Student Perceptions of Green FinTech Adoption

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

Technology has become a key instrument for addressing climate change concerns in the modern era. Specifically, it gave rise to Green FinTech, which can significantly mitigate adverse environmental effects by incentivising people to engage in pro-environmental behaviour and green finance. Green FinTech is a novel, unexplored green technology phenomenon with a nascent adoption rate. To address this gap, this study investigates whether the proposed research model – which extends the Technology Acceptance Model (TAM) with the Theory of Planned Behaviour (TPB) and incorporates perceived risk and perceived trust – can offer a more comprehensive understanding of the adoption of Green FinTech for the students at the University of Waterloo. This study has investigated the influence of TAM constructs, namely perceived usefulness and perceived ease of use, on users' attitudes towards Green FinTech. Additionally, it has explored the effects of TPB constructs, including attitude, social norms, and perceived behavioural control, on the intention to adopt Green FinTech. The research used a quantitative approach: data collection by questionnaire. Based on the research model, eight hypotheses were developed and tested using structural equation modelling techniques (SEM-PLS). The research results indicate that attitude, social norms, and perceived behavioural control significantly affect the intention to use Green FinTech applications. Notably, the perceived usefulness emerges as the primary driver shaping attitudes toward Green FinTech usage. Although perceived ease of use and perceived trust also contribute positively to attitude formation, their impacts are comparatively smaller. Surprisingly, perceived risks do not significantly influence the attitude toward Green FinTech adoption. Moreover, the study reveals that perceived trust is a significant mediator between perceived risk and attitude towards using Green FinTech applications. To enhance adoption rates, Green FinTech service providers should prioritise the usefulness of their services in environmental protection, address consumer needs, and ensure data protection to foster trust. Remarkably, the research model elucidates 68% of the variance in attitude and 54% in the intention to use Green FinTech, offering a comprehensive understanding of individual adoption determinants, thus contributing significantly to the literature on Green FinTech adoption.

Keywords: Theory of Planned Behaviour (TPB), Trust, Green FinTech, Technology Acceptance Model (TAM), Perceived Risk, Behavioural Intention

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Chapter 1. Introduction

The environment is under extreme stress from both resource depletion and pollution caused by human activities. According to Jambeck et al. (2015), an average individual's annual production of plastic waste is 52 kilogrammes. Air pollution, primarily caused by petrol or diesel emissions (Gupta, 2020), is linked to climate change and poor human health (Kinney, 2018). Numerous human and environmental systems, including ecosystems and human health, are in danger from climate change's adverse and irreversible effects (National Academies Press, 2010). Like some other countries, Canada is also facing issues relating to air pollution. The Canadian Climate Institute (2023) report shows that the country's overall carbon emissions rose by 2.1% in 2023 compared to the previous year. Hence, it is imperative to address environmental challenges and mitigate the adverse impacts of climate change to fulfil the primary goal of the Paris Agreement: limiting the rise in global mean temperature to below 2 degrees Celsius (UNFCCC, 2015).

In light of the above, the United Nations (UN) unveiled 17 Sustainable Development Goals (SDGs) and the Ten Principles of the UN Global Compact. Among the main concerns are sustainability, climate change, and environmental protection. Sustainable development, which is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (The World Commission on Environment and Development, 1987, p. 43), involves economic, social, resource, and environmental sustainability (Giddings et al., 2002). One of the crucial ways to promote environmental sustainability is to reduce carbon emissions (Erdoğan et al., 2020) by encouraging people to become involved in eco-friendly activities (Ashfaq et al., 2021) and to provide financial support towards green projects such as renewable energy and reforestation (Aboalsamh et al., 2023).

One of the technologies that might help people achieve sustainable development is FinTech. FinTech has been recognised by the UN as one of the central innovations that can help reach the SDGs (United Nations, 2020). The concept of FinTech emerged from the key terms "financial" and "technology" (Gomber et al., 2018) and is defined as a "technology-enabled financial innovation that could result in new business models, applications, processes or

products with an associated material effect on financial markets and institutions and the provision of financial services" (Financial Stability Board, 2017, p.7). Liu et al. (2020) classified FinTech into nine types: (1) online lending platforms; (2) crowdfunding; (3) transaction and payment terminal platforms; (4) personal finance management platforms; (5) digital currencies; (6) mobile point of sale models; (7) robo-advisors; (8) e-banking; and (9) InsurTech. FinTech revolutionised the financial landscape by leveraging cutting-edge technology and providing transparent, resilient, cost-effective, and efficient financial products and services (Ebrahimi, 2023).

Numerous studies have analysed the role of FinTech in achieving the SDGs from various perspectives. In the realm of social development, Haddad and Hornuf (2019), Salampasis and Mention (2018) have underscored FinTech's pivotal role in fostering a more equitable society by advancing financial inclusion. Financial inclusion, which entails providing access to financial services to all individuals, directly bolsters resilience, poverty alleviation, and inequality reduction (Arner et al., 2020; Le et al., 2019). For example, mobile-based financial services, by providing secure and user-friendly transaction platforms and reducing transaction costs (Bayar et al., 2021), have included small and midsize enterprises (SMEs) (Abbasi et al., 2021), poor people from developing countries (Museba et al.,2021), and vulnerable farmers (Anshari et al., 2019) into the financial market. In terms of environmental and ecological development, FinTech can facilitate the building of renewable energy and environmental infrastructure and hasten the deployment of funds for energy and environmental projects by providing affordable and sufficient financing (Knuth, 2018). The new FinTech categories of Social and Green FinTech emerged because of FinTech's significant efforts concerning the SDGs. Furthermore, the name "Sustainable Fintech" was given to FinTech, which focuses on providing social and economic benefits (Al-Okaily et al., 2021).

"Green FinTech", according to Puschmann et al. (2020), is any customer-financial or nonfinancial institution interaction facilitated by information technology that affects one of the SDGs related to climate change, namely 7 (Affordable and Clean Energy), 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production), 13 (Climate Action), 14 (Life Below Water), 15 (Life on Land), and 17 (Partnerships for the Goals). Green FinTech focuses on

FinTech-related innovations that address environmental protection and climate change. On November 30, 2021, the Green Digital Finance Alliance and the Swiss Green FinTech Network in Europe announced the first-ever Green FinTech taxonomy. This taxonomy categorises Green FinTech into seven domains: (1) green digital payment and account solutions, (2) green digital investment solutions, (3) digital ESG data and analytics solutions, (4) green digital crowdfunding and syndication platforms, (5) green digital risk analysis and insure-tech, (6) green digital deposit and lending solutions, and (7) green digital asset solutions. In scholarly discourse, Green FinTech has been classified based on its contributions to facilitating green finance and promoting pro-environmental behaviour.

Effectively implementing the Paris Agreement and achieving the SDGs necessitates substantial investments. The Paris Agreement includes a commitment to "[making] finance flows consistent with a pathway toward low greenhouse gas emissions and climate-resilient development" (UNFCCC, 2015, p.2). The private sector ought to direct its investment endeavours towards more sustainable objectives; nevertheless, research indicates that the majority of its capital remains allocated to non-sustainable assets, with sustainable ones comprising merely 5% to 25% of global assets (Eccles & Klimenko, 2019). Moreover, Canada faces a substantial climate investment gap, estimated to be as high as $115 billion annually (Sustainable Finance Action Council, 2022).

Green finance emerges as the solution for bridging the "green financial gap" (D'Orazio & Popoyan, 2019; Hafner et al., 2020). It aims to offer operating capital, investment, financing, and other financial services for environmentally beneficial initiatives (Wang & Zhi, 2016; Zhou et al., 2020). As opposed to traditional finance, green finance gives more significant consideration to environmental interests (Zhou et al., 2020). Puschmann et al. (2020) highlighted that Green FinTech channels consumer efforts towards green investing. Particularly, FinTech offers user-friendly, cost-effective platforms for retail investors to engage with investment opportunities that yield both environmental benefits and financial returns (Badía et al., 2021).

Pro-environmental behaviour, also named “ecological behaviour”, “environmentally friendly behaviour”, or “environmentally sustainable behaviour”, refers to a range of behaviours that benefit the environment, such as afforestation, recycling, energy conservation, pollution reduction and so on (Monroe, 2003; Steg et al., 2014). Kollmuss and Agyeman (2002) defined pro-environmental behaviour as the sort of behaviour that intentionally minimises the negative impact an action can have on the environment. Stern et al. (1999) stated that individuals perceive an obligation to pro-environmental behaviour when they believe their actions can help protect the environment. Although pro-environmental behaviour is often considered commendable, it is often unprofitable, unpleasant, time-consuming, or effort-consuming than harmful behaviour to the environment (Cao et al., 2022). Therefore, guiding people to put low-carbon actions into practice more effectively is crucial to long-term environmental sustainability.

There is a potential for Green FinTech to mitigate the challenges associated with pro-environmental behaviour. First, Green FinTech offers digital account solutions, allowing consumers to easily track and offset carbon emissions associated with their financial transactions using mobile phones. Secondly, Green FinTech enables consumers to reliably verify the certifications of purportedly green products before making purchases (Kouhizadeh et al., 2021). Furthermore, Green FinTech enables the creation of an electronic currency that can be used as a financial reward for any eco-behaviour (Vergara & Agudo, 2021). Finally, Green FinTech has the potential to motivate users towards eco-friendly behaviours by leveraging engaging gaming platforms that reward green actions with redeemable “points” or “coupons” (Wang & Yao, 2020). Thus, Green FinTech applications have the potential to stimulate and enable green behaviour by offering platforms that are transparent, convenient, entertaining, and accessible through mobile phones (Al nawayseh, 2020; Merello et al., 2022; Zavolokina et al., 2016).

Despite the significant potential of Green FinTech in environmental protection, Liu and others argued that these products remain relatively novel and have not yet seen significant adoption by both the private and public sectors (Liu et al., 2022). There has been a notable scarcity of empirical studies focusing on the adoption and diffusion aspects of Green FinTech.

Prior research on the adoption of Green FinTech has predominantly focused on specific sectors within the Green FinTech landscape. For instance, studies have explored the adoption of green robo-advisors (Au et al., 2021; Faradynawati & Söderberg, 2022), green crowdfunding (Bourcet & Bovari, 2020; Wasiuzzaman et al., 2021), peer-to-peer renewable energy trading (Pumphrey et al., 2020), Alipay's gaming platform Ant Forest (Ashfaq et al., 2021, 2023a; Mi et al., 2021; Wang et al., 2022; Yang et al., 2018; Zhang et al., 2020), and Green Banking (GB) Technology (Bouteraa et al., 2021, 2022; Iqbal et al., 2018, 2019, 2021; Malik & Singh, 2022). Most authors have highlighted that Green FinTech applications encounter specific challenges related to user trust and risk concerns (Aboalsamh et al., 2023; Bourcet & Bovari, 2020; Bouteraa et al., 2022; Iqbal et al., 2019, 2021; Malik & Singh, 2022; Pumphrey et al., 2020). For instance, individuals often struggle to ascertain where their information is stored and who might access it, raising concerns about data privacy and security. Furthermore, although a significant portion of the research has concentrated on examining how technological factors outlined in the Technology Acceptance Model (TAM) (Davis, 1989) affect the adoption of Green FinTech (Ashfaq et al., 2021, 2023a; Bouteraa et al., 2021, 2022; Iqbal et al., 2018, 2019, 2021; Malik & Singh, 2022; Yang et al., 2018), there has been limited investigation into the influence of psychological factors on adoption. The adoption behaviour of Green FinTech has been investigated as a novel form of pro-environmental behaviour (Ashfaq et al., 2021, 2023a; Mi et al., 2021; Wang et al., 2022; Zhang et al., 2020). The study by Li et al. (2019), which reviewed the literature on determinants of pro-environmental behaviour, revealed that psychological factors derived from the Theory of Planned Behavior (TPB) (Ajzen, 1985) have proven to be the most effective in predicting behaviour (Botetzagias et al., 2015; Graham-Rowe et al., 2014; Hage et al., 2009; Sidique et al., 2010). Therefore, exploring the impacts of psychological factors such as a person's attitude in addition to the technological factors is imperative for a thorough understanding of the technology diffusion process of Green FinTech to enhance its effective adoption among financial consumers.

The primary users of FinTech services are currently dominated by the younger generation, often referred to as Generation Z or Gen Z (Abu Daqar et al., 2020), who are highly attuned to the technological revolution (Seemiller & Grace, 2019). Indeed, Generation Z

individuals, aged between 10 and 25 and born between 1997 and 2012, are frequently the focus of recent research, with sampling concentrated on university campuses (Beal & Delpachitra, 2003; Chen & Volpe, 1998; Ergün, 2018; Philippas & Avdoulas, 2020). This demographic includes university students and young faculty members, representing the primary age groups of youth. Moreover, youth populations typically possess higher education levels beyond high school and demonstrate proficiency in modern communication technology, aligning well with the targeted sample (Lestari, 2019; Szabó et al., 2021; Szymkowiak et al., 2021; Wee & Goy, 2022). A notable body of literature is dedicated to exploring FinTech adoption within Generation Z (Abu Daqar et al., 2020; Akturan & Tezcan, 2012; Daragmeh et al., 2021; Philippas & Avdoulas, 2020; Sharif & Naghavi, 2021; Singh & Sharma, 2023; Solarz & Swacha-Lech, 2021). However, there is a gap in the research literature regarding the analysis of Green FinTech adoption, specifically among youth. This presents an opportunity for further investigation and research to understand how Generation Z adopts Green FinTech solutions.

The research presented in this thesis addresses gaps in the existing literature by introducing a conceptual framework that integrates the Technology Acceptance Model (TAM) and the Theory of Planned Behavior (TPB), supplemented by factors such as perceived risk and trust. Furthermore, it offers empirical insights into how these factors influence the adoption of Green FinTech among students at the University of Waterloo. Therefore, this research provides an excellent opportunity to broaden the contexts in which Green FinTech adoption has been studied.

1.1. Statement of Purpose

The present research aims to identify factors of students' adoption of Green FinTech, explore relationships among these variables, and examine whether the proposed model can offer a more comprehensive understanding of this adoption. This study consists of a quantitative analysis investigating the hypotheses of the research model, which is based on the combined TAM-TPB by Taylor and Todd (1995). A questionnaire was administered for this study using Qualtrics online software and distributed to University of Waterloo students.

In the research model, attitude, social influence, and perceived behavioural control influencing the intention to use Green FinTech are derived from the Theory of Planned Behaviour (TPB), while the constructs of perceived usefulness and perceived ease of use are drawn from the Technology Acceptance Model (TAM). Furthermore, the model incorporates the factors of perceived risk and perceived trust as additional determinants influencing the adoption of Green FinTech. The intention to use Green FinTech is the outcome variable, while attitude, social influence, and perceived behavioural control are predictor variables. An outcome variable is an outcome of the influence of predictor variables (Creswell & Creswell, 2018), while predictor variables influence those outcomes (Creswell & Creswell, 2018). The constructs of attitude and trust serve as mediating variables, which are positioned between predictor and outcome variables, effectively transmitting the effect of predictor variables on outcome variables (Creswell & Creswell, 2018). Specifically, the attitude towards Green FinTech use may mediate the relationships among perceived usefulness, perceived ease of use, perceived trust, and intention to use Green FinTech. Additionally, perceived trust mediates the relationship between perceived risk and intention to use Green FinTech. With the understanding that user demographic characteristics such as age, education, gender, and experience can influence FinTech adoption (Agyei et al., 2022; Ashfaq et al., 2020; Giovanis et al., 2012; Reith et al., 2020), these variables were controlled for in the current study to mitigate any systematic variance that could potentially impact the empirical results (Waheed & Zhang, 2020; Zafar et al., 2021; Zhang et al., 2020).

1.2. Research Questions

This thesis will pursue two main questions:

1) What factors influence students' behavioural intention to adopt Green FinTech?
2) Can the combined TAM-TPB model explain the intention to adopt Green FinTech?

1.3. Significance of the study

According to Aboalsamh et al. (2023), Green FinTech adoption is crucial for sustainable development, but its adoption is yet in the nascent stage. The successful adoption of FinTech heavily relies on users' acceptance of services, which is influenced by their favourable

perceptions of the technology's characteristics (Al-Okaily et al., 2021). However, the lack of trust and concerns about certain risks might negatively impact these perceptions. These issues suggest the importance of examining the impact of risk and trust concerns on the use of Green FinTech services.

Furthermore, FinTech development is driven by the adoption of the youth population (Solarz & Swacha-Lech, 2021). Previous research has not explicitly examined the intentions of young generations to use Green FinTech. Hence, this study aims to fill this gap by investigating the adoption of Green FinTech among students at the University of Waterloo.

Individual characteristics, including psychological factors from TPB, successfully impacted the intention to perform pro-environmental behaviour. While numerous studies have explored the adoption of Green FinTech as a novel aspect of environmentally conscious behaviour, few have integrated these factors into the investigation of Green FinTech adoption. Indeed, particularly in the age of social media, which is widely embraced by Generation Z (Schnackenberg & Johnson, 2019), individuals' decisions to adopt technology are primarily influenced by cognitive pressure from society (Abrahão et al., 2016; Ameen et al., 2020; Grover & Kar, 2020). Hence, a gap exists for a comprehensive model that integrates these factors into the research on Green FinTech adoption.

Specifically, the research makes the following four significant contributions to scholarly knowledge about the adoption of Green FinTech services:

1. Prior studies have mostly concentrated on exploring the adoption of FinTech by youth, with few studies investigating adoption in the context of a novel form of FinTech - Green FinTech. This study addresses this lack.
2. Several studies have emphasised the importance of studying technological factors and their role in influencing users' intention to use Green FinTech (Ashfaq et al., 2021, 2023a; Bouteraa et al., 2021, 2022; Iqbal et al., 2018, 2019, 2021; Malik & Singh, 2022; Yang et al., 2018). Still, few studies have explored the impacts of psychological factors (Ashfaq et al., 2021; Bourcet & Bovari, 2020; Mi et al., 2021; Pumphrey et al., 2020; Wang et al., 2022; Zhang et al., 2020). This study has

established the roles of social norms, attitudes, and perceived behavioural control from TPB in the adoption process of Green FinTech.

3. Previous studies have employed the Combined TAM-TPB model to examine FinTech adoption (Lee, 2009; Obaid & Aldammagh, 2021; Safeena et al., 2013), but none have utilised the model to elucidate adoption within the context of Green FinTech. This study addresses this gap.
4. This research provides empirical insights into the effects of technological, psychological, risk, and trust factors on the intention to adopt Green FinTech.

1.4. Research Approach

This study tested a combined TAM and TPB model to answer the research questions. A survey data collection approach with convenience and cluster sampling methods was chosen. The research is based on data collection through a questionnaire. The data collection process spanned approximately three months during the fall semester of 2023. The sampling frame for the study was students from the University of Waterloo. In total, 785 questionnaires were collected.

The construct measurement for the quantitative part of the study was developed based on previous studies, with minor adjustments in wording to align with the context of Green FinTech. Partial least squares Structural Equation Modelling (PLS-SEM) was used to test the model. The study followed a structured methodology: first, administering a questionnaire to collect data; second, assessing the measurement scales for convergent and discriminant validity; and finally, employing a structural equation model to test the proposed hypotheses and explore the determinants of Green FinTech adoption intentions.

1.5. The Thesis Outline

This thesis is organised into five chapters. This chapter delivers background information on the research problem, followed by the purpose of the research. It also presents the research approach and explains the thesis structure.

Chapter 2 reviews the literature on FinTech, Social FinTech, and Green FinTech adoptions. It describes theories adopted by scholars on FinTech adoption and explores the factors that influenced individuals' decisions to use FinTech, Social FinTech, and Green FinTech. Based on the literature and research gap, this chapter offers a research model and hypotheses at the end.

Chapter 3 summarises the research methodology used in the study, including an extensive overview of the selected approach and the underlying reasons. The chapter goes into detail on the data collection methods, participant selection criteria, and questionnaire development. Furthermore, it provides an overview of the data analysis approaches applied in this research.

Chapter 4 describes the findings of quantitative data collection and analysis, including the tests of measurement and structural models. The chapter concludes by analysing the results of hypothesis testing.

