- Received government transfer: through a mobile phone (% age 15+)

Some of the independent variables show statistically significant relationships with emissions, but in a negative way. For example, **"Made or received a digital payment (% age 15+)"** has a positive and statistically significant coefficient (p-value = 0.0160), showing that increased engagement in digital financial transactions correlates with higher emissions. This could be linked to the infrastructural and energy demands associated with digital payment systems, potentially highlighting a trade-off between technological progress and environmental impact.

On the other hand, "Made a utility payment: using a mobile phone (% age 15+)" has a negative and statistically significant effect (p-value = 0.0014), suggesting that making utility payments via mobile phones is associated with reduced emissions. This might reflect more efficient energy use or the adoption of environmentally friendly practices facilitated by mobile payment systems.

Other variables, such as "Received government payments: through a mobile phone", show marginal significance. While these may have some relevance to emissions, further analysis with refined data or additional control variables is needed to clarify their impact.

The choice of a fixed-effects model is relevant here, as it accounts for unchanging differences between entities, such as geographic, institutional, or structural factors. This is supported by the results of the F-test for Poolability (p-value=0.0000). This allows the model to focus on changes within entities over time, making the results more credible by minimizing the risk of omitted variable bias.

Despite identifying significant predictors, the findings point to areas for improvement. High standard errors for some coefficients and the insignificance of others suggest potential issues like multicollinearity or insufficient variation in certain variables. Expanding the dataset, incorporating additional relevant variables (such as industrial activity or renewable energy adoption), and exploring interaction effects could improve the model's ability to explain emissions.

Although there are limitations, this study provides valuable insights into the connections between digital financial inclusion and environmental outcomes. It emphasizes the need for balanced policy approaches that support technological progress while addressing its environmental consequences. These findings contribute to understanding the dual challenges of fostering digital transformation and promoting sustainable development.

### 3.3 Synthesis of Findings

The synthesis of findings brings together insights from both the SWOT analysis supported by case studies and the panel data regression model to show a comprehensive understanding of how green fintech impacts sustainable development and its goals.

The SWOT analysis gives a strategic basis by identifying key strengths, weaknesses, opportunities, and threats within the green fintech scope. It highlights the potential for fintech to drive sustainability and enhance financial inclusion by supporting environmentally friendly financial products. On the other hand, it open up some challenges, such as regulations and technological limitations, that could hinder the growth of green fintech initiatives.

The case studies demonstrate how fintechs are applying these theoretical insights in practice. These examples show that fintech companies are successfully leveraging digital platforms to promote sustainable financial practices. However, some companies encounter obstacles, such as infrastructure gaps or shortage of workforce, which align with the weaknesses and threats outlined in the SWOT analysis.

The panel data regression model provides a quantitative analysis to measure the impact of digital finance penetration on emissions. The findings indicate a positive association between digital payments and emissions, suggesting that the expansion of digital financial services may contribute to higher energy demands, which is consistent with concerns raised in the SWOT analysis. However, the model also shows that mobile payments for utility bills are associated with lower emissions, pointing to the potential for green fintech to foster more sustainable practices when applied thoughtfully.

By integrating these findings, it becomes clear how the insights from the SWOT analysis connect with the results of the regression model. For instance, the positive relationship between digital payments and emissions, as identified in the regression, can be viewed as a threat, as noted in the SWOT analysis. Conversely, the negative relationship between mobile utility payments and emissions presents an opportunity for fintech companies to focus on solutions that promote sustainability, as also highlighted in the SWOT analysis.

The implications of these findings are significant for regulators, financial institutions, and fintech companies. Policymakers can create an environment that supports the growth of green fintech by addressing regulatory challenges and boosting infrastructure development. Financial institutions can

improve the opportunities defined in the SWOT analysis by offering more sustainable financial products, while fintech companies can focus on innovative solutions that reduce the environmental impact of their services and improve the carbon footprint.

The synthesis of findings also points to areas for further research, such as exploring new fintech innovations that may mitigate the environmental impact of digital finance or conducting additional quantitative studies to deepen the understanding of how digital finance influences emissions. Overall, the combination of SWOT analysis supported by case studies and the empirical analysis provides a more comprehensive view of the role of green fintech in sustainable development, offering both strategic insights and data-driven recommendations for a change in a positive direction.

#### 3.4 Conclusions & Suggestions

To conclude, this research study aimed at the exploration of the role of green fintech in boosting sustainable development, with a specific focus on its impact on emissions and the broader environmental implications of digital finance. The research incorporated theoretical insights from a SWOT analysis and fixed-effects panel data regression model to provide a complete understanding of the challenges and opportunities as part of the green fintech scope.

The findings show that, while green fintech has considerable potential to support sustainable development, its impact on emissions is not explainable in straightforward manner. The panel data regression model revealed that the overall increase of digital finance, particularly through digital payments, is positively associated with higher emissions, likely due to the infrastructural and energy demands of digital payment systems. However, some specific applications of fintech, such as mobile utility payments, were found to be negatively associated with emissions, suggesting that targeted innovations within green fintech can contribute to environmental sustainability.

From a strategic view, the SWOT analysis identified main strengths and opportunities for green fintech, such as the enabling financial inclusion and provision of innovative, environmentally-friendly financial services and products. However, it also pointed to meaningful weaknesses and threats, that include regulatory barriers, technological limitations, and the potential environmental costs associated with expanding digital financial services. These insights were confirmed by the regression model, which emphasized the need for a balanced approach to digital finance adoption that carefully considers both the environmental benefits and costs.

By combining the findings from both the SWOT analysis and the regression model, this thesis

provides meaningful information into the complex relationships of integrating fintech into sustainable development strategies. It showcases the importance of policy measures that can mitigate the negative environmental impacts of digital finance while maximizing its potential for promoting financial inclusion and sustainability.

In conclusion, the research contributes to the growing literature and knowledge on the intersection of digital finance and environmental sustainability, offering a detailed and comprehensive understanding of green fintech's role in addressing global environmental challenges. The results of this study offers practical recommendations for regulators and financial institutions and opens routes for further research. Future studies could explore the long-term effects of specific green fintech innovations, the role of renewable energy in powering digital finance infrastructure, and the potential for fintech to drive systemic change in industries with high environmental footprints. Through innovation and thoughtful regulation, green fintech can play a crucial role in achieving sustainable development goals, but careful consideration of its environmental implications is essential for ensuring that its benefits outweigh its costs.

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- ClimateTrade, Offset Carbon Footprint ClimateTrade™
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- Clarity AI, AI Sustainability Platform & Solutions | Clarity AI
- SolarCoin, SolarCoin
- Power Ledger, Home Powerledger