Chapter 5 discusses the research results and their implications, as well as how they contribute to existing literature. The chapter also sheds light on the limitations of the study and provides valuable insights that can be useful for Green FinTech developers. It ends by summarising the main takeaways from the research and providing a concise conclusion.

Chapter 2. Literature Review

This thesis aims to investigate the influence of technological and psychological factors, as well as risk and trust, on the adoption of Green FinTech. This chapter reviews the existing literature on factors influencing the adoption of FinTech and Social FinTech. It also discusses factors that influence the intention to use Green FinTech. The main findings and views are presented to provide the required theoretical background for this study.

The chapter is divided into five main sections. After this introductory section, Section 2.1 provides background on issues relating to risks and trust that might influence FinTech adoption. Section 2.2 discusses behavioural models of FinTech usage and identifies the key factors affecting it. Section 2.3 reviews the literature relating to the primary factors impacting the usage of Social FinTech. Section 2.4 discusses the significant factors influencing the use of Green FinTech. Section 2.5 describes the conceptual framework of this thesis.

2.1. FinTech adoption background

The use of FinTech as a medium for providing various financial services has significantly expanded. FinTech startups and technology developers offer financial services to multiple entities, including the government, financial customers, and traditional finance institutions (Lee & Shin, 2018). However, financial customers perceive several risk and trust concerns concerning FinTech, which deter its adoption. Focusing on the technology side of implementing FinTech will not make its usage successful; users' intentions to use FinTech and the factors influencing intentions are critical factors in achieving FinTech growth and development (Al-Okaily et al., 2021).

2.1.1. Perceived Risk

When individuals confront decisions, they assess risk, a tendency that heightens, especially in novel or unfamiliar circumstances (Weegels & Kanis, 2000). Consequently, perceived risk is a pivotal factor in evaluating systems, technologies, and financial choices. Peter and Ryan (1976) characterise perceived risk as subjectively anticipated loss, while Featherman and Pavlou (2003) describe it as the potential loss encountered in pursuit of a desired outcome. Within the realm

of FinTech, perceived risk encapsulates concerns regarding the possible adverse consequences of using FinTech services.

Lee (2009) categorised five distinct types of risks associated with using FinTech: performance risk, individual risk, financial risk, time risk, and cyber risk.

Performance risk encompasses the threat of virus attacks, worms, and other malware that can lead to malfunctions, data corruption, or software failures, ultimately impeding users' desired performance of FinTech services. Consequently, users frequently harbour apprehensions regarding potential system server failures or internet interruptions while using FinTech services, which could incur unforeseen costs.

Individual risk pertains to risks stemming from human errors, such as the user's careless handling of data and inaccurate submissions (Iqbal et al., 2021).

Another risk type identified in the literature is *financial risk*, which involves the potential for financial loss due to fraud or monetary expenditure associated with using a technology (Lee, 2009).

Another type of risk inherent in FinTech is *time risk.* Time risk entails the loss of time and inconvenience resulting from difficulties in navigation due to disruptions in internet connections, mobile networks, or electricity lines, website downtime, or loss of server connections (Lee, 2009). Previous studies, such as those by Martins et al. (2014) and Mha (2015), have suggested that time risks may negatively impact the adoption intention of a technology.

The final dimension of risk considered in this study is *cyber risk*, also known as security risk. Cyber risk entails individuals' reluctance to embrace FinTech services due to the potential threat of cybercrimes, such as hacking, identity theft, or password theft (Lee, 2009). Macchiavello and Siri (2020) noted that FinTech introduces significant operational risks, including cyber, legal, and outsourcing risks. Findings from the study by Yang et al. (2015) highlight users' concerns about the theft of their private information while using mobile payment platforms.

Despite FinTech's considerable benefits, such as increased control over clients' finances, faster financial decision-making, and the capacity to send and receive payments in seconds, there remains a trade-off between efficiency and data security. This trade-off arises from collecting and storing vast amounts of personal data (Hommel & Bican, 2020; Ignatyuk et al., 2020; Ozili, 2018; Singh, 2022), highlighting the importance of implementing robust data protection measures to enhance trust in FinTech applications (Hinson et al., 2019).

2.1.2. Perceived Trust

FinTech adoption is closely linked to a high level of trust, which is a multifaceted concept reflecting one party's willingness to be vulnerable to the actions of another based on the expectation that the latter will perform specific actions (Mayer et al., 1995). Trust assumes paramount importance within relationships in situations of risk or uncertainty (Mayer et al., 1995). For instance, trust in a mobile-based payment system hinges on factors such as user control, reliability, security, and the reputation of the entity overseeing the system (Duane et al., 2014). Given the escalating threat of cybercrimes and the potential for remote hacking of customers' phones (Malaquias & Hwang, 2016), trust emerges as a critical factor in financial transactions involving inherent risks (Malaquias & Hwang, 2016; McKnight et al., 2002).

Drawing from McKnight and Chervany's (2001) trust framework, there are two dimensions of trust: structural assurance (SA) and trust belief (TB).

Perceptions of trust regarding mobile money service providers are associated with *structural assurance* (Zhou, 2014a), which mitigates perceived risks among mobile money service users.

Trust belief is grounded in the perception of mobile money service providers' trustworthiness, encompassing beliefs concerning ability, integrity, and benevolence (Gefen et al., 2003; Park et al., 2012). *Ability* denotes the capability of mobile money service providers to fulfil their responsibilities through requisite experience and expertise (McKnight et al., 2002, p. 337). *Integrity* signifies adherence to commitments and promises by mobile money service providers (McKnight et al., 2002, p. 337). *Benevolence* reflects the concern of mobile money service providers for users' interests beyond their own expected benefits (McKnight et al., 2002, p. 337). Trust assumes critical importance as it assuages users' apprehensions and concerns

regarding FinTech services (Lu et al., 2011; Malaquias & Hwang, 2016), potentially influencing adoption.

2.1.3. Behavioural models relevant to FinTech use

Numerous prior studies have found theoretical correlations between the adoption of FinTech and various theoretical frameworks. These frameworks include the Technology Acceptance Model (TAM) (Davis, 1989), the Innovation Diffusion Theory (IDT) (Rogers, 1995), the Theory of Planned Behaviour (TPB) (Ajzen, 1985), the Unified Theory of Acceptance and Use of Technology (UTAUT1) (Venkatesh et al., 2003), the UTAUT2 (Venkatesh et al., 2012), the UTAUT3 (Venkatesh et al., 2016). From these theories, TAM and UTAUT are the most-used theoretical backgrounds (Firmansyah et al., 2022; Saputra et al., 2023).

The Theory of Planned Behaviour (TPB), stemming from the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975), has proven effective in predicting and understanding user adoption of various information systems (Ajzen, 1991). According to TPB, a user's *behavioural intention* to utilise technology directly influences *their actual behaviour*, with intention being positively influenced by attitude, subjective norms, and perceived behavioural control. *Attitude* refers to the degree to which an individual views the performance of a specific behaviour as favourable or unfavourable (Eagly & Chaiken, 1993; Graham-Rowe et al., 2015). *Subjective norms* represent the perceived societal pressure to engage in or refrain from a behaviour (Ajzen et al., 2007). *Perceived behavioural control* pertains to an individual's perception of their capability to perform a behaviour (Ajzen, 1991). For instance, Alshater et al. (2022) reveal that attitude and perceived behavioural control are two crucial factors determining the adoption of digital currency.

Davis (1989) devised the Technology Acceptance Model (TAM) to comprehend the factors influencing employees' acceptance and utilisation of new technologies introduced in the workplace. In the model, *the intention to use* an information system directs its *actual usage*. *The perceived ease of use (PEOU) and perceived usefulness (PU)* elucidate a user's intention to utilise the system. PU and PEOU are described as "the extent to which an individual believes that using a specific system would enhance their performance" and "the extent to which an

individual believes that using a specific system would be effortless," respectively (Davis, 1989, p. 320). Research on FinTech adoption extensively leveraged the TAM (Albayati et al., 2020; Arias-Oliva et al., 2019; Chowdhury & Hussain, 2022; Duane et al., 2014; Elhajjar & Ouaida, 2019; Gbongli et al., 2019; Hasan et al., 2021; Hu et al., 2019; Jaradat & Mashaqba, 2014; Liébana-Cabanillas et al., 2014; Shaikh et al., 2020; Singh et al., 2020, 2021; Upadhyay & Jahanyan, 2016). It was found that FinTech adoption is influenced significantly by perceived ease of use, as users perceive it as user-friendly and easy to operate (Albayati et al., 2020; Duane et al., 2014; Gbongli et al., 2019; Jaradat & Mashaqba, 2014; Upadhyay & Jahanyan, 2016). Similarly, research underscores the pivotal role of perceived usefulness in FinTech adoption, as it pertains to the convenience it offers users to access their finances online and conduct transactions without the need to visit a physical bank branch (Albayati et al., 2020; Duane et al., 2014; Jaradat & Mashaqba, 2014; Liébana-Cabanillas et al., 2018; Shaikh et al., 2020; Singh et al., 2020; Upadhyay & Jahanyan, 2016).

Expanding upon the TAM, Venkatesh et al. (2003) developed the Unified Theory of Acceptance and Use of Technology (UTAUT) as a thorough synthesis of previous technology acceptance research. UTAUT comprises four key constructs—*performance expectancy, effort expectancy, social influence, and facilitating conditions*—that influence the *behavioural intention* to use technology*. Performance expectancy* refers to the extent to which using technology will benefit consumers in performing certain activities, while *effort expectancy* denotes the ease associated with consumers' use of technology. *Social influence* gauges consumers' perception regarding the importance others (e.g., family and friends) place on using a particular technology, and *facilitating conditions* refer to consumers' perceptions of the resources and assistance available to conduct a behaviour. According to UTAUT, performance expectancy, effort expectancy, and social influence the behavioural intention to use technology, whereas behavioural intention and facilitating conditions determine its use.

Later, Venkatesh et al. (2012) expanded UTAUT by including additional constructs of *hedonic motivation, price value,* and *habit* to predict behavioural intention and use behaviour. *Hedonic motivation* refers to the fun or pleasure obtained from applying technology. It has been demonstrated to have a crucial impact in deciding technological acceptance and use

(Brown & Venkatesh, 2005). *Price value* represents consumers' cognitive trade-off between the perceived benefits of applications and the monetary cost of using them, with a positive impact on intention when the benefits outweigh the costs (Dodds et al., 1991). *Habit* is the degree to which people tend to perform behaviours automatically due to learning (Limayem et al., 2007). Although conceptualised similarly, it is operationalised in two distinct ways: as a prior behaviour (Kim & Malhotra, 2005) or the perception of behaviour as automatic (Limayem et al., 2007).

In 2016, the UTAUT3 framework was introduced as an extension to the UTAUT2 model by incorporating an additional independent variable, *personal innovativeness* in Information Technology (IT). Farooq et al. (2017) identified it as a consistent personality attribute that motivates people to try out new technology breakthroughs. Several researchers, including Fakhoury and Aubert (2017), Oliveira et al. (2016), Farah et al. (2018), Awa et al. (2017), Koenig-Lewis et al. (2015) and Liébana-Cabanillas et al. (2014) relied on UTAUT for their research; for instance, Fakhoury and Aubert (2017) and Farah et al. (2018) found that all factors from UTAUT2 contribute to digital services adoption. Similarly, Chan et al. (2022), in their investigation of open banking adoption in Australia, found that performance expectancy, effort expectancy, and social influence positively influence the adoption of open banking.

Rogers (1995) introduced the Innovation Diffusion Theory (IDT) to enhance comprehension of the dissemination and uptake of innovative technologies. In IDT, diffusion is defined as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 1995, p. 10), while innovation is described as "an idea, practice, or object perceived as new by the individual" (Rogers, 1995, p. 11). According to IDT, innovations possess five significant characteristics: *relative advantage, compatibility, complexity, trialability, and observability*. These features are used to help understand user adoption and decision-making processes. The construct of *relative advantage* aligns closely with perceived usefulness, while *complexity* corresponds to perceived ease of use (Moore & Benbasat, 1991). *Compatibility* refers to "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" (Rogers, 1995, p. 224). *Trialability* represents "the degree to which an innovation

may be experimented with on a limited basis" (Rogers, 1995, p. 243), while *observability* denotes "the degree to which the results of an innovation are visible to others" (Rogers, 1995, p. 244). Some innovations yield easily observable and communicable results, whereas others do not.

In recent years, various studies have employed DOI. For instance, Gounaris and Koritos (2008) integrated TAM, DOI, and perceived characteristics of innovation (PCI) to forecast the adoption of virtual banking products. A decade later, Elhajjar and Ouaida (2019) utilised the compatibility factor from DOI to explore mobile banking adoption, though they found no significant impact of the variable on adoption. Table 1 below summarises the theories described, including references.

Table 1

Classifications of Previous Theory Usage

Theory	Factors that lead to adoption	Description	Reference
Technology acceptance model (TAM)	Perceived usefulness; perceived ease of use; attitude	Adoption decisions depend on the ease of the product and its influence on the person's performance.	(Davis, 1989)
Unified theory of acceptance and use of technology (UTAUT)	Performance expectancy; effort expectancy; social influence; and facilitating conditions	Adoption decisions are influenced by both personal factors and external factors.	(Venkatesh et al., 2003)
Unified theory of acceptance and use of technology (UTAUT2)	Performance expectancy; effort expectancy; social influence; and facilitating conditions; hedonic motivation; price value; habit	Adoption decisions are influenced by the factors of UTAUT + hedonic motivation, price value, habit.	(Venkatesh et al., 2012)
Unified theory of acceptance and use of technology (UTAUT3)	Performance expectancy; effort expectancy; social influence; and facilitating conditions; hedonic motivation; price value; habit; personal innovativeness	Adoption decisions are influenced by the factors of UTAUT2 + personal innovativeness.	(Venkatesh et al., 2016)
Diffusion of innovation (DOI)	Relative advantage; compatibility; complexity; trialability; and observability	Resemblance refers to the speed at which innovation spreads, a process influenced by both the innovation itself and environmental factors, such as communication channels and social support systems.	(Rogers, 1995)
Theory of Planned Behaviour (TPB)	Attitude; subjective norms; perceived behavioural control; intention	Adoption decisions depend on how individuals perceive the value of a product, social pressures, and their ability to control the behaviour. Intentions are assumed to capture the motivational factors that influence behaviour; they are indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behaviour.	(Ajzen, 1985)

Note. From the author's elaboration.

2.1.4. Key factors influencing FinTech usage

The factors influencing FinTech adoption were categorised into two groups: internal factors and external factors. Internal factors encompass perceptions of technology characteristics and individual traits, while external factors include governmental support and socio-cultural aspects.

2.1.4.1. Internal Factors

Consumer internal perceptions of *technology characteristics*, particularly ease of use and usefulness, significantly influence adoption decisions in FinTech. Perceived benefits, convenience, accessibility, security, privacy, and trust are also crucial in shaping consumers' intentions to use financial technology services.

Perceived ease of use, an essential innovation attribute, significantly influences individual responses to technology. Higher perceived ease of use correlates with increased intention to use (Changchit et al., 2017). Conversely, perceived usefulness reflects consumers' cognitive beliefs, which can shape their intention to use a product or service (Shiau et al.,2020). Thus, when consumers perceive a FinTech innovation as beneficial and user-friendly, they are more inclined to adopt it. Furthermore, studies have examined the impact of perceived benefits of FinTech on technology adoption. One significant benefit of FinTech is its potential to enhance the convenience and accessibility of financial services for users, particularly those in remote areas or facing challenges accessing traditional financial services. For instance, research has demonstrated that perceived benefits significantly influence the intention to use FinTech applications (Al nawayseh, 2020).

Other critical characteristics of technology products include security and privacy (Changchit et al., 2017). Perceived risk, defined as the potential loss or negative consequences consumers may encounter when using financial technology, can negatively influence the intention to use FinTech services (Abdul-Rahim et al., 2022; Ali et al., 2021; Chan et al., 2022; Ryu, 2018). Furthermore, the perception of trust has been identified as a crucial element in FinTech adoption due to the virtual nature of customer interactions with FinTech platforms,

necessitating a high level of trust (Ali et al., 2021; Chan et al., 2022; Hasan et al., 2021; Jünger & Mietzner, 2020; Nangin et al., 2020; Stewart & Jürjens, 2018).

Previous research has explored various characteristics of adopters at both *individual and organisational levels*. Facilitating conditions, encompassing technology competency, experience, and beliefs, are crucial factors influencing FinTech adoption (Changchit et al., 2017; Eze et al., 2013). Additionally, motivation, habit, and value are significant drivers of adoption (Fakhoury & Aubert, 2017; Farah et al., 2018). Personal innovativeness, referring to an individual's inclination to try out new information systems, has impacted the adoption of mobile payment services (Hu et al., 2019; Kim et al., 2010; Madan & Yadav, 2016; Thakur & Srivastava, 2014; Yang et al., 2012).

Various characteristics can lead to different adoption decisions; for instance, one's emotional reactions, such as attitude and affective states, play a crucial role in decision-making (Karimi & Liu, 2020). Studies by Agyei et al. (2022), Sharif and Naghavi (2021), Al-Okaily et al. (2021) have demonstrated that perceived enjoyment significantly affects the behavioural intention to adopt FinTech services.

Demographic factors such as gender, knowledge, and experience influence individuals' intentions to adopt FinTech (Agyei et al., 2022; Balakrishnan & Shuib, 2021; Biucky et al., 2017; Çera et al., 2021; Giovanis et al., 2012; Haider et al., 2018; Khan et al., 2017; Lee et al., 2019; Majumdar & Pujari, 2022; Philippas & Avdoulas, 2020; Reith et al., 2020; Sharif & Naghavi, 2021; Wamba et al., 2021; Yen & Wu, 2016). For instance, research by Giovanis et al. (2012) on the adoption of internet banking services in Greece revealed that younger, predominantly male customers with substantial prior IT experience, who perceive compatibility with the new service, represent a more promising target demographic for internet banking. Furthermore, another crucial aspect impacting technology usage and acceptance is the availability of information to customers about mobile banking. Majumdar and Pujari (2022) highlighted knowledge as the primary factor influencing the acceptance and usage levels of mobile banking apps in the UAE.

2.2.4.2. External Factors

External influences outside of an individual can affect its decision-making processes. In particular, external factors, including *government support and sociocultural aspects*, significantly influence the adoption of FinTech solutions.

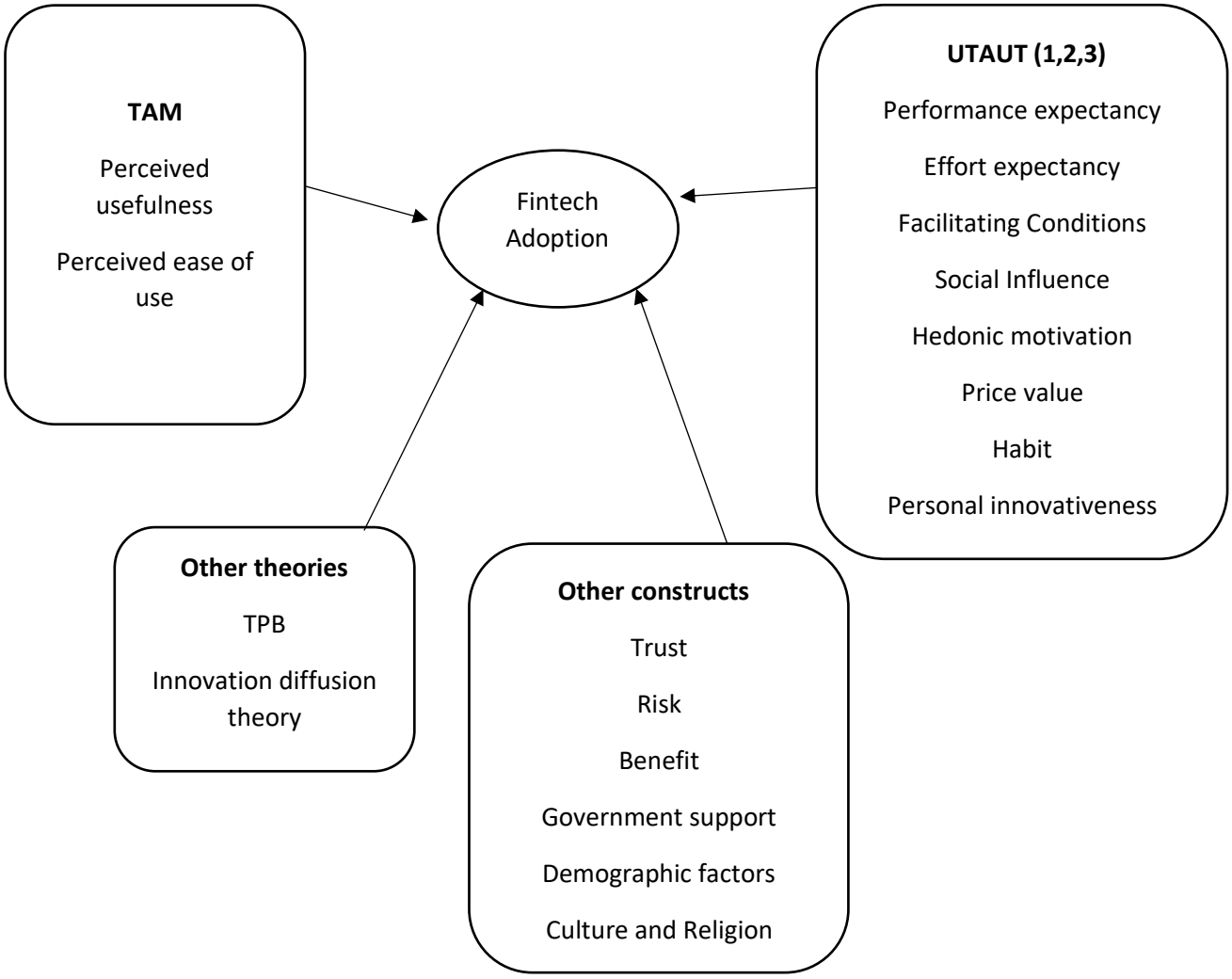
Government backing is significant in driving FinTech adoption among consumers and organisations (Chong et al., 2010). Leveraging its credibility, the government can enhance the trustworthiness of products or services by bolstering the publicity of technological applications and investing in infrastructure such as communication network development. This, in turn, renders FinTech services more appealing to potential consumers. The studies by Marakarkandy et al. (2017) and Madan and Yadav (2016) underscore the importance of government support in fostering trust towards online banking products and predicting behavioural intentions to embrace mobile wallet solutions.

Furthermore, cultural, religious, and social factors also shape consumers' adoption decisions (Chan et al., 2022; Singh et al., 2020). For instance, Ma et al. (2014) discovered that consumers in cultures valuing independence exhibit a greater inclination to adopt radically new products. Similarly, Jamshidi and Hussin (2016) introduced a novel construct termed perceived religiosity (PR) and found a positive and significant correlation between PR and the intention to use Islamic credit cards. They posited that individuals with a stronger adherence to religious obligations are more likely to opt for Islamic credit cards.

Figure 1 below shows the summary of factors that have been found to impact FinTech adoption.

Figure 1

The determinants of FinTech adoption in literature



Note. From the author's elaboration.

2.2. Factors impacting Social FinTech usage

Ayala (2021) introduces the "Social FinTech" concept to describe FinTech enterprises that conduct financial activities for profit while promoting societal progress by addressing poverty and enhancing prosperity. Similarly, Davdra (2017) recognises the transformative capacity of FinTech firms and suggests the term "Socially Responsible FinTech" to denote companies engaged in ethical initiatives with a profound commitment to the welfare of their customers and communities.

Specifically, mobile money (m-money) services have been extensively utilised in impoverished nations to elevate citizens' financial standing and combat poverty (Didenko, 2018). M-money services, a type of FinTech, enable individuals with mobile phones to establish mobile money accounts with mobile network operators and deposit cash in exchange for electronic money (Aker et al., 2016). Many individuals in developing countries migrate from their hometowns in pursuit of livelihoods. Consequently, they often need to remit money to their families regularly. However, visiting bank branches for money transfers can be time-consuming and incur additional costs, with financial transactions becoming costly due to associated fees. In such scenarios, m-money emerges as a convenient and cost-effective medium, making financial services more accessible and affordable for them (Aker & Mbiti, 2010; Must & Ludewig, 2010).

The literature underscores the immense utility of m-money for impoverished populations, owing to reduced transaction costs, expedited processes, and enhanced security of funds (Donovan, 2012). For instance, Kikulwe et al. (2014) demonstrated that mobile money usage positively impacts household income by facilitating remittances from relatives and friends. Similarly, Museba et al. (2021) observed that mobile money services have a positive effect on the low-income segment in Uganda, enhancing access to affordable financial services, with person-to-person and grocery payments being notable daily transactions facilitated by agent networks within communities. Moreover, Aker et al. (2016) revealed that a mobile money cash transfer initiative in Niger has enhanced household diet diversity and intra-household bargaining power for women by addressing logistical challenges in cash transfers, including

time savings associated with mobile transfers. Additionally, Suri et al. (2021) investigated the adoption of M-Shwari, one of the world's most popular digital loan services, in Kenya. Their study found that 34% of eligible households utilised the loan, leading to improved financial access and resilience.

FinTech presents novel avenues for including financially marginalised entities within the financial system, including smallholders and small to medium-sized enterprises (SMEs), by furnishing them with a broader spectrum of financial services and products, thereby transforming them into asset generators (Gabor & Brooks, 2017). Several studies have delved into the impact of FinTech on mitigating the financial constraints SMEs face, such as lack of collateral and inadequate availability of detailed financial information (Beck & Demirguc-Kunt, 2006). Abbasi et al. (2021) uncovered a positive correlation between peer-to-peer (P2P) lending FinTech platforms and SMEs' access to leverage. The utilisation of FinTech enables the accurate assessment of the credit risk associated with SMEs, thereby enabling them to qualify for loans. This finding is corroborated by Sheng (2021) and Agyekum et al. (2022), who highlighted a heightened availability of funds to SMEs if banks incorporate FinTech into their operations.

The studies conducted by Hinson et al. (2019) and Chueca Vergara and Ferruz Agudo (2021) underscore the transformative potential of Social FinTech in reshaping agricultural business processes toward sustainability. Specifically, FinTech offers farmers diversified avenues for accessing funding and conducting transactions, including crowdfunding platforms and digital payment systems. Moreover, it provides a digital marketplace that connects various stakeholders—such as farmers, landowners, investors, and consumers—into a transparent, empowering, and resourceful platform (Anshari et al., 2019; Rana et al., 2021). By reducing the reliance on intermediaries, FinTech enables smallholder farmers to directly engage with buyers and end-users, thereby mitigating the risk of corruption (Kos & Kloppenburg, 2019). Furthermore, the disruptions caused by the COVID-19 pandemic in agricultural commodity supply chains have exacerbated challenges for smallholder farmers (Quayson et al.,2020). Quayson et al. (2020) explored the potential of digital payments and blockchain technology in bolstering the financial resilience of smallholder cocoa farmers post-pandemic. They discussed that these technologies could facilitate access to financing and enable the digital

documentation of payments, thereby enhancing transaction traceability and mitigating physical risks such as theft, fraud, and robbery attacks.

2.2.1. Social FinTech Adoption

In contemporary research on FinTech adoption, various studies have investigated the factors contributing to financial inclusion through FinTech innovations (Al nawayseh, 2020; Baganzi & Lau, 2017; Chauhan, 2015; Della Peruta, 2018; Murendo et al., 2018; Najib et al., 2021; Narteh et al., 2017; Osei-Assibey, 2015; Rahman et al., 2017; Senyo & Osabutey, 2020).

The research conducted by Jaradat & Mashaqba (2014) centred on the adoption of FinTech within Jordan. Their findings revealed that the behavioural intentions of Jordanian citizens were influenced by perceived usefulness, perceived ease of use, and subjective norms. Similarly, Al nawayseh (2020) investigated the adoption of FinTech applications in Jordan to enhance financial resilience during the COVID-19 pandemic. The study also indicated that perceptions of benefits and social influence influenced the intention to use FinTech.

Moreover, various other studies have identified the influence of technological and social factors on the behavioural intention to use mobile money services (Chauhan, 2015; Murendo et al., 2018; Narteh et al., 2017; Senyo & Osabutey, 2020; Tobbin et al., 2011; Upadhyay & Jahanyan, 2016). For instance, Najib et al. (2021) analysed the factors affecting FinTech adoption among small food business owners and revealed that performance expectations, social influence, and facilitation conditions significantly influenced the intention to adopt the technology.

Furthermore, the impact of perceived risk and perceived trust constructs has yielded conflicting findings across studies. Unlike Al nawayseh (2020), Narteh et al., (2017), Senyo and Osabutey (2020), who reported no significant influence of perceived risk on behavioural intention, Baganzi and Lau (2017), Osei-Assibey (2015), Tobbin et al. (2011) revealed a notable adverse effect of this variable on the intention to use mobile money services. Similarly, Al nawayseh (2020), Chauhan (2015), Narteh et al. (2017), Tobbin et al. (2011), Upadhyay and Jahanyan (2016) highlighted a significant positive effect of perceived trust on the intention to use mobile money services, while Baganzi and Lau (2017) did not observe a significant relationship between trust beliefs and behavioural intentions.

2.3. Factors impacting Green FinTech usage

As mentioned, FinTech holds significant potential in green finance and fostering pro-environmental behaviour. The following sections will discuss various Green FinTech types that target either domain.

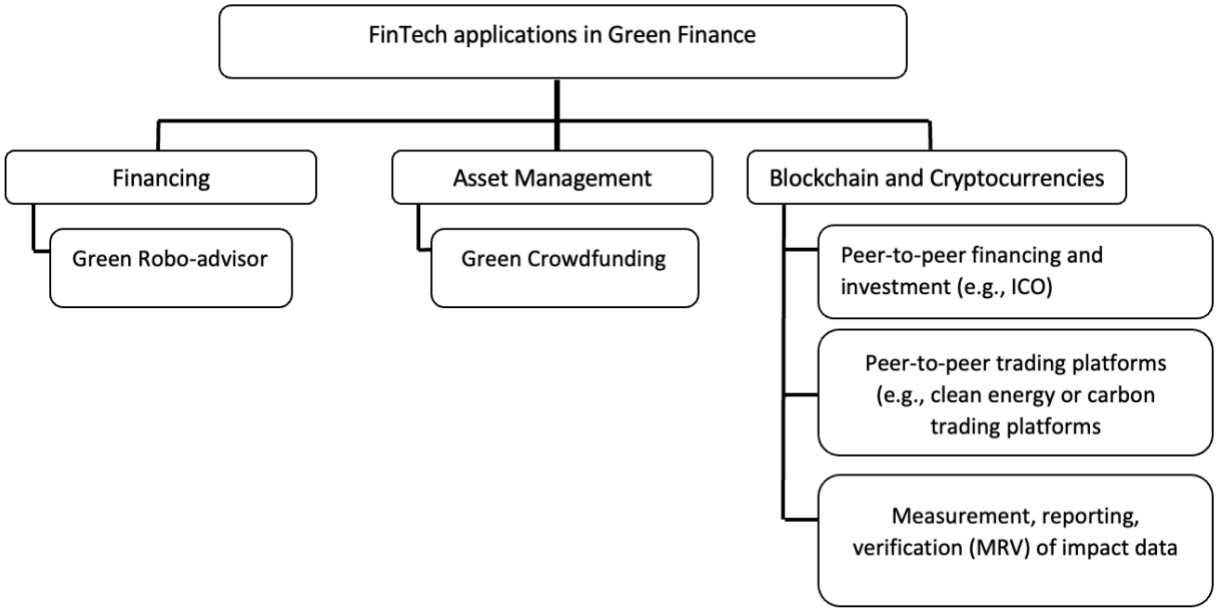
2.3.1. FinTech and Green Finance

The European Banking Institute (EBI) paper by Macchiavello and Siri (2020) initiates a discourse on "Green FinTech," aiming to bridge the realms of FinTech and green finance and stimulate research in this emerging and promising domain. It explores the potential of Green FinTech to bolster green finance (Moro-Visconti et al., 2020) by offering inventive solutions to address environmental and climate change challenges (Ranchber, 2018). Additionally, it delves into how Green FinTech can innovate in tracking climate finance, assessing climate impact, and facilitating climate adaptation efforts (Thomason et al., 2018).

In Figure 2, Migliorelli and Dessertine (2019) classified FinTech in Green Finance into Financing (Green Robo-advisor), Asset Management (Green Crowdfunding) and Green Blockchain and Cryptocurrencies (Peer-to-Peer financing and investment, Peer-to-Peer trading, and Measurement, Reporting, and Verification (MRV) of impact data).

Figure 2

FinTech and Blockchain Applications in Green Finance



Note. From "The Rise of Green Finance in Europe: Opportunities and Challenges for Issuers, Investors and Marketplaces," by Migliorelli, M., & Dessertine, P, 2019, p.210 (https://doi.org/10.1007/978-3-030-22510-0). Copyright 2019 by Springer International Publishing.

Robo-advisors offer low-cost, optimal computer-automated investment advice and portfolio management services with lower minimum investment requirements than traditional portfolio managers, allowing younger individuals to invest (Citi, 2016; Fisch et al., 2018; Kaya, 2017). The platforms identified as *green robo-advisors* are exclusively concentrated on sustainable investing or offer the option to select sustainable investing (Migliorelli & Dessertine, 2019). Sustainable investing is described as "an investment approach that considers environmental, social and governance (ESG) factors in portfolio selection and management" (GSIA, 2016, p. 6).

The subsequent form of Green FinTech is crowdfunding. Crowdfunding platforms permit small businesses to raise capital from a large pool of donors at lower fixed and transaction costs (Belleflamme et al., 2014; Lam & Law, 2016). *Green crowdfunding* streamlines the process for green ventures to secure financial assistance and gain access to a broader investor base,

including private investors. Acquiring financial resources for small green projects is challenging because they commonly cannot access traditional funding channels (e.g. banks and institutional investors) due to their relatively lower profitability potential and perceived higher risk compared to larger, more conventional ventures (Lam & Law, 2016; Plunkett et al., 2016).

Green FinTech has expanded to encompass blockchain services. Blockchain is a distributed ledger that records and retains transactions over a peer-to-peer network in an eternal, immutable, and transparent manner (Citi, 2016; PWC, 2018). *Green Blockchain* is classified into Peer-to-Peer financing and investment, Peer-to-Peer trading platforms, and Measurement, Reporting and Verification (MRV) of impact data.

> *Peer-to-peer financing and investment* deliver advanced methods to fund and invest in green projects, like blockchain-enabled crowdsourcing via token sales. Each token is a cryptographically protected digital asset (Howell et al., 2018) with a certain right to utilise or access future goods and services (Li & Mann, 2018). Investors can purchase the project's tokens during the token sale in exchange for cryptocurrency or fiat currency (Diemers et al., 2018). This also includes green enterprises that can generate and sell tokens on green goods and services. For instance, WePower, a platform for trading green energy, secured funding via token sales (WePower, 2018).
>
> *Peer-to-peer trade and exchange platforms*, such as those for clean energy and carbon credits, offer alternative ways to financially support eco-friendly enterprises. Blockchain enables the tokenisation of goods, such as carbon emissions, which can be traded for other cryptocurrencies and conventional money (Blakstad & Allen, 2018). For example, The Poseidon and Climatecoin platforms produce internal tokens that correspond to the carbon credits acquired from specific emission-reduction programmes. Consumers can then purchase the tokens to cut their carbon footprint (Climatecoin, 2018; Poseidon, 2018). SunContract platform allows peer-to-peer renewable energy trading through tokens. Each token implies a specific amount of solar energy and grants the token holder the right to own it after the trade (SunContract, 2017).

Finally, blockchain can improve the *MRV process* by generating transparent, credible, and validated impact data for green projects (Fuessler et al., 2018). For the expansion of green finance, transparency plays a focal role, predominantly through comprehensive reporting by green initiatives regarding their capital utilisation and the environmental impacts of their projects. Gathering and verifying impact data, which includes calculating the CO2 emissions reduction realised by a funded project, is essential to evaluate its environmental impact. The MRV principle focuses on providing transparency in the effects of climate interventions. Nonetheless, Fuessler et al. (2018) noted five challenges: lack of trust in data, difficult and costly data collection, impact quantification and reporting, quality assurance and control, and expensive emission reduction verification. Blockchain technology can overcome MRV challenges, improve the process and produce trustworthy, transparent, and verified impact data (Fuessler et al., 2018). Blockchain transactions and data can be traced back to their origin and validated by the network, making impact data collecting more efficient and cost-effective (Fuessler et al. 2018). Automation and smart contracts can strengthen impact reporting and quality assurance (Fuessler et al., 2018), reducing the potential for errors and manipulation. Furthermore, blockchain provides secure and immutable data storage (Meunier, 2018). Blockchain, in conjunction with Artificial Intelligence (AI), can boost the efficiency of emission reduction verification (Fuessler et al. 2018) and avoid double-counting (Sanderson, 2018).

Phillips and Johnson (2021) contend that information costs, such as the time spent searching, learning, and grasping initial information about investment products (Aristei and Gallo, 2021), alongside transaction costs, encompassing brokerage fees, account setup expenses, and fees associated with trading volume (e.g. Guiso et al., 2008; Haliassos & Bertaut, 1995; Vissing-Jorgensen, 2003), present notable hurdles for prospective green investors. However, green robo-advisors and blockchain technology can alleviate these obstacles by providing cost-effective, streamlined (automated) investment guidance and reliable, transparent, and validated impact data for green funds. Ultimately, Green FinTech platforms

enable individual investors to invest in green initiatives in a quicker, more affordable, and transparent manner.

2.3.2. FinTech and Pro-environmental Behaviour

Wang and Yao (2020) highlighted the dual roles of information technology-based mobile platforms as both "enablers" and "accelerators" of pro-environmental behaviour. Innovative green lifestyle practices like mobile payments, shared bicycles, and electronic receipts rely on information technology as their "enabler," facilitating their implementation. Moreover, information technology can act as an "accelerator" in fostering pro-environmental behaviour. For example, certain FinTech platforms have the potential to shape consumer behaviour towards reducing carbon footprints, even without overtly positioning themselves as green (Macknight, 2020).

The research conducted by Wang and Yao (2020) delved into the Ant Forest platform, a green initiative implemented by FinTech through gamification—a strategy that incorporates game design elements into non-game contexts (Deterding et al., 2011). In August 2016, Alipay, a leading global mobile payment service, introduced the Ant Forest program as part of its mobile application. This program, structured as an environmental mobile game, encourages users to engage in tree planting activities, with virtual trees symbolising real trees planted by the Ant Forest Department for successful users. To accumulate "green energy" and contribute to tree planting, users are encouraged to undertake eco-friendly actions such as walking, using shared bicycles, opting for electronic invoices, and utilising public transportation. The Alipay system monitors these activities and rewards users with green energy accordingly, which must be manually collected by interacting with their mobile screens. As a third-party payment application, Alipay facilitates various low-carbon behaviours associated with mobile payments, including using public transportation and purchasing tickets online. Concurrently, it fosters adopting a green lifestyle by gamifying pro-environmental actions. Similarly, another application, Pensumo, a mobile savings platform, encourages users to save towards their pensions by participating in eco-challenges (Pensumo, n.d.).

Sheoran and Kumar (2022) identified one significant obstacle to green consumption in the realm of green electronic products: greenwashing. Coined by environmentalist Jay Westerveld (1986), greenwashing refers to the convergence of two company behaviours: poor environmental performance and positive communication regarding environmental performance (Chueca Vergara & Ferruz Agudo, 2021; Delmas & Burbano, 2011, p. 65). Essentially, greenwashing entails presenting a company, product, or service as environmentally friendly or beneficial despite potential inconsistencies with reality. The opacity from greenwashing often fosters consumer doubt regarding the authenticity of green product claims, leading to a decreased willingness to purchase such products.

Blockchain technology is a solution to this challenge, particularly concerning green certifications (Kouhizadeh et al., 2021). By enabling immutable data recording throughout the production process in a distributed ledger (Choi et al., 2019, 2020), blockchain offers consumers a means to verify the accuracy of green information. Consequently, this transparency can bolster consumer confidence in green products, thereby increasing the likelihood of their purchase (Choi, 2019).

Furthermore, certain FinTech services provide eco-friendly digital payment and account solutions that empower users to monitor and offset their carbon footprint effortlessly. For example, platforms such as Commons (2018) and Doconomy (2018) allow individuals to track the carbon emissions associated with their financial transactions using mobile devices and counterbalance these emissions by supporting environmentally friendly projects. Notably, Doconomy has introduced the world's inaugural credit card with a carbon limit.

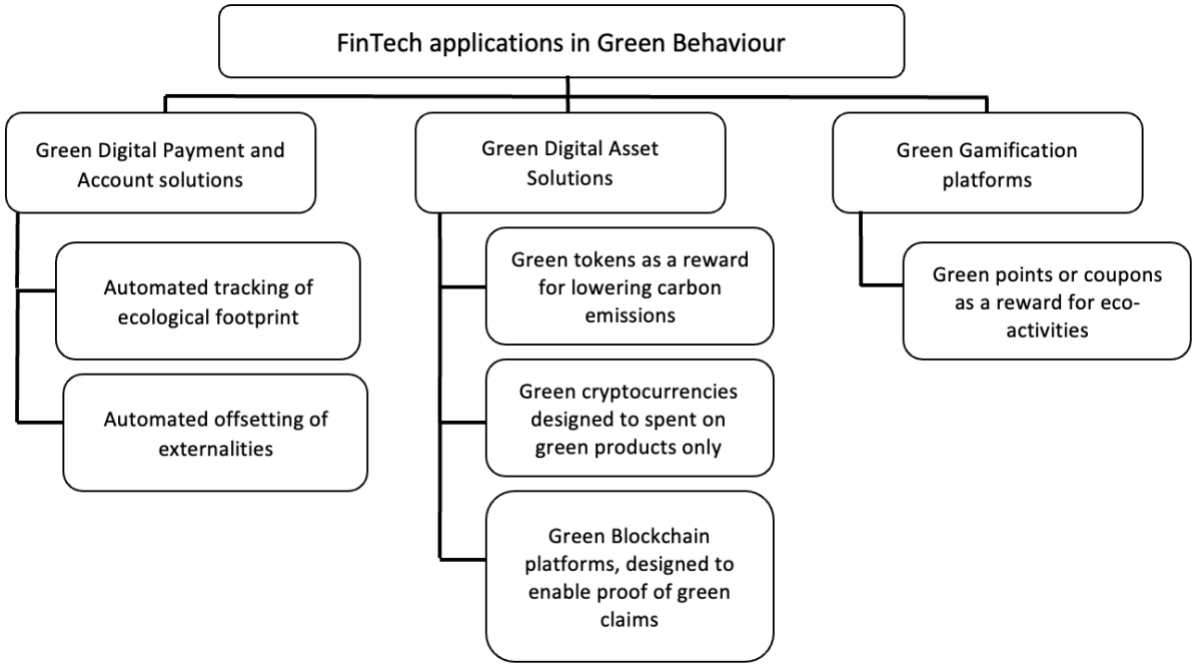
Lastly, another form of Green FinTech utilises coins or tokens to incentivise pro-environmental actions. By leveraging local tokens, businesses or projects can offer rewards or stocks of specialised cryptocurrency tokens in exchange for eco-friendly behaviours performed by network users (Vergara & Agudo, 2021). For example, CarbonX (2014) evaluates products and services based on their carbon footprint and provides GOODcoins to customers who purchase carbon-neutral goods (GoodCoins, 2014). Similarly, users of RecycleToCoin (2017) may earn coins for recycling plastic, aluminium, and steel cans. Upon delivering recyclables to local

collection points, customers receive unique Quick Response (QR) codes, which can be redeemed for rewards. The ECO coin (2015) also rewards coins to users who engage in green practices. The authenticity of individuals' eco-behaviours is verified using tools like IoT sensors, accredited vendors, and inspectors (Andoni et al., 2019). Additionally, the My Drop in the Oceans (2015) platform brings together individuals and businesses, incentivising responsible behaviour by providing a digital currency that can be used to purchase products or services from participating establishments.

Based on the described literature, this thesis offers the classification of FinTech applications in green behaviour, as shown below (Figure 3).

Figure 3

FinTech applications in Pro-environmental behaviour



Note. From the author's elaboration.

2.3.3. Green FinTech adoption

There is a scarcity of literature dedicated to examining the factors influencing the adoption of Green FinTech.The studies that focused on the adoption of FinTech that promotes green

finance mainly focused on examining characteristics of private investors that use Green FinTech. For example, Au et al. (2021) found that awareness of sustainable aspects significantly impacted the adoption of sustainable robo-advisors by German private investors. Additionally, their findings revealed that being male, younger and more experienced is positively associated with using Green FinTech. In contrast, Faradynawati and Söderberg (2022) found that sustainable investments are preferred by robo-advisor clients who are female and older in Sweden, Norway, and Finland. They explained that women are more concerned about the environment than men. Furthermore, apart from the adoption of green robo-advisors, some studies have delved into the adoption of green crowdfunding. Wasiuzzaman et al. (2021) found that environmental concern significantly affects the willingness to support crowdfunded green projects in Brunei. According to Bourcet and Bovari (2020), individuals' attitudes toward the Renewable Energy (RE) sector and their perceptions of the risks linked with RE crowdfunding constitute the principal factors influencing investment decisions in RE crowdfunding among the populace in France. Demographic characteristics of age, education, and social support towards RE are also essential factors in RE crowdfunding. Similarly, Pumphrey et al. (2020) identified that consumers' trust and social factors affect peer-to-peer energy trading in the United Kingdom. Additionally, their study found that consumers value easiness of use and cost factors while participating in energy trading.

There is also an increasing interest in research on the adoption of Ant Forest. Most prior studies have focused on empirically examining the factors affecting users' continuance intention (CI) toward Ant Forest (AF). Researchers focused on: (1) factors affecting CI toward AF as a new type of green behaviour and a gamification design (Ashfaq et al., 2021, 2023; Mi et al., 2021; Wang et al., 2022; Yang et al., 2018; Zhang et al., 2020); and (2) the impact of AF on stimulating behavioural change towards green behaviour (Cao & Liu, 2023; Cao et al., 2022; Chen et al., 2023; Huang et al., 2023; Sun & Xing, 2022; Zhang, 2023).

The following studies showed a positive impact of hedonic motivations, including perceived enjoyment and satisfaction towards CI to use AF (Ashfaq et al., 2021; Wang et al., 2022; Zhang et al., 2020). In alignment with the findings above, the study by Mi et al. (2021) demonstrated that users' sense of gratification serves as a significant psychological incentive motivating

continued engagement with Ant Forest. Indeed, Hartman et al. (2006) noted that consumers not only utilise the technologies they adopt for productive tasks but also for hedonic purposes.

Other studies have highlighted the significant positive influence of individual characteristics, such as environmental concern, on the CI (Ashfaq et al., 2021; Zhang et al., 2020). Furthermore, certain researchers have pointed out the considerable impacts of social factors, including social influence, social interaction, social gratification, and perceived social support, on CI (Ashfaq et al., 2021; Mi et al., 2021; Wang et al., 2022; Yang et al., 2018; Zhang et al., 2020).

Alongside individual characteristics, studies have shown the positive effect of technological factors, such as perceived entertainment, perceived usefulness, primary task support, and convenience, on users' decisions to continue using AF (Ashfaq et al., 2021, 2023a; Yang et al., 2018). In addition to identifying factors facilitating CI, certain authors have also explored barriers affecting intentions to continue using AF (Ashfaq et al., 2021; Zhang et al., 2020). Specifically, Zhang et al. (2021) demonstrated that perceived costs, including time and effort, negatively influence satisfaction, while Ashfaq et al. (2021) identified privacy concerns, usage barriers (ease of use), and green scepticism as deterrents to the adoption of AF.

Green Banking (GB) Technology, akin to Green FinTech, has recently garnered attention in the literature. It represents a novel banking concept rooted in environmental sustainability principles, encompassing the incorporation of structural and technological enhancements into banking operations and advocating for paperless-based financial services (Bouteraa et al., 2022). Several studies have delved into consumer adoption of GB (Bouteraa et al., 2021, 2022; Iqbal et al., 2018, 2019, 2021; Malik & Singh, 2022).

Most studies on GB adoption have focused on the influence of technological dimensions on the intention to use GB. Iqbal et al. (2018) and Iqbal et al. (2019) discovered that performance expectancy, effort expectancy, and facilitating conditions play pivotal roles in capturing clients' overall perceptions of green banking in emerging economies. Similarly, Iqbal et al. (2021) established that task attractiveness, defined as efficiency in performing tasks, affects the behavioural intention to use GB. Malik and Singh (2022) also demonstrated that perceived ease

of use and perceived usefulness, particularly in terms of time-saving and effective finance management, significantly influence customers' adoption of GB.

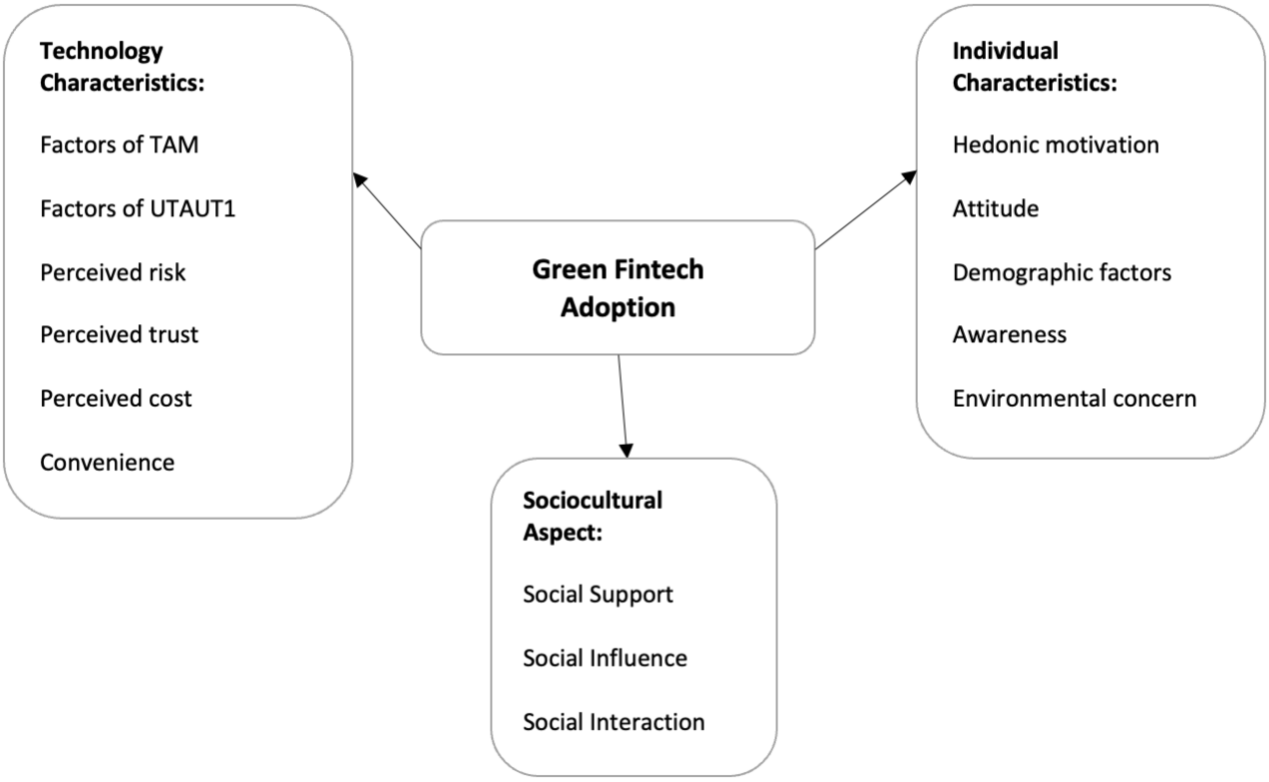
Furthermore, some studies focused on the impacts of risks and trust on the intention to use green banking technology. For instance, Iqbal et al. (2019) discovered that reliability and privacy significantly enhance performance expectancy. Similarly, the findings from the research conducted by Iqbal et al. (2021) reaffirmed the negative impact of perceived risk on attractiveness, thereby affecting clients' behavioural intention towards green banking services. Interestingly, Bouteraa et al. (2022) found that the effects of security and privacy were negligible on customers' intention to adopt GB technology in the UAE. Moreover, the study conducted by Malik and Singh (2022) indicated that perceived trust towards GB appeared to wield a substantial influence on the perceived usefulness and perceived ease of use factors.

Recently, Aboalsamh et al. (2023) conducted a study focusing on the influence of Green FinTech on sustainability and consumer behaviour within smart cities, as perceived by organisations in the Middle East. Their findings indicate that Green FinTech initiatives foster sustainability by incentivising companies to invest in renewable energy, thereby gaining access to funds at reduced interest rates. However, the research also highlights significant barriers to the adoption of these initiatives by organisations, notably concerns related to data security and a lack of awareness regarding available Green FinTech products and services.

Based on the described literature in this section, this thesis offers Figure 4, which summarises factors impacting Green FinTech adoption.

Figure 4

Factors influencing Green FinTech adoption



Note. From the author's elaboration.

2.4. Research Model and Hypotheses

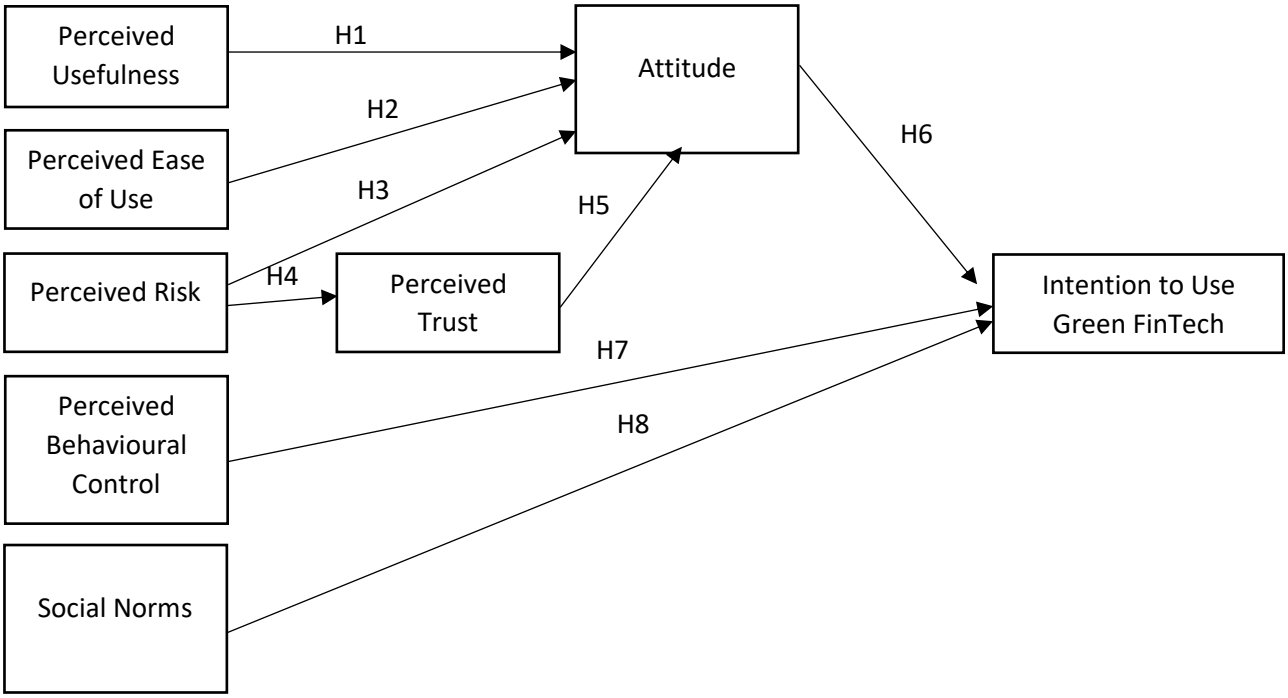
This thesis uses the Combined TAM and TPB (C-TAM-TPB) (Taylor & Todd, 1995) to examine Green FinTech adoption by the University of Waterloo students. Taylor and Todd (1995) integrated the predictors of the Theory of Planned Behaviour (TPB) with constructs from the Technology Acceptance Model (TAM), creating a hybrid model. Their research revealed that this hybrid approach offers a more comprehensive understanding of behavioural intention, as it considers factors influencing system use through both design and implementation strategies. Several studies across various technological contexts have adopted combined TAM and TPB frameworks to successfully explain the usage of the technology (Gómez-Ramirez et al., 2019; Ha

et al., 2019; Lee, 2009; Obaid & Aldammagh, 2021; Safeena et al., 2013; Song & Jo, 2023; Wong et al., 2024; Wu & Chen, 2005; Xie et al., 2017).

As previously mentioned, while TAM was widely used in the literature on FinTech adoption due to its ability to assess the impact of technological aspects on adoption, TPB has shown notable success in predicting pro-environmental behaviours across various studies (Botetzagias et al., 2015; Graham-Rowe et al., 2014; Hage et al., 2009; Sidique et al., 2010). Hence, this study explores whether factors of both TAM and TPB based on Combined TAM-TPB could be pivotal in users' adoption of Green FinTech. Additionally, given the significant findings from numerous studies regarding the influence of perceived risk and trust factors on Green FinTech adoption (Aboalsamh et al., 2023; Ashfaq et al., 2021; Bourcet & Bovari, 2020; Iqbal et al., 2021; Malik & Singh, 2022; Pumphrey et al., 2020), the research model will also integrate these factors. To our knowledge, no prior studies have incorporated trust and perceived risk into the Combined TAM-TPB within the context of Green FinTech adoption. The following theoretical framework (Figure 5) is expected to provide a more thorough explanation of the intention to use Green FinTech through the integration of two dominant theories in the fields of FinTech adoption and consumer behaviour.

Figure 5

The research model tested in this study



Note. From the author's elaboration.

Since Green FinTech is a relatively novel concept and its services are gradually being introduced, this study employs the intention to use it as a proxy for actual usage. Intention to use (ITU) Green FinTech relates to an individual's willingness to use Green FinTech services (Davis, 1989). As stated earlier, according to TAM (Davis, 1989), the intention of using an information system drives the actual use. Thus, this thesis will focus on determining the effects of the model's constructs on the intention to use Green FinTech.

According to the literature, a user's attitude towards using technology (ATU) is impacted by behavioural beliefs, such as perceived usefulness (PU) of a system, perceived ease of use (PEOU) of a system, perceived trust (PT), and perceived risk (PR) (Akturan & Tezcan, 2012; Albayati et al., 2020; Davis, 1989; Elhajjar & Ouaida, 2019; Gefen et al., 2003; Hung et al., 2013; Lee, 2009; Liébana-Cabanillas et al., 2014).

Perceived usefulness (PU) denotes the users' inclination to adopt a service based on their belief that utilising FinTech can yield positive outcomes (Ryu, 2018). Green FinTech enables

consumers to contribute to environmental preservation through simpler adoption of sustainable consumption and investment options (Greg Gannon & Carola Hieker, 2022). Furthermore, research by Yuen et al. (2021) indicated that the perceived utility of Green FinTech in enhancing the emotional well-being of consumers who feel responsible for environmental conservation can significantly influence adoption rates. There is evidence in the literature demonstrating a positive impact of Perceived Usefulness (PU) on ATU (Aslam et al., 2017; Belanche et al., 2019; Chuang et al., 2016; Davis, 1989; Elhajjar & Ouaida, 2019; Venkatesh & Davis, 2000). Furthermore, the following studies showed the positive effect of perceived usefulness on the intention to use Green FinTech (Ashfaq et al., 2023b; Malik & Singh, 2022).

Perceived ease of use (PEOU) pertains to consumers' perception of the level of comfort and effort required to familiarise themselves with FinTech services. When users perceive FinTech services as convenient, user-friendly, and straightforward to navigate, they are more likely to adopt them (Riquelme & Rios, 2010). Several studies demonstrate the positive impact of the Perceived Ease of Use (PEOU) on ATU (Belanche et al., 2019; Chen et al., 2002; Chuang et al., 2016; Davis, 1989; Elhajjar & Ouaida, 2019; Lee & Kim, 2009; Schierz et al., 2010; Yang & Yoo, 2004). In the context of Green FinTech usage, some studies found a significant positive effect of PEOU on the decision to use Green FinTech (Ashfaq et al., 2021; Malik & Singh, 2022; Pumphrey et al., 2020).

Perceived Trust (PT) in FinTech applications refers to users' confidence in the reliability, integrity, and goodwill of these platforms (Liao et al., 2011; Lu et al., 2011; Stewart & Jürjens, 2018). Greater trust in the service provider enhances users' willingness to use the service (Koksal, 2016). The following studies found the positive impact of PT on ATU and the use of Green FinTech (Dianty & Faturohman, 2023; Hu et al., 2019; Pumphrey et al., 2020; Singh, 2022).

Perceived Risk (PR) represents a manifestation of distrust, with many researchers asserting it as the primary factor negatively impacting the adoption of mobile payment systems (Dianty & Faturohman, 2023; Elhajjar & Ouaida, 2019; Gefen et al., 2003; Kim & Prabhakar, 2000; Martins

et al., 2014; Slade et al., 2015). In the field of Green FinTech adoption, studies by Aboalsamh et al. (2023), Ashfaq et al. (2021), Iqbal et al. (2021), and Pumphrey et al. (2020) outlined the negative role of perceived risk in adopting Green FinTech.

Furthermore, it was found that perceived risk and perceived trust exhibit an inverse relationship (Al nawayseh, 2020; Ali et al., 2021; Chin et al., 2018; Kim & Koo, 2016; Rouibah et al., 2016; Slade et al., 2015).

Thus, the following hypotheses are proposed:

Hypothesis H1: Perceived usefulness (PU) will positively influence the attitude towards usage.

Hypothesis H2: Perceived ease of use (PEOU) will positively influence the attitude towards usage.

Hypothesis H3: Perceived risk (PR) will negatively influence the attitude towards usage.

Hypothesis H4: Perceived risk (PR) will negatively influence the perceived trust.

Hypothesis H5: Perceived trust (PT) will positively influence the attitude towards usage.

Attitude refers to users' subjective judgments and personal inclinations toward something (Zhao et al., 2010). Within the framework of TAM, it has been observed that a positive attitude toward new technology is a prerequisite for adopting that technology (Belanche et al., 2019; Chuang et al., 2016; De Luna et al., 2019; Dianty & Faturohman, 2023; Gupta & Arora, 2017; Hsu & Lin, 2016; Lee, 2009; Ng & Kwok, 2017; Schierz et al., 2010; Singh et al., 2020). Consumers' willingness to use Green FinTech services is contingent upon their favourable perceptions of this behaviour and their positive expectations regarding its performance.

Thus, we posit the following hypothesis:

Hypothesis H6: Attitude (ATU) will positively influence the intention to use Green FinTech.

Perceived behavioural control (PBC) pertains to situations where individuals do not have complete control over their behaviour. PBC increases when individuals perceive they possess the necessary resources and abilities to perform the behaviour. According to TPB, PBC serves as

a robust predictor of behavioural intention (Lee, 2009; Mazambani & Mutambara, 2020; Niswah et al., 2019; Nugroho et al., 2018; Safeena et al., 2013; Ting et al., 2016; Tucker et al., 2019). Additionally, PBC is influenced by facilitating conditions and self-efficacy (Hung et al., 2013; Susanto & Goodwin, 2013). Facilitating conditions refer to individuals' perceptions of the available resources (e.g., smartphones, access to download applications) and support (e.g., technical assistance from application vendors, technological infrastructure) when using FinTech platforms (Venkatesh et al., 2003). In the context of Green Banking (GB) technology adoption, the research found that facilitating conditions significantly impact the intention to use technology (Iqbal et al.,2018;2019).

Thus, we posit the following hypothesis:

Hypothesis H7: Perceived Behavioural Control (PBC) will positively influence the intention to use Green FinTech.

Social norm (SN) is defined as an individual's belief regarding whether the majority of significant others expect him to engage or not engage in a particular behaviour (Fishbein & Ajzen, 1975). Social influence has been observed to exert a positive and significant impact on the adoption of FinTech applications such as mobile payment and banking (Abrahão et al., 2016; Al nawayseh, 2020; Liébana-Cabanillas et al., 2018; Oliveira et al., 2016; Singh et al., 2020; Teo et al., 2012, 2015; Xie et al., 2021). Moreover, evidence indicates that social factors play a positive role in adopting Green FinTech (Ashfaq et al., 2021; Mi et al., 2021; Pumphrey et al., 2020; Wang et al., 2022; Yang et al., 2018).

Thus, we posit the following hypothesis:

Hypothesis H8: Social norms (SN) will positively influence the intention to use Green FinTech.

2.5. Summary

The chapter examined and reviewed the literature related to the research questions posed in this thesis. It discussed information technology adoption theories and factors concerning consumers' adoption and use of FinTech. The literature on FinTech adoption has used TAM, UTAUT, TPB, and DOI theories the most.

In the realm of Social FinTech, technological and social factors wield the most significant influence on individuals' intentions to embrace such technologies. However, the literature presents divergent findings regarding the effects of perceived risk and trust on users' intentions.

Regarding the adoption of Green FinTech, a dominant theme emerged, highlighting the pivotal role of data security and privacy in adoption decisions. Moreover, the integration of gamification to promote green behaviour underscores the significance of hedonic motivations in fostering adoption. In the sphere of FinTech within green finance, factors such as awareness of sustainability aspects and environmental concerns were found to impact decisions regarding FinTech adoption for green investments. Conversely, the influence of demographic factors yielded conflicting results.

In summary, the literature encompassing various types of FinTech has enriched our comprehension of the factors shaping individuals' intentions to adopt FinTech. Nonetheless, the adoption of Green FinTech, being a nascent subtype, remains relatively underexplored in existing literature. To bridge this gap and deepen our insights into this emerging phenomenon, this thesis developed a research model combining TAM and TPB with risk and trust factors to empirically analyse individuals' intentions to adopt Green FinTech. To the best of our knowledge, this thesis represents the first comprehensive endeavour to propose such a model, thereby addressing the issue of individuals' limited adoption rates of Green FinTech.

Chapter 3. Research Method

This chapter discusses the research methodology, which includes a quantitative approach. Section 3.1 discusses the study's philosophical worldview. Section 3.2 describes the research design. Section 3.3 discusses population and sample, sample recruitment, and questionnaire design and development. Section 3.4 provides an overview of the data analysis procedures and techniques.

3.1. Research Approach

This study tested the research model's hypotheses using a quantitative research approach (Creswell & Creswell, 2018). Furthermore, based on the literature review by Firmansyah et al. (2022), most research on FinTech adoption consists of empirical papers using the quantitative method.

This study proposes a postpositivist philosophical worldview. Like postpositivist emphasises the need to examine the causes that impact outcomes (Creswell & Creswell, 2018), the following research seeks to identify the variables that influence students' adoption of Green FinTech. Furthermore, given the reductionistic nature of the postpositivist worldview, which tends to consolidate ideas into a limited set for hypothesis testing, such as variables (Creswell & Creswell, 2018), this research aims to investigate the proposed relationships between the variables of TAM and TPB, perceived risk, perceived trust, and intention to use Green FinTech. The research will focus on constructing numerical measurements of predictor and outcome variables, which is consistent with the postpositivist philosophy.

3.2. Research Design

This study employed a survey design, which is a nonexperimental research form. Many prior researchers have used the survey design to study the adoption of information technology (e.g. Gilbert et al., 2004; Horst et al., 2007; Liu et al., 2005; Suh & Han, 2003).

The main objective of this study is to empirically assess the factors that influence the intention to use Green FinTech based on the Combined TAM-TPB model. A cross-sectional survey design was used to investigate the hypothesised relationships between factors at a

single point in time. Because of the novel concept of Green FinTech, which entails establishing exploratory relationships before manipulating certain factors for assessing causal relationships in an isolated and controlled setting, an experimental design was deemed unsuitable. Moreover, surveys can be distributed to a large and representative sample of the population, allowing for more generalisable results for the established relationships. On the other hand, experimental designs often involve a limited sample size, which might not provide a comprehensive representation of the University of Waterloo student population.

3.3. Methods

The research method below covers the descriptions of the sample and population selection, as well as the development of the questionnaire.

3.3.1 Population and Sample

This thesis examines the factors affecting the intentions of students at the University of Waterloo to use Green FinTech. The emphasis is on the younger age groups, as they are more inclined to experiment with new technology and financial services. Furthermore, Generation Z and Millennials accounted for 54% of FinTech usage for lending purposes in Canada (TransUnion Canada, 2020).

Clustering and convenience methods were employed for sampling. During the clustering process, students at the University of Waterloo were first divided into six clusters according to their faculties: Engineering, Mathematics, Science, Applied Health Studies, Arts, and Environment. The following groups were categorised based on the premise that engineering students are more proficient with technological aspects, environmental students are more knowledgeable about environmental matters, and accounting and finance students are competent with financial aspects. All aspects are present within the concept of Green FinTech. Including students from all faculties in the sample is justified to widen the scope of the study on Green FinTech adoption, particularly considering the likely lack of familiarity with the topic of students from the other faculties.

The next step in the sampling approach was convenience sampling. Convenience sampling is a non-probability sampling strategy that selects participants based on their availability and willingness to take part in the study (Creswell & Creswell, 2018). Because the researcher of this study had the advantage of direct access to students from all departments, convenience sampling emerged as a practical and efficient approach to acquire participants for data collection. Furthermore, convenience samples consisting of university students have been frequently used by research studies in social psychology and consumer behaviour fields (Peterson & Merunka, 2014). In this research, convenience sampling was deemed appropriate for its effectiveness in facilitating preliminary exploration and iterative refinement of instruments in the context of Green FinTech. While convenience sampling may bring biases that restrict the credibility of findings when compared to random sampling, it is an effective tool for beginning investigations into emerging concepts like Green FinTech.

This study followed Roscoe's (1975) rule for determining sample size (Sekaran & Bougie, 2016). It stated that if a sample is broken into sub-samples, a minimum sample size of 30 for each category is required. This study collected at least 30 students in each of the faculties for the sample.

This study received ethics clearance for research involving humans before data collection (see Appendix B). The Office of Research Ethics at the University of Waterloo evaluates ethical considerations in the design, implementation, and dissemination of research and grants an Ethics Clearance certificate to the study that meets participant safety and welfare requirements.

The sampling recruitment was accomplished by contacting instructors across all faculties via email and soliciting their assistance in distributing a survey poster and an information letter to their students. The survey was performed on the online platform Qualtrics, which sped up and simplified the data collection procedure (Creswell & Creswell, 2018). The data collection commenced in October 2023 and concluded by December 2023. The information letter and survey poster detailed the research description, clarifying participation’s voluntary and

anonymous nature. The letter further asserted that submitting the completed questionnaire implied consent for the data to be used exclusively for research purposes (see Appendix A).

3.3.2. Development of the Questionnaire

The questionnaire used in this study was meticulously crafted to address key design considerations, including length, question order, wording, sequence, and layout (Rea & Parker, 2014). It consisted of 33 questions. The final version of the questionnaire is provided in Appendix A.

The questionnaire started with a consent form and a brief description of the concept of Green FinTech. Examples were included to illustrate the existence of Green FinTech applications, recognising that students might not have been familiar with them. The questionnaire consisted of two parts (A – B) containing 33 Items. Each section was prefaced with a concise introduction to ensure a smooth flow within the questionnaire. Part A included 27 questions regarding the participants' perceptions of potential benefits and drawbacks of Green FinTech on a 7-point Likert Scale that ranges from "Strongly Disagree" to "Strongly Agree". Part B asked 6 questions about participants' demographic and background information, such as age, sex, education, and experience. The subsequent section discusses the questionnaire's structure and the constructs' measurement items.

3.3.2.1. Measurement items and constructs

The first part of the questionnaire (Part A) included instruments (survey items) corresponding to the constructs of interest in this research. Appendix C contains the table of measurement items used in the questionnaire and the literature sources. The questionnaire incorporates items adapted from the studies on FinTech adoption but revised to match this study's objective.

A 7-point Likert scale (ranging from "1, strongly disagree" to "7, strongly agree") was employed in this study to measure all items since it has been widely used by scholars (Sekaran & Bougie, 2019). In this regard, researchers recommend using a 7-point scale as it allows for increased variability in measurements and offers a broader spectrum of options (Dillman et al.,

2014). Furthermore, Foddy (1996) stated that a minimum of a 7-point scale is required to guarantee the reliability and validity of the scale.

3.3.2.1.1. Social Norms

Table 2 presents the three items used to measure social norms. These items were developed by Venkatesh et al. (2012) and modified slightly to suit the Green FinTech domain.

Table 2

Items to measure social norms

- People who are important to me would think that I should use Green FinTech.
- People who influence my behaviour would think that I should use Green FinTech.
- People whose opinions I value would prefer that I use Green FinTech.

3.3.2.1.2. Perceived Risk

Table 3 shows the three items used to measure perceived risk. All items were taken from an instrument used by Kim et al. (2008) and reworded slightly to suit the Green FinTech domain.

Table 3

Items to measure perceived risk

- Using Green FinTech is associated with a high level of risk.
- There is a high level of uncertainty in using Green FinTech.
- Overall, I think that there is little benefit to using Green FinTech compared to traditional financial services.

3.3.2.1.3. Perceived Trust

The five items from Shaw (2014) were used to measure students' perceived trust related to the use of Green FinTech. These items are listed in Table 4. Modifications were made to the selected items to suit the Green FinTech domain.

Table 4

Items to measure perceived trust

- Green FinTech would have adequate features to protect my security.
- Green FinTech would keep my financial information secure.
- Green FinTech would have adequate features to protect my privacy.
- Green Fintech would keep my personal data safe.
- Green Fintech is trustworthy.

3.3.2.1.4. Perceived usefulness

Perceived usefulness was measured using four items. These items were taken from an instrument developed by Venkatesh et al. (2003) and were reworded to suit use in the Green FinTech environment. Table 5 below shows four items.

Table 5

Items to measure perceived usefulness

- I think that using Green FinTech would enable me to accomplish my green activities more quickly.
- I think that using Green FinTech would make it easier for me to carry out my green activities.
- I think Green FinTech is useful.
- Overall, I think that using Green FinTech is advantageous.

3.3.2.1.5. Attitude

Attitude towards Green FinTech use was measured using three items. These items are listed in Table 6. The first item was taken from an instrument developed by Venkatesh et al. (2003), the second item was used from an instrument developed by Chin and Lin (2016), and the third item was adopted from an instrument created by Boyko et al. (2011). All of the items were modified to suit the Green FinTech domain.

Table 6

Items to measure attitude

• Using Green FinTech is a good idea to accomplish my green activities.
• I have a positive view toward using Green FinTech for monitoring carbon emissions.
• I think using Green FinTech is beneficial for protecting the environment.

3.3.2.1.6. Perceived behavioural control

Table 7 shows three items that were used to measure perceived behavioural control. The first item was taken from an instrument developed by Zhang et al. (2016), the second item was used from an instrument developed by Venkatesh et al. (2003), and the third item was adopted from an instrument created by Taylor and Todd (1995). Some wording was altered to suit the Green FinTech environment.

Table 7

Items to measure perceived behavioural control

• Using Green FinTech is convenient to accomplish my green activities.
• I have the resources, the knowledge, and the ability to make use of Green FinTech.
• I think I would be able to use Green FinTech.

3.3.2.1.7. Perceived ease of use

Three items, taken from an instrument used by Laksamana et al. (2023) and slightly reworded to suit the Green FinTech domain, were used to measure the perceived ease of use of Green FinTech services, as shown in Table 8.

Table 8

Items to measure perceived ease of use

- I think that learning to use Green FinTech would be easy.
- I think that interaction with Green FinTech would not require a lot of mental effort.
- I think that it would be easy to use Green FinTech to accomplish my green activities.

3.3.2.1.8. Intention to use Green FinTech

The three items shown in Table 9 measure the intention to use Green FinTech. All of the items were taken from an instrument developed by Venkatesh et al. (2012). Item wording was modified slightly to suit use in the Green FinTech domain.

Table 9

Items to measure intention to use Green FinTech

- I intend to adopt Green FinTech in the future.
- I predict that I will frequently use Green FinTech in the future.
- I will strongly recommend others to use Green FinTech.

3.3.2.2. Background information

The second part of the questionnaire (Part B) covered the demographic and background questions about the participants, as shown in Table 10 below. It consisted of 6 items (see Appendix A). Age was measured on a four-category scale (18-24; 25-30; 31-39;40>). The education levels that students pursued were measured using three categories (Bachelor's degree, Master's degree, PhD). Level of experience using Green FinTech was measured on a four-point scale (None; Beginner; Intermediate; Advanced). Whether students had previously used Green FinTech was measured using two categories (Yes, No). These items were obtained to help profile the participants based on their age, gender, and educational background to gain greater insights into their previous experience and expertise.

Table 10

Background and demographic items

- How old are you?
- What sex are you?
- What level of education are you pursuing?
- In which faculty or affiliated institution are you currently enrolled?
- Which statement best describes your level of experience using Green FinTech?
- Have you ever used Green FinTech?

3.4. Data analysis

This section describes the data analysis techniques chosen to support the research. As previously mentioned, the questionnaire was used to collect data. Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed to assess the model, and Stata software was utilised for this purpose in the research.

PLS-SEM is a frequently used technique for examining latent variable models, mainly in exploratory research focused on theory development (Hair et al., 2014,2017, 2019). It is a vital statistical tool widely utilised across various disciplines, notably in the social sciences and marketing, for data analysis (Bahta et al., 2021; Begum et al., 2022; Waheed et al., 2021). Unlike other SEM approaches, PLS-SEM offers notable flexibility regarding distributional assumptions and the ability to handle intricate predictive models (Chin & Newsted, 1999). This approach is particularly advantageous for analysing causal research models involving multiple constructs and items (Lai et al., 2009). Moreover, PLS-SEM is chosen for this study to explore structural relationships that best elucidate and forecast the dependent variable, as it aims to maximise the explained variance of the dependent variable through adjustments to model parameters (Hair et al., 2017).

PLS-SEM data analysis typically entails two main steps (Hair et al., 2019). Firstly, it involves assessing the latent variables and their associated measurement items, known as the measurement model. Subsequently, it includes testing the significance of path coefficients,

known as the structural model. The initial phase involves determining the validity of the measurement model, followed by hypothesis testing through examination of the structural model.

3.4.1. Measurement model assessment

The measurement model underwent evaluation for convergent validity and discriminant validity. Convergent validity is demonstrated when each measurement item strongly correlates with its intended construct (Gefen & Straub, 2005). Convergent validity was assessed through criteria such as item loadings and their significance, composite reliability, Cronbach's alpha, and average variance extracted (AVE) (see Table 11). Meeting the established criteria for convergent validity indicates that the items converge on the proposed latent construct.

Table 11

Criteria used for convergent validity

Convergent validity criteria	Guideline	Source
Item loadings	>=0.70	Hulland (1999)
Composite Reliability	>=0.70	Hair et al. (1995)
Average Variance Extracted	>=0.50	Hair et al. (1995)
Cronbach alpha coefficient	>=0.70	Gefen and Straub (2005)

Note. From the author's elaboration.

According to Table 11, measurement items that did not load satisfactorily on their constructs (>=0.7) were dropped from the model.

Composite reliability was employed to evaluate the internal consistency of the measurement model. It is a comprehensive measure of reliability derived from the item loadings estimated within the model. Composite reliability should ideally exceed 0.7 to be deemed acceptable (Hair et al., 1995).

Cronbach's alpha assesses the degree of inter-correlation among items within a group, indicating the extent to which the items measure a single latent variable. While PLS commonly employs composite reliability for validating the measurement model, both Cronbach's alpha and composite reliability were utilised in this analysis. Cronbach's alpha has a similar

interpretation as composite reliability, with values of at least 0.7 considered acceptable (Hair et al., 1995).

The Average Variance Extracted (AVE) indicates the proportion of variance in the indicators explained by the latent construct. AVE value exceeding 0.5 is generally acceptable (Hair et al., 1995).

The measurement model was also examined for discriminant validity. Discriminant validity confirms that each measuring item correlates weakly with all other constructs except the one it is supposed to be linked. Discriminant validity was tested by comparing AVE and inter-construct correlations, which is done in two steps:

1) Comparing item cross-loadings to construct correlations;
2) Assessing the ratio of the square root of the AVE of each construct to the correlations of this construct with all other constructs.

Satisfactory discriminant validity is achieved when each item loads more highly on its construct than on other constructs. Additionally, the average shared variance between a construct and its indicators should surpass the shared variance between the construct and any other constructs in the model (Gefen & Straub, 2005).

3.4.2. Structural model assessment

The structural model is tested to assess the interrelationships of the constructs in the model. The structural model was evaluated based on three criteria below:

1) The ability to explain variation in the dependent variables;
2) Multicollinearity between predictor variables;
3) The significance of the path coefficients.

The squared multiple correlations (R^2) of the structural equations of these variables estimate the variance explained by the dependent variables. R^2 was used as an estimate of how much of the variation of the outcome variable is explained by the predictor variables (Hair et al., 1995).

Collinearity, also known as multicollinearity, refers to the scenario in which two or more predictor variables in a statistical model exhibit linear relationships (Alin, 2010). Before evaluating the structural relationships, it is imperative to assess collinearity to ensure it does not bias the regression outcomes. The variance inflation factor (VIF) is commonly employed to gauge the collinearity of the indicators. VIF values exceeding 5 indicate significant collinearity concerns among the indicators of measured constructs (Hair et al., 2019).

The last evaluation criterion assesses the structural model's validity by examining the significance of the proposed relationships' path coefficients and p-values (Hair et al., 1995). Stata provides path coefficients, indicating the strength of associations between constructs. Apart from their significance, the strength of these relationships was also examined. Correlations below 0.2 were classified as weak, between 0.2 and 0.5 as moderate, and those exceeding 0.5 as strong (Cohen, 1988).

3.5. Summary

This chapter outlines the research methodology employed in the study, which used a quantitative approach through questionnaire administration. The population and sample of the study are students at the University of Waterloo. The sample method was done by clustering students into six faculties. The sample recruitment was performed by contacting class instructors to distribute the questionnaire. The data collected started in October 2023 and ended in December 2023. The questionnaire consisted of two parts; the first part included 27 survey items corresponding to 8 constructs; the second part consisted of 6 demographic and background questions. Survey items were used from the existing studies on FinTech adoption and modified to suit the Green FinTech domain. Data analysis included measurement model assessments for checking convergent and divergent validity and structural model assessments for examining the explanatory power of the model and the significance of path coefficients.

The subsequent chapter will present the results derived from the quantitative testing of the research model.

Chapter 4. Quantitative Findings

4.1. Introduction

This chapter reports on the results of the quantitative data collection and analysis that were carried out as described in Chapter 3. The questionnaire was designed to collect the quantitative data required to understand the impact of factors on Green FinTech use intentions, as discussed in Chapter 2. Section 4.2 presents descriptive information about the participants and their experience using Green FinTech. Section 4.3 discusses the measurement model testing, followed by a discussion of the test of the structural model in Section 4.4.

4.2. Descriptive statistics

This section provides background information about the participants and describes their experience using Green FinTech. As previously mentioned in Chapter 3, 785 responses were received. However, only 563 questionnaires were usable for data analysis after excluding missing data. The missing data originates from students who initially consented to participate but opted not to proceed after encountering the concept of Green FinTech. This might suggest that the complexity of the Green FinTech concept might have posed a challenge for some participants, indicating a need for simplification in future research to ensure clearer comprehension and higher participation rates.

4.2.1. Participants' profile

Of the respondents who provided information about their gender, 315 (56%) were female, 227 (40%) were male, 4 (0.7%) were intersex, 13 (2.3%) preferred not to say, and 4 (0.7%) had not responded. This information allows the participants to be compared with the distribution of students at the University of Waterloo. According to the Waterloo Equity 2021 survey on the university's website (UWaterloo, 2021), 52% of Waterloo students reported that they identified as women, 45% identified as men, and 6% reported as another gender identity. Therefore, the gender balance of participants in our sample is consistent with the results from the survey conducted by the University of Waterloo, where more than 13,000 students responded.

Table 12 shows the overall participants' age distributions. The largest category of respondents was those between 18 and 24 (84.37%), followed by those in the 25 to 30 age range (11.19%). Only 21 respondents were 31 or over. This shows that our sample consisted mostly of Generation Z and Millennials.

Table 12

Age distribution of survey participants

Age Ranges	Categories	Count	Percentage
	18-24	475	84.37%
	25-30	63	11.19%
	31-39	20	3.55%
	>40	1	0.18%

Table 13 below shows the educational level that participants are pursuing at the University of Waterloo. Most respondents (81.53%) are pursuing a Bachelor's Degree, followed by (13.85%) of respondents studying for a Master's degree. Only 3.91% of respondents are the PhD candidates. According to the data from the University of Waterloo's Student Headcounts statistics, in the fall 2023 term, 34,549 (88%) registered students were from Undergraduate degrees and 4710 (12%) students were from Graduate degrees (UWaterloo, n.d.). Thus, the education level balance of participants in the sample is consistent with the population of the University of Waterloo.

Table 13

Education levels of survey participants

Education	Categories	Count	Percentage
	Bachelor's Degree	459	81.53%
	Master's Degree	78	13.85%
	PhD	22	3.91%

Table 14 below shows the faculty and affiliated colleges that participants are enrolled in at the University of Waterloo. Most of the respondents (34.81%) are in the faculty of Art,

followed by (19.36%) of respondents studying in the faculty of Engineering. The survey had a similar proportion of students from the faculties of Mathematics (14.74%), Science (13.14%), and Environment (10.83%). Only 6.30% responded stated that they are in the faculty of Health (5.68%), Conrad Grebel University College (0.18%), and St. Jerome's University (0.53%).

According to the data from University of Waterloo's Student Headcounts statistics, in the fall 2023 term, 7936 (20.21%) registered students were from Arts, 10,053 (25.61%) students were from Engineering, 8437 (21.49%) students were from Mathematics, 6043 (15.39%) were from Science, 2627 (6.67%) were from Environment, and 3196 (8.14%) were from Health. Only 13 (0.03%) students were from Conrad Grebel University College, and 398 (1.01%) were from St. Jerome's University (UWaterloo, n.d.). Thus, the proportion of faculty balance of participants in the survey is almost consistent with the population of the University of Waterloo.

Table 14

Faculties or affiliated colleges that participants are enrolled in

Faculties or affiliated college	Categories	Count	Percentage
	Arts	196	34.81%
	Engineering	109	19.36%
	Mathematics	83	14.74%
	Science	74	13.14%
	Environment	61	10.83%
	Health	32	5.68%
	Conrad Grebel University College	1	0.18%
	St. Jerome's University	3	0.53%

Table 15 below illustrates the participants' Green FinTech use background. Responses indicated that 75.13% of the participants stated they had no experience using Green FinTech, and 19.18% believed they had beginner levels of Green FinTech experience. Only 4.97% responded that they had intermediate to advanced levels of experience. This shows that Green FinTech is still in its nascent stages of adoption within the surveyed sample.

Table 15

Green FinTech use background

	None		Beginner		Intermediate		Advanced	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Level of Green FinTech use	423	75.13%	108	19.18%	24	4.26%	4	0.71%

Table 16 below illustrates the participants' responses on whether they have ever used Green FinTech. Responses indicated that only 10.48% of participants have ever utilised green technology.

Table 16

Actual usage of Green Fintech by participants

Actual usage:	Categories	Count	Percentage
Have you ever used Green FinTech?	Yes	59	10.48%
	No	504	89.52%

Table 17 below shows the profile of participants who responded yes to the question in Table 16. Responses indicated that most students who ever used Green FinTech are between 18 and 24 years of age (68.97%) and are pursuing a bachelor's degree (68.97%). Furthermore, of the respondents who provided information about their sex, 50% were female, and 43% were male. Interestingly, it appears that a higher percentage of students from Engineering (34.48%) and Arts (27.59%) disciplines have experimented with Green FinTech compared to those from the Environment (10.34%).

Table 17

Profile of students that have ever used Green FinTech

	Categories	Count	Percentage
Age	18-24	40	68.97%
	25-30	11	18.97%
	31-39	7	12.07%
	>40	0	0
Sex	Female	29	50.00%
	Male	25	43.1%
	Intersex	2	3.45%
Education	Bachelor's Degree	40	68.97%
	Master's Degree	14	24.14%
	PhD	4	6.90%
Faculty or Affiliated College	Arts	16	27.59%
	Engineering	20	34.48%
	Mathematics	8	13.79%
	Science	5	8.62%
	Environment	6	10.34%
	Health	3	5.17%
	Conrad Grebel University College	0	0
	St. Jerome's University	0	0

6.2.3. Summary information on the research constructs

Table 18, presented below, offers a concise overview of the research constructs. The responses to the items used to measure each construct were averaged for each participant, and descriptive statistics regarding these summary measures of the primary constructs are provided to offer insights into their overall levels and distribution.

All constructs showed a wide range of values. The mean of constructs showed values ranging from 3 (Somewhat disagree) to 5 (Somewhat agree). The table shows that, on average, participants were not sure about the influence of social norms (mean: 4.34 out of 7) and were not sure about their future intentions of using Green FinTech (mean: 4.40 out of 7). It was also clear that, on average, participants were not very concerned about risks (mean: 3.72 out of 7) and had a relative trust in Green FinTech services (mean:4.55 out of 7). The table shows that, on average, participants perceived that Green FinTech would be useful to them (mean: 5.16 out

of 7) and had a positive attitude towards Green FinTech (mean: 5.17 out of 7). Regarding perceived ease of use and perceived behavioural control, on average, the participants had reasonable confidence in the ability to use Green FinTech (mean: 4.97 out of 7). They also perceived having reasonable control over using Green FinTech (mean: 4.90 out of 7).

Table 18

Construct Summary Information

Construct	Mean	Median	Std
Social Norms	4.34	4	1.42
Perceived Risk	3.72	3	1.45
Perceived Trust	4.55	5	1.20
Perceived Usefulness	5.16	5	1.28
Attitude	5.17	5	1.27
Perceived Behavioural Control	4.90	5	1.33
Perceived Ease of Use	4.97	5	1.29
Intention to use	4.40	4	1.50

4.3. Testing the measurement model

The criteria discussed in Chapter 3 were used to validate the measurement model. Two main aspects of validity were considered: convergent and discriminant validity. This section demonstrates how both were achieved.

4.3.1. Convergent validity

Convergent validity is met when each measurement item has a strong correlation with its proposed construct (Gefen & Straub, 2005). Appendix C shows the complete list of measurement items used in this assessment and their labels.

The initial aspect of the model examined was item loadings. Table 19 below shows the initial outer loading value for each item about its latent variable.

Table 19

Initial outer loading values

Item	Loading	Item	Loading
SN1	0.901	ATU1	0.889
SN2	0.930	ATU2	0.904
SN3	0.893	ATU3	0.888
PR1	0.833	PBC1	0.802
PR2	0.910	PBC2	0.769
PR3	0.524	PBC3	0.813
PT1	0.841	ITU1	0.928
PT2	0.912	ITU2	0.940
PT3	0.902	ITU3	0.903
PT4	0.913	PEOU1	0.827
PT5	0.832	PEOU2	0.802
PU1	0.860	PEOU3	0.899
PU2	0.878		
PU3	0.865		
PU4	0.840		

According to Hulland (1999), item loadings should surpass 0.7. All items not meeting this criterion were dropped from the model, as listed in Table 20 below. Each construct is further discussed below.

Table 20

Outer loadings' final value

Item	Loading	Item	Loading
SN1	0.901	ATU1	0.889
SN2	0.930	ATU2	0.904
SN3	0.893	ATU3	0.888
PR1	0.845	PBC1	0.802
PR2	0.931	PBC2	0.769
PT1	0.842	PBC3	0.813
PT2	0.912	ITU1	0.928
PT3	0.902	ITU2	0.940
PT4	0.913	ITU3	0.903
PT5	0.831	PEOU1	0.827
PU1	0.860	PEOU2	0.802
PU2	0.878	PEOU3	0.899
PU3	0.865		
PU4	0.840		

Social Norms

Analysis of the social norms construct showcased that all three items reflected the measured construct. Therefore, all items were retained.

Perceived Risk

Two out of three items measuring the perceived risk of Green FinTech use loaded sufficiently on the construct. One item (PR3) was dropped as it did not meet the criteria. PR3 stated, "Overall, I think there is a little benefit to using Green FinTech compared to traditional financial services". The statement may fail to elucidate the risks associated with Green FinTech, rendering it ineffective in assessing perceived risk.

Perceived Trust

All the items were good indicators of perceived trust in Green FinTech use, and the construct satisfied this requirement for convergent reliability.

Perceived Usefulness

All item loadings of perceived usefulness of Green FinTech use were above 0.7. The items were good indicators of the construct.

Attitude Towards Use

All item loadings of attitude towards Green Fintech use were above 0.7, satisfying the criteria. Therefore, the items were considered to be good indicators of attitude construct.

Perceived Behavioural Control

All three items of the Perceived Behavioural Control construct loaded at greater than 0.7, so they were retained.

Perceived Ease of Use

Analysis of the Perceived Ease of Use of Green FinTech construct shows that the items were above the accepted loading of 0.7; therefore, they were retained.

Intention to Use

All item loadings of intention to use Green FinTech were above 0.7. Therefore, all items were good indicators of the construct.

The second criterion for convergent validity evaluated was composite reliability. Table 21 below shows that all composite reliability values were greater than 0.70. Thus, they showed the internal consistency of the constructs in the measurement model.

Table 21

Convergent validity measures

Construct	AVE	Composite Reliability	Cronbach alpha
Social Norms	0.83	0.93	0.89
Perceived Risk	0.79	0.88	0.74
Perceived Trust	0.78	0.95	0.93
Perceived Usefulness	0.74	0.92	0.88
Perceived Ease of Use	0.71	0.88	0.81
Attitude	0.80	0.92	0.87
Perceived Behavioural Control	0.63	0.84	0.72
Intention to Use	0.85	0.95	0.91

The third convergent validity criterion assessed was Cronbach alpha, which measures the reliability of construct indicators. Cronbach alpha should be above 0.7. Table 21 shows that the Cronbach alpha values for each construct in the model were greater than 0.7 and, therefore, met the requirements.

The last convergent validity criterion assessed was AVE. As shown in Table 21 above, all AVE values were greater than 0.5, which is considered acceptable. Thus, this convergent validity criterion was also satisfactory.

The examination of all four established convergent validity criteria confirmed convergent validity. Discriminant validity was examined next.

4.3.2. Discriminant validity

As previously stated, discriminant validity is demonstrated when each item demonstrates weak correlations with all constructs except for the one it theoretically correlates to. As stated in Chapter 3, a construct should share more variance with its measures than with other constructs in the proposed model. Discriminant validity was examined in two steps, as shown below.

The first step was observing the indicators' cross-loadings on their corresponding construct. Table 22 below presents the cross-loading measurements for each item. By observing the shaded loadings, where each group corresponds to a single construct, it becomes

evident that all values surpass the rest of the values within the same column and row. Consequently, the loadings of items on their respective constructs were higher than the cross-loadings, fulfilling the first criterion.

Table 22

Table of cross-loadings

Item	Social Norms	Perceived Risk	Perceived Trust	Perceived Usefulness	Attitude	Perceived Behavioural Control	Perceived ease of Use	Intention to Use
SN1	0.90	0.05	0.26	0.49	0.42	0.36	0.29	0.53
SN2	0.93	0.03	0.31	0.49	0.41	0.40	0.30	0.54
SN3	0.89	0.02	0.39	0.55	0.49	0.40	0.34	0.55
PR1	0.09	0.84	-0.15	-0.13	-0.14	-0.08	-0.06	0.00
PR2	-0.01	0.93	-0.23	-0.15	-0.11	-0.14	-0.10	-0.12
PT1	0.27	-0.18	0.84	0.35	0.37	0.42	0.32	0.34
PT2	0.28	-0.22	0.91	0.41	0.40	0.46	0.36	0.34
PT3	0.27	-0.17	0.90	0.40	0.41	0.45	0.34	0.39
PT4	0.30	-0.19	0.91	0.44	0.41	0.44	0.37	0.38
PT5	0.41	-0.21	0.83	0.52	0.48	0.47	0.39	0.46
PU1	0.44	-0.11	0.40	0.86	0.69	0.54	0.46	0.48
PU2	0.45	-0.11	0.39	0.88	0.71	0.55	0.49	0.51
PU3	0.50	-0.15	0.42	0.87	0.72	0.56	0.50	0.64
PU4	0.53	-0.17	0.46	0.84	0.70	0.55	0.47	0.62
ATU1	0.49	-0.10	0.45	0.81	0.89	0.63	0.52	0.60
ATU2	0.42	-0.16	0.40	0.70	0.90	0.57	0.46	0.59
ATU3	0.38	-0.10	0.42	0.68	0.89	0.56	0.42	0.52
PBC1	0.41	-0.11	0.42	0.71	0.74	0.80	0.50	0.53
PBC2	0.24	-0.07	0.38	0.32	0.33	0.77	0.45	0.36
PBC3	0.33	-0.12	0.41	0.43	0.42	0.81	0.64	0.45
PEOU 1	0.23	-0.09	0.33	0.38	0.34	0.59	0.83	0.35
PEOU 2	0.24	-0.04	0.29	0.31	0.29	0.48	0.80	0.33
PEOU 3	0.36	-0.09	0.39	0.62	0.59	0.60	0.90	0.50
ITU1	0.55	-0.07	0.41	0.61	0.60	0.52	0.47	0.93
ITU2	0.55	-0.06	0.38	0.61	0.58	0.53	0.47	0.94
ITU3	0.55	-0.08	0.42	0.59	0.59	0.53	0.42	0.90

The second step in the analysis of discriminant validity was to assess the square root of the AVE of each construct and the associated correlations, as proposed by Fornell and Larcker (1981). Table 23 below presents the construct inter-correlations and the square root of the average variance extracted for each construct (highlighted in bold on the diagonal). In all instances, the square root of the average variance extracted surpasses the corresponding construct inter-correlations, thereby affirming discriminant validity. Hence, both steps confirm the discriminant validity of the measurement model.

Table 23

Discriminant validity

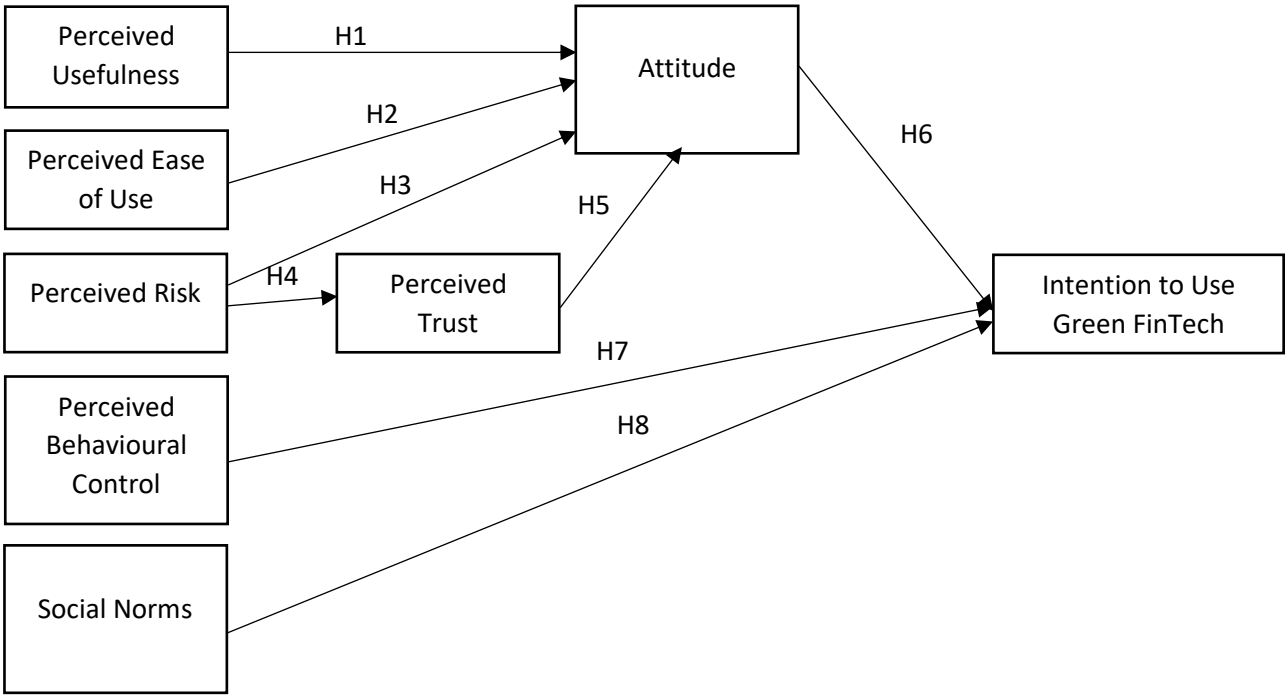
Item	1	2	3	4	5	6	7	8
1.Social Norms	**0.91**							
2.Perceived Risk	0.04	**0.89**						
3.Perceived Trust	0.35	-0.22	**0.78**					
4.Perceived Usefulness	0.56	-0.15	0.49	**0.86**				
5. Attitude	0.49	-0.14	0.48	0.82	**0.89**			
6.Perceived Behavioural Control	0.42	-0.13	0.51	0.64	0.66	**0.79**		
7.Perceived Ease of Use	0.34	-0.09	0.41	0.56	0.52	0.67	**0.84**	
8.Intention to Use	0.60	-0.08	0.44	0.65	0.64	0.57	0.49	**0.92**

4.4. Test of the structural model

Once the measurement model had been validated, the structural model was assessed. The model and hypotheses are shown in Figure 5. As described in Chapter 3, the structural model was evaluated based on two main criteria: its ability to explain the variance in the dependent variables and the significance of path coefficients. They were assessed in this research in the first portion of this section. Collinearity, relationship strengths and total indirect effects were also discussed.

Figure 5

The research model tested in this study



Note. From the author's elaboration.

4.4.1. Variance Explained

The first evaluation technique was to test whether the model could account for the variation in the dependent variables. Table 24 below shows the R^2 values for the dependent variables. Only 5% of the variance in perceived trust towards Green FinTech was explained by perceived risk. Perceived trust, perceived risk, perceived ease of use, and perceived usefulness explained 68% of the variance in attitude towards Green FinTech use. The model explained 54% of the variability in the intention to use Green FinTech.

Table 24

R-square values

Construct	R^2
Attitude	0.68
Perceived Trust	0.05
Intention to use	0.54

4.4.2. Test for Collinearity

Before assessing the structural model, multicollinearity among constructs must be examined. Collinearity issues occur with variance inflation (VIF) values above 5 (Hair et al., 2019). As shown in Table 25, VIF values for all constructs were less than 5.

Table 25

Variance inflation (VIF) values

Construct	Perceived Trust	Attitude	Intention to Use
Social Norms			1.342
Perceived Risk	1.000	1.054	
Perceived Trust		1.396	
Perceived Usefulness		1.654	
Attitude			1.928
Perceived Behavioural Control			1.798
Perceived Ease of Use		1.506	

4.4.3. Assessment of path coefficients

The third criterion used to confirm the structural model was the significance of the path coefficients. It was evaluated by analysing the p-values of the hypothesised relationships. All of the suggested hypotheses indicate the direction of the proposed relationships. Table 26 below provides the values for the path coefficient and p-values for the proposed relationships. The data presented in Table 26 indicates that the only non-significant p-value among the paths examined pertains to Hypothesis 3. The p-values for all other paths were significant.

Table 26

Significance of path coefficients

Path	Path coefficient	P-value
H1: Perceived Usefulness → Attitude	0.733***	0.000
H2: Perceived Ease of Use → Attitude	0.079**	0.007
H3: Perceived Risk → Attitude	0.001	0.974
H4: Perceived Risk → Perceived Trust	-0.217***	0.000
H5: Perceived Trust → Attitude	0.087**	0.002
H6: Attitude → Intention to use Green FinTech	0.334***	0.000
H7: Perceived Behavioural Control → Intention to use Green FinTech	0.206***	0.000
H8: Social Norms → Intention to use Green FinTech	0.349***	0.000

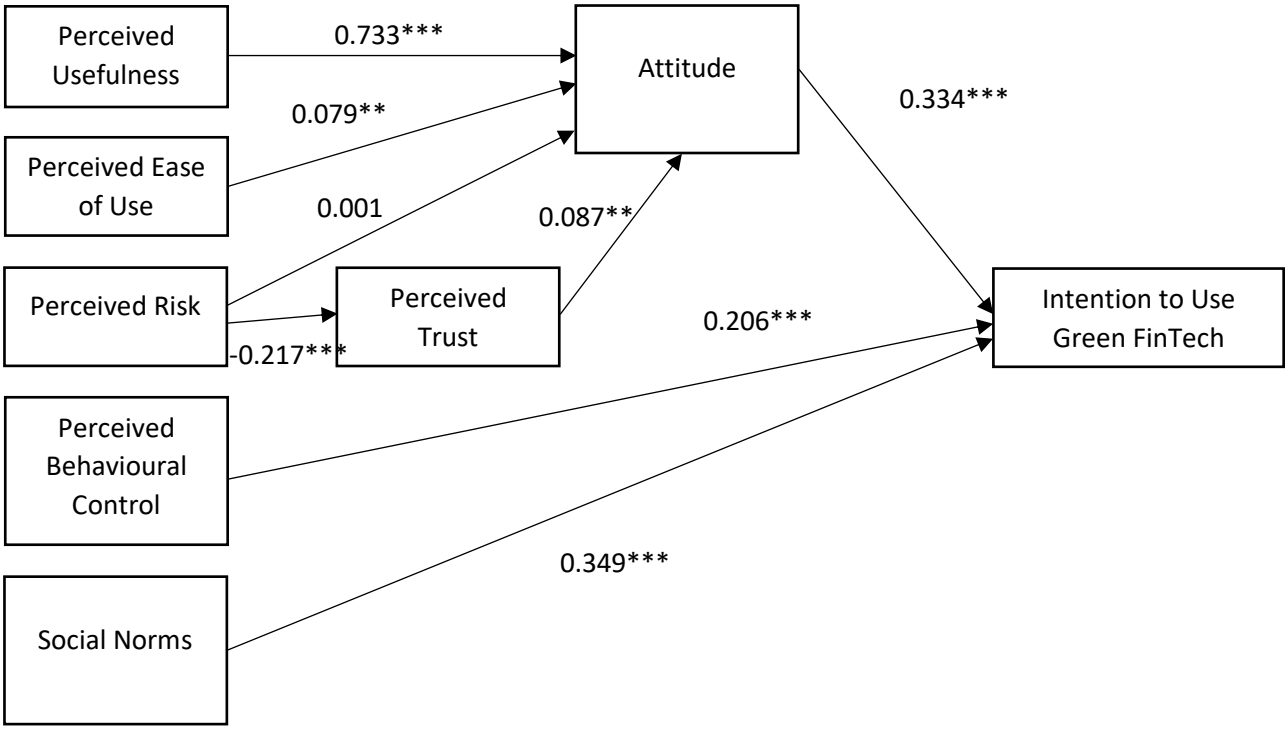
Note. **p<0.01, ***p<0.001.

4.4.4. Hypothesis Testing

Figure 6 shows the research model with eight hypotheses. The figure below summarises the testing results.

Figure 6

Structural Model



Note. The numbers are path coefficients.

Significant at p<0.01, * Significant at p<0.001.

The results of the PLS-SEM model tests for each of the hypotheses are described below.

Hypothesis H1: Perceived usefulness will positively influence attitudes towards Green FinTech use.

Perceived usefulness demonstrated a significant positive influence on the attitude towards Green FinTech use. Therefore, this hypothesis was supported.

Hypothesis H2: Perceived ease of use will positively influence attitude towards Green FinTech use.

Perceived ease of use demonstrated a significant positive influence on the attitude towards Green FinTech use. Therefore, this hypothesis was supported.

Hypothesis H3: Perceived risk will negatively influence attitudes towards Green FinTech use.
Perceived Risk demonstrated an insignificant positive influence on the attitude towards Green FinTech use. Therefore, this hypothesis was not supported.

Hypothesis H4: Perceived risk of Green FinTech use will negatively influence perceived trust towards Green Fintech use.
Perceived Risk significantly negatively influenced the perceived trust towards Green FinTech use. Therefore, this hypothesis was supported.

Hypothesis H5: Perceived trust towards Green FinTech use will positively influence attitude towards Green Fintech use.
Perceived trust demonstrated a significant positive influence on the attitude towards Green FinTech use. Therefore, this hypothesis was supported.

Hypothesis H6: Attitude towards Green FinTech use will positively influence the intention to use Green FinTech.
Attitude demonstrated a significant positive influence on the intention to use Green FinTech. Therefore, this hypothesis was supported.

Hypothesis H7: Perceived behavioural control of Green FinTech use will positively influence the intention to use Green FinTech.
Perceived Behavioural Control demonstrated a significant positive influence on the intention to use Green FinTech, supporting this hypothesis.

Hypothesis H8: Social norms will positively influence the intention to use Green FinTech.
Social norms demonstrated a significant positive influence on the intention to use Green FinTech. Therefore, this hypothesis was supported.

4.4.5. Assessment of relationships strength

As mentioned in Chapter 3, the strength of the significant relationships was also of interest. Relationships were classified as weak if the correlation was less than 0.2, moderate if it was between 0.2 and 0.5, and strong if it was greater than 0.5 (Cohen, 1988). As shown in Figure 6

above, the analysis showed one strong relationship between Perceived usefulness and attitude towards Green FinTech.

The following relationships were of moderate strength:

- Perceived risk and perceived trust towards Green FinTech use;
- Perceived behavioural control and intention to use Green FinTech;
- Social Norms and intention to use Green FinTech;
- Attitude towards use and intention to use Green FinTech.

The following relationships were of weak strength:

- Perceived ease of use and attitude towards Green FinTech;
- Perceived trust and attitude towards Green FinTech;

4.4.6. Post-Hoc Analysis

Constructs within models have both direct and indirect effects on each other. One or more intervening constructs mediate indirect relationships between two constructs. Thus, in addition to the direct relationships shown in Table 26 and Figure 6, indirect relationships were also reported. Table 27 below demonstrates the direct and indirect effects estimated for the structural model.

As can be seen from the column on direct effects, social norms and attitude were the major influences on the intention to use Green FinTech. When considering indirect effects, perceived usefulness showed the biggest impact on intention to use Green FinTech via its influence on attitude. Additionally, the indirect effect from perceived ease of use had a significant positive but limited impact on the intention to use Green FinTech through the influence on the attitude. The indirect effects from other constructs showed no influence on the intention to use Green FinTech.

Furthermore, the indirect effect between perceived risk and attitude towards use is statistically significant. As declared in Table 27, perceived risk does not have a significant direct impact on attitude. However, perceived risk significantly affects trust, which in turn has a

significant effect on attitude. This indicates that trust fully mediates the relationship between perceived risk and attitude towards using Green FinTech (Hair et al., 2019).

Table 27

Direct and Indirect Effects

Effect	Direct	Indirect
Social Influence →Intention to use Green FinTech	0.349***	
Perceived Risk→ Perceived Trust	-0.217***	
Perceived Risk → Attitude	0.001	**-0.019***
Perceived Risk → Intention to use Green FinTech		**-0.006**
Perceived Trust → Attitude	0.087***	
Perceived Trust → Intention to use Green FinTech		**0.029**
Perceived Usefulness → Attitude	0.733***	
Perceived Usefulness → Intention to use Green FinTech		**0.244***
Attitude→Intention to use Green FinTech	0.334***	
Perceived Behavioural Control → Intention to use Green FinTech	0.206*	
Perceived Ease of use → Attitude	0.079*	
Perceived Ease of use → Intention to use Green FinTech		**0.026***

Note. *p<0.05, ***p<0.001.

4.5. Summary

This chapter reported the results of the data analysis undertaken to test the proposed model. Firstly, the descriptive characteristics of the participants and their use of Green FinTech at the time of the survey were presented. Deficient levels of current use were reported, with 94% of students having beginner to no experience using Green FinTech and 90% having never used the technology.

The chapter then presented the assessment of the measurement model. The final measurement model was satisfactory and suitable for testing the structural model. The chapter then presented the evaluation of the structural model against the criteria established in

Chapter 3, and the results of the tests of the hypotheses were presented. This testing included the ability of the model to explain variance in the dependent variables and the significance of path coefficients. The results indicated that the research model accounted for over 50% of the variations in both attitude and intention to use Green FinTech. Seven out of eight hypotheses were upheld, demonstrating strong empirical backing for the theoretical model. Perceived risk was found to have no significant direct effect on the attitude towards Green FinTech use but had a significant negative indirect effect on the variable through the mediating effect of perceived trust. Moreover, perceived usefulness had the greatest significant direct impact on attitude and an indirect effect on the intention to use Green FinTech. Social norms exhibited the most significant influence on the intention to use Green FinTech, followed by the impacts of attitude towards use and perceived behavioural control.

Chapter 5. Discussion and Conclusion

This chapter discusses the quantitative research results presented in Chapter 4. Section 5.1 discusses the research model and the roles of each construct in influencing the intention to use Green FinTech. The chapter then presents Section 5.2, which discusses the study's limitations and the implications of the research. Some recommendations for Green FinTech developers are presented. Section 5.3 concludes the thesis by summarising the key features of the research and its significance.

5.1. Model discussion

The study reported in this thesis examines the impacts of the factors of TAM and TPB, as well as the effects of risk perceptions and trust on the intentions of University of Waterloo students to use Green FinTech. This research introduced and tested a model that has not yet been applied to the adoption of Green FinTech services. The model uses the combined TAM and TPB to examine the intention to use Green FinTech. It also draws on the broader FinTech acceptance literature and recent work on the adoption of Social and Green FinTech.

Figure 6 shows the supported paths for the model as found in this study. It shows that attitude towards using Green FinTech was influenced by perceived usefulness, perceived ease of use and perceived trust. In turn, attitude towards use significantly influenced the intention to use Green FinTech services. The results, therefore, suggest that when students have favourable feelings about Green FinTech, they are more likely to use it. Perceived risk did not influence attitude but significantly impacted perceived trust. Social norms and perceived behavioural control were also found to play an important role in the intention to use Green FinTech services.

As stated earlier, the model explained 54% of the total variance in the students' intended adoption behaviour. According to Chin (2010), R^2 values of an endogenous latent construct are considered 0.75 (substantial), 0.50 (moderate) and 0.25 (weak). Shih and Fang (2004) employed a combined TAM and TPB model, revealing that their framework elucidated 66% of the variance in the intention to use Internet banking. Likewise, Kumari and Devi (2023) demonstrated that their model explained 68.9% of the variance in the intention to use blockchain technology, while Ho et al. (2020) accounted for 66% of the variance in the intention to adopt mobile banking. Consequently, the present research model exhibits a comparable moderate explanatory power in explaining the variability in the intention to adopt Green FinTech.

The next sections discuss the model relationships and highlight the roles of each proposed factor in influencing the intention to use Green FinTech.

5.1.1. Role of Perceived Usefulness

As hypothesised and in line with TAM and prior studies, such as Albayati et al. (2020), Lee (2009), and Hu et al. (2019), perceived usefulness emerges as a crucial factor shaping individuals' attitudes toward Green FinTech adoption. This investigation reveals that students at the University of Waterloo exhibit a pattern similar to other FinTech adopters, wherein their attitude toward Green FinTech usage is contingent upon their perception of its utility in enhancing their ability to make environmentally-conscious financial decisions.

5.1.2. Role of Perceived Ease of Use

As anticipated, perceived ease of use exerts a significant influence on individuals' attitudes toward the adoption of Green Fintech. This finding aligns with previous research, such as Albayati et al. (2020) and Schierz et al. (2010). Specifically, they demonstrated that perceived ease of use positively impacts the intention to use mobile payment services (Schierz et al., 2010) and the intention to use blockchain technology (Albayati et al., 2020). Consistent with these findings, this study indicates that students at the University of Waterloo, like other FinTech users, base their attitudes toward Green FinTech on their perception of how effortless the technology is to use.

5.1.3. Roles of Perceived Risk and Perceived Trust

Contrary to expectations, perceived risk did not exert an influence on attitudes toward the use of Green FinTech. This finding deviates from previous research, such as Lee (2009), Martins et al. (2014), and Dianty and Faturohman (2023). Martins et al. (2014) highlighted the significant inverse impact of perceived risk on consumer attitudes toward mobile payment systems, affecting their intention to use such facilities. Similarly, Dianty and Faturohman (2023) observed that the adoption of FinTech lending platforms was influenced by perceived risk through the negative impact on user attitudes.

In contrast, supporting our findings, Akturan and Tezcan (2012) conducted a study on university students' perceptions of mobile banking and found no significant relationship between attitude and financial risk, time risk, and privacy risk. The authors suggested that the lack of association between perceived risk and attitude could be attributed to the age of the respondents, who were university students aged 18-30. With its educational background, this particular age group typically possesses substantial technology experience. Scholars across various domains widely acknowledge that prior exposure to technology at the individual level shapes one's expectations, either positively or negatively, regarding their ability to use that technology or related ones (Lee et al., 2003). Featherman and Pavlou (2003) affirmed that university students, being younger, more adept with computers, and more accustomed to internet-based transactions, tend to perceive lower levels of risk compared to the general population. Hence, regulators should prioritise delineating the risks linked to Green FinTech, particularly for young users.

Furthermore, the risks associated with Green FinTech might be perceived differently depending on the type of Green FinTech. For example, Au et al. (2021) and Faradynawati and Söderberg (2022) assessed the risks associated with investments, such as risk appetite and risk tolerance, when analysing the adoption of green robo-advisors. Future research could examine the effects of different types of risks based on the kind of Green FinTech product.

Studies by Hu et al. (2019), Al nawayseh (2020), and Ali et al. (2021) have identified that perceived risk affects attitude primarily through its negative influence on trust. This finding

aligns with the results obtained in this thesis, supporting both Hypothesis 4 and Hypothesis 5. Similarly, Dianty and Faturohman (2023) observed the impact of perceived trust on the attitude towards FinTech lending services. This suggests that perceived trust serves as a mediator in the relationship between attitude and perceived risk. In this mechanism, perceived risk exerts a notably adverse effect on trust, while trust actively encourages users to embrace FinTech services. Thus, the perceived risk associated with Green FinTech services significantly undermines the trust levels users place in these services.

5.1.4. Role of Attitude Towards Use

The relationship between attitude and intention to use Green FinTech services supported hypothesis 6. This is consistent with the results of Hu et al. (2019), Zhang et al. (2018), Belanche et al. (2019), and Chuang et al. (2016). Belanche et al. (2019) discovered that the intention to use robo-advisors is influenced by attitude, while Zhang et al. (2018) established a positive relationship between attitude and the behavioural intention to use mobile banking services. Therefore, this study confirms that if students at the University of Waterloo perceive Green FinTech favourably, it positively impacts their intention to use it.

Furthermore, this study did not consider the impacts of individual characteristics considering environmental attributes such as environmental attitude and environmental knowledge. As established by Kaiser et al. (1999), attitudes toward the environment significantly affect ecological behaviour. Further studies could assess the impact of environmental attitudes on the attitude towards using Green FinTech. It is conceivable that individuals with a favourable attitude towards the environment might also have a favourable attitude towards Green FinTech use.

5.1.5. Role of Social Norms

Social norms emerge as the most significant determinant of the intention to adopt Green FinTech. This underscores the importance students place on social influences from their friends, family, or work environment regarding Green FinTech. This indicates that when students perceive pressure from their social circles to embrace technology with green initiatives, it fosters an intention to use Green FinTech applications. A collectivist culture prevalent among

University of Waterloo students could explain the notable impact of social norms on their propensity to adopt Green FinTech applications. Schwartz (1990) defined collectivism as "giving priority to in-group goals over personal goals" (p. 140). The study by Walker et al. (2008) found that Canadian students value horizontal collectivism the highest, which includes perceiving the self as a part of the collective and seeing all members as the same (Singelis et al., 1995). This cultural orientation likely enhances the influence of social norms on individual behaviours, contributing to the observed pattern of Green FinTech intention adoption among the University of Waterloo students.

That result is consistent with the studies of Ashfaq et al. (2021), Yang et al. (2018), Singh et al. (2020), and Xie et al. (2021). Ashfaq et al. (2021) demonstrated the significance of social influence as a sub-variable affecting the adoption of Ant Forest, while Xie et al. (2021) identified a strong correlation between social influence and individuals' intention to adopt FinTech.

5.1.6. Role of Perceived Behavioural Control

As expected, perceived behavioural control positively impacts the intention to use Green FinTech. This implies that when students perceive themselves as having the cognitive ability, resources, and control necessary to use Green FinTech, they are more inclined to develop an intention to adopt it.

This result is consistent with Lee (2009), Mazambani and Mutambara (2020), Nugroho et al. (2018), and Safeena et al. (2013). The research uncovered a notable positive correlation between perceived behavioural control and the intention to use electronic money (Nugroho et al., 2018), as well as the intention to adopt cryptocurrency (Mazambani & Mutambara, 2020).

5.1.7. Summary of the Roles of Constructs

In conclusion, this thesis reveals inconsistencies solely in the role of perceived risk and its impact on attitude, contrasting with existing studies. It suggests that the young generation, with their extensive exposure to technology, may perceive fewer risks linked to new technologies. Moreover, future research could investigate whether a significant relationship exists between perceived risk and attitude across different Green FinTech products and

services. However, other constructs exhibited anticipated relationships consistent with established theory and literature.

5.2. Research limitations

Several limitations should be acknowledged in this study. Firstly, it was conducted during the nascent phase of Green FinTech development. Consequently, the intention to use Green FinTech services served as a surrogate for actual usage. Therefore, conducting another study in subsequent years would be invaluable as more Green FinTech services are anticipated to be established. Furthermore, Karahanna (1999) found that a unitary set of beliefs about information technology differs in the pre-adoption and post-adoption stages. Specifically, the study found that social norms induce initial adoption, while the attitude towards the technology, enhanced by the perceptions of usefulness and image, solely drives sustained usage.

Another potential limitation lies in the restricted participant pool comprised solely of University of Waterloo students. Although students were selected due to their age bracket, which aligns with the youth demographic, and their higher levels of technology literacy, their responses may not be fully indicative of broader populations. Consequently, may be constrained. Conducting a replication of the study with a more diverse sample and across different locations would be beneficial.

As mentioned earlier, the model accounted for 54% of the variance in the intention to use Green FinTech. Incorporating additional variables derived from UTAUT 2,3 theories, such as innovativeness and hedonic motivations (Ashfaq et al., 2021; Wang et al., 2022; Zhang et al., 2020), along with other factors like awareness (Aboalsamh et al., 2023; Au et al., 2021) and environmental concern (Wasiuzzaman et al., 2021; Zhang et al., 2020), could potentially enhance the exploratory capacity of the model. Subsequent studies should investigate these aspects, building on the findings of this exploratory research, to understand Green FinTech adoption.

Furthermore, this study explored the influence of perceived risk on the intention to use Green FinTech at a general level. The items of the construct did not delve into the effects of

multidimensional risks, such as performance, social, time, financial, and security risks, on the intention to use FinTech (Lee, 2009; Ryu, 2018; Tang et al., 2020). Therefore, future research endeavours could investigate their impacts within the context of Green FinTech adoption.

Lastly, limitations may also stem from participant recruitment and responses. The data were collected via emails distributed to instructors, potentially introducing biases in the systematic nature of recruitment. Additionally, since the questionnaire relied on students' self-reported beliefs and perceptions regarding Green FinTech, responses may be influenced by the bias, where participants may provide responses they believe align with societal expectations rather than their true beliefs.

5.3. Research Contributions

The sections below will describe the theoretical, methodological, and practical contributions of this study.

5.3.1. Theoretical Contribution

After examining the factors of TAM, TPB, and trust and risk perceptions in the adoption of Green FinTech among University of Waterloo students, this study offers several contributions to the literature. Firstly, it enhances the theoretical comprehension of Green FinTech adoption among young individuals by introducing a novel theoretical framework previously unexplored in the Green FinTech domain. Furthermore, this framework, combining TAM and TPB with perceived risk and trust, contributes to the theory of Combined TAM-TPB and empirically establishes that the inclination of young populations to adopt Green FinTech is influenced by their attitude, societal pressures, and perceived technological control. This study also unveils that perceived risk does not directly influence the attitude towards using Green FinTech; rather, it operates through the mediating factor of perceived trust. Secondly, this study confirmed the significant role of psychological factors alongside technological aspects in influencing the intention to use Green FinTech. Lastly, it demonstrates that the Combined TAM-TPB model can moderately explain the variation in the intention to use Green FinTech, suggesting its further applicability in the domain of Green FinTech adoption. Furthermore, since most of the

hypotheses were supported, the relationships between the constructs on Green FinTech adoption were consistent with the findings of studies on general FinTech adoption.

5.3.2. Methodological Contribution

This study provides methodological insights in addition to its theoretical contribution. As previously noted, only one survey item was excluded from the questionnaire, and the remaining items passed convergent and discriminant validity tests. This highlights the potential for future research to utilise these instruments in the realm of Green FinTech adoption or other pertinent domains. Furthermore, it demonstrates that the instruments were comprehensible and manageable for research participants.

5.3.3. Practical Implications

The study revealed that among the University of Waterloo students, social influence followed by attitude exerts the most significant impact on the intention to use Green FinTech. Perceived usefulness emerges as the primary driver of attitude towards Green FinTech usage. The perceived value derived from Green FinTech applications should prompt FinTech developers to devise innovative strategies, models, and green financial services to bolster adoption rates.

Moreover, perceived trust significantly influences students' intention to use Green FinTech and mediates the relationship between perceived risk and attitude towards Green FinTech. These findings underscore the importance of fostering customer trust for Green FinTech service providers, who should prioritise implementing trust-building strategies to encourage product usage. Additionally, despite the inherent risks present in technology, students did not perceive risks associated with using Green FinTech. As a result, practitioners can integrate this understanding into their marketing strategies.

Lastly, the descriptive analysis found that most students aged 18-24 have engaged with Green FinTech at least once. To capitalise on this trend, Green FinTech providers should tailor their strategies and services to align with this demographic group's specific preferences, needs, and concerns. This entails ensuring accessibility and usability and delivering tailored messaging to enhance adoption rates.

5.4. The Research Conclusion

The recent massive technological advancement led to the establishment of Green FinTech, which aims to battle the challenges associated with the requisite achievement of carbon emissions reduction. There is enormous potential for Green FinTech to narrow the green investment gap and stimulate green behaviour through convenient, user-friendly, less costly, and transparent platforms.

However, despite advancements, consumer adoption of Green FinTech is still in its early stages, highlighting a substantial gap in research concerning the factors that drive its adoption. This gap is particularly pronounced given the widespread appeal of FinTech among the younger demographic. Hence, there is a pressing need to investigate the perceptions towards the adoption of Green FinTech within this specific demographic category. Moreover, FinTech introduces various risks that could discourage consumers from embracing the technology. Performance, individual, financial, time, and cyber risks pose potential barriers to fostering trust in FinTech, a critical factor in encouraging adoption.

The primary aim of this study was to explore the factors shaping the intention to use Green FinTech among University of Waterloo students. This research introduced and evaluated the combined TAM and TPB model while incorporating perceived risk and perceived trust factors. The research model was examined through quantitative data analysis, revealing significant influences of attitude, social norms, and perceived behavioural control on students' intentions to adopt Green FinTech services. Additionally, perceived usefulness, perceived ease of use, and perceived trust emerged as significant determinants influencing attitudes toward Green FinTech usage. Notably, perceived risk indirectly impacted attitudes toward Green FinTech use by undermining perceived trust. Furthermore, perceived usefulness emerged as the most influential factor shaping attitudes toward Green FinTech services. This study supported seven of the eight proposed hypotheses, shedding light on the complex dynamics underpinning Green FinTech adoption among university students.

The study effectively addressed the research question as intended. The combined TAM-TPB model provided a moderate explanatory power for understanding the intention to adopt Green FinTech, aligning with findings from previous studies on FinTech adoption.

This research has significantly contributed to the academic literature by extending the knowledge in the nascent field of Green FinTech adoption. It has empirically examined the relationships between the factors of TAM and TPB, perceived risk, perceived trust, and intention to use Green FinTech by youth age groups. Previous research in the Green FinTech domain has not yet explored the model of combined TAM and TPB. Thus, this study gave a more comprehensive understanding of the intention to use Green FinTech.

The study elucidated some limitations, including its temporal positioning during the nascent phases of Green FinTech development and its exclusive concentration on the University of Waterloo students, thereby constraining generalizability and the potential introduction of biases due to its dependence on self-reported survey data. Future research should consider broader samples, incorporate additional variables, and investigate multidimensional risks.

Overall, the study found that perceived trust mediates the relationship between perceived risk and attitude towards Green FinTech use. Other factors such as perceived usefulness and perceived ease of use significantly impact the attitude towards Green FinTech use. It was interesting to note that the influence of the perceived usefulness of Green FinTech services was about eight times stronger than the effect of perceived trust on attitude. Students' beliefs about Green FinTech services are influenced by how useful they believe these services are at protecting the environment rather than their perception of the trustworthiness of the services. Furthermore, three psychological factors- attitude, social norms, and behavioural control- positively impact the intention to use Green FinTech. The effect of social pressure seems to play the most important role in students' intention to use green technology. The study recommends Green FinTech developers pay greater attention to the role of risks and put in place security and privacy controls. The anticipated value derived from using Green FinTech applications ought to incentivise Green FinTech providers to innovate novel strategies, frameworks, and eco-friendly financial services, thereby fostering increased adoption rates.

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Appendices

Appendix A: Questionnaire

Survey Poster

Department of SEED (School of Environment, Enterprise, and Development)
University of Waterloo

PARTICIPANTS INVITED FOR RESEARCH IN GREEN FINTECH

We are looking for volunteers for a study on the University of Waterloo students' views on Green Financial Technology.

Your participation will consist of one online survey in Qualtrics.

The anonymous survey will take approximately 7-8 minutes of your time. In appreciation for your time, you will be entered into a draw to win a $100 Amazon gift card.

For more information about this study, please contact:

Ainur Zhetpisbayeva (Master's student from SEED)
at
1-519-888-4567 x48065 or
E-mail: azhetpis@uwaterloo.ca

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board.

https://uwaterloo.ca1.qualtrics.com/jfe/form/SV_6ro4inYXAm5Esxo

Information Letter

Study Title: The assessment of Green FinTech adoption

Faculty Supervisor: Olaf Weber, PhD, School of Environment, Enterprise, Development, University of Waterloo. Phone: 1-519-888-4567 x48065, Email: oweber@uwaterloo.ca

Student Investigator: Ainur Zhetpisbayeva, candidate of MSc of Sustainability Management, School of Environment, Enterprise, Development, University of Waterloo. Email: azhetpis@uwaterloo.ca

This letter explains what the study is about, possible risks and benefits, and your rights as a research participant. You may print/save a copy for your records. If you do not understand something in the letter, please ask one of the investigators before consenting to participate.

What is the study about?

You're invited to take part in a research study of what the University of Waterloo students think about Green FinTech applications. Green FinTech, in simple terms, is all about using technology to help protect the environment and make eco-friendly choices with our money. It's like using smartphones or computer apps to do things that are good for the planet while managing your finances. For instance, it might mean using a special app to invest your money in projects that fight climate change, like building solar power plants or protecting forests. Or it could involve using online tools to keep track of and reduce your environmental impact, like how much energy you use or how many emissions your spending produces. So, Green FinTech is a way to combine technology and finance management to make the world a better and more sustainable place. This study's goal is to find out what students believe are the determinants of their Green FinTech usage.

What does participation involve?

Participation in the study will consist of an online anonymous questionnaire that takes approximately 7-8 minutes. First, you will be asked to read information about the concept of "Green Fintech". Afterwards, the first part of questions will ask you about your perspectives on Green FinTech on 7-point Likert Scale that ranges from "Strongly Disagree" to "Strongly Agree". Then, you will be asked for demographic and background information such as age, sex, education, and experience. This information will be used to compare the frequency of answers between the categories. All questions ask you to choose 1 answer only.

Who may participate in the study?

In order to participate, you must be 18 years of age or older and a student at the University of Waterloo and affiliated colleges.

Is participation in the study voluntary?

Your participation in this study is voluntary. You may decline to answer any question(s) you prefer not to answer by skipping to the next question and may stop participating at any time by not submitting your responses and closing your web browser.

Will I receive anything for participating in the study?

In appreciation of the time you have given to this study, you can enter your email address into a draw for 1 prize. You will be asked to input your email address for purposes of participating in the draw in a separate online questionnaire. The link to this questionnaire will be given at the end of the research survey. The prize includes a $100 electronic gift card to Amazon. Your odds of winning the prize are based on the number of individuals who participate in the study. We expect that approximately at least 180 individuals will take part in the study. Information collected to draw for the prizes will not be linked to the study data in any way, and this identifying information will be stored separately, and then destroyed after the prize has been provided. The amount received is taxable. It is your responsibility to report this amount for income tax purposes.

What are the possible benefits of the study?

Participation in this study will not provide any personal benefit to you. The data collected from this study seeks to offer valuable evidence-based insights into the emerging field of green financial technology, which, despite its promising potential to promote sustainable financial practices, remains relatively nascent.

What are the risks associated with the study?

There are no known or anticipated risks associated with participation in this study. If a question or the topic makes you uncomfortable, you can choose not to respond.

How is data collected, stored, and protected?

This anonymous questionnaire will not ask for your name or other identifying information. As described above, email addresses will be separately collected to participate in the draw. Removing your responses later is not possible because the researchers will have no way of identifying which responses are yours. This survey is hosted by Qualtrics, which has multiple safeguards in place, although no Internet transmission is ever fully secure. Collected data will be securely stored on a password-protected UW server for a minimum of one year.

Who is sponsoring/funding this study?

No funding.

Has the study received ethics clearance?

This study has been reviewed and received ethics clearance through the University of Waterloo Research Ethics Board (REB 12345). If you have questions for the Board, contact the Office of Research Ethics, toll-free at 1-833-643-2379 (Canada and USA), 1-519-888-4440, or reb@uwaterloo.ca.

Who should I contact if I have questions regarding my participation in the study?

If you have any questions about this study or need more information before you decide whether to participate, please contact one of the researchers named above.

Questionnaire on Qualtrics

'"The Green Fintech adoption"

Start of Block: Consent Form

ONLINE CONSENT FORM

Study Title: The assessment of Green FinTech adoption.
By providing your consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

- ○ I agree to participate in this study (1)
- ○ I do not agree to participate in this study (2)

End of Block: Consent Form

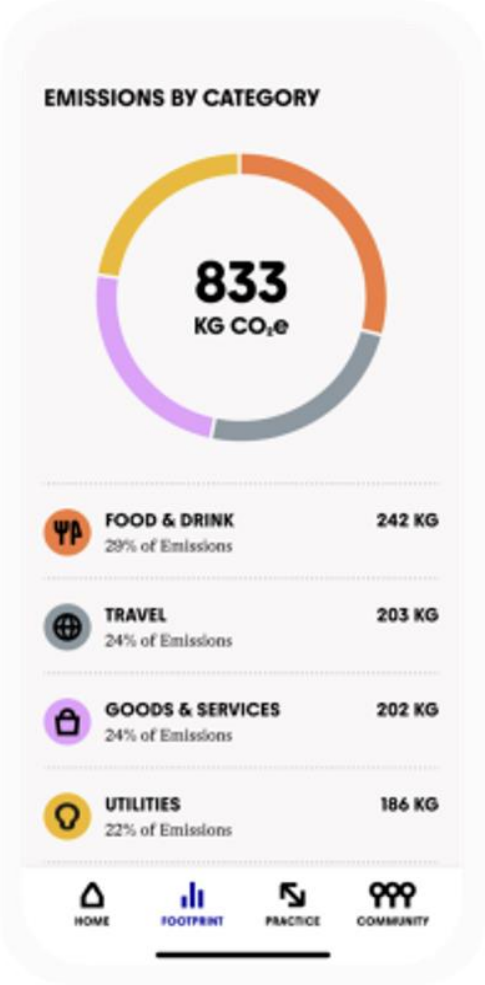
Start of Block: Background information about the concept of Green Fintech

The concept of "**Green Fintech**" (reading time = approx. 4 minutes)

Have you ever heard of **FinTech**? If you're using popular financial technology applications like PayPal, Apple Pay, Google Pay, or Alipay, you're already a FinTech user. FinTech, short for financial technology, is all about using technology to make financial services easier and more convenient, like handling financial transactions right from your phone. It's about utilising digital tools and platforms to simplify tasks such as sending money to friends, making purchases, or managing your finances.

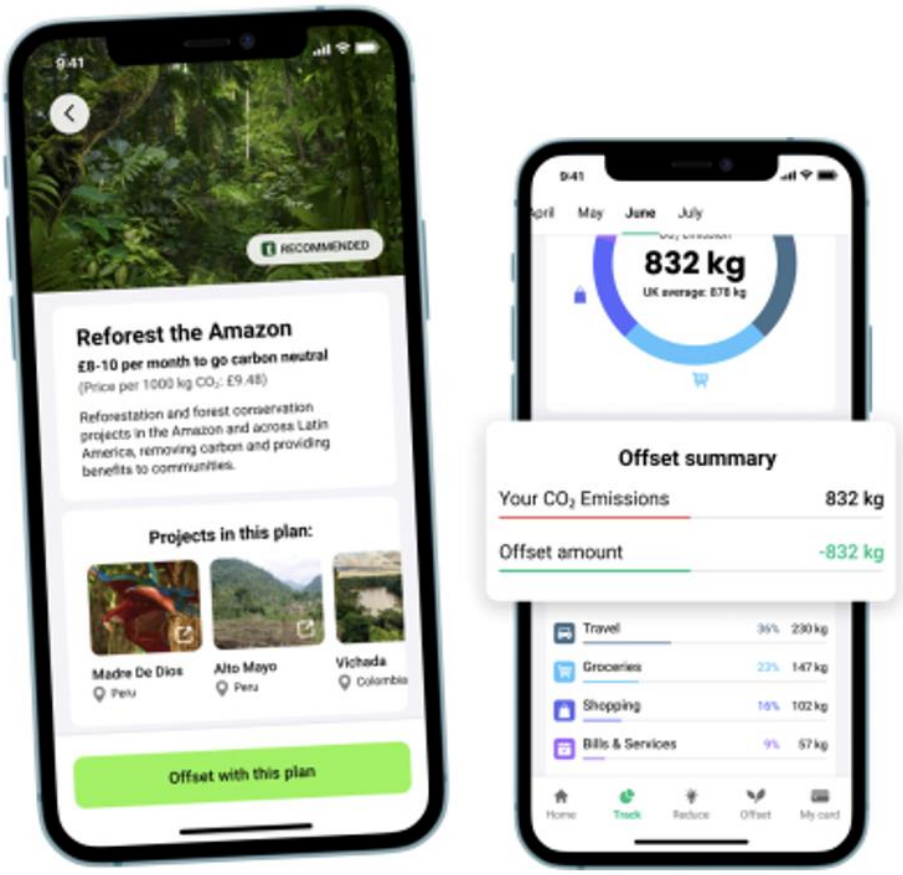
One of the types of Fintech is **"Green FinTech"**. "Green fintech" refers to the application of financial technology solutions to support environmentally sustainable practices and the transition to a low-carbon economy.
Examples of Green Fintech for consumers:
1. **Carbon Footprint Trackers:** Green fintech companies create tools and platforms that measure the amount of carbon dioxide emissions associated with your purchases, allowing you to understand and manage your environmental impact.

For example, users of the "Commons" app can view the biggest carbon drivers in their spending history.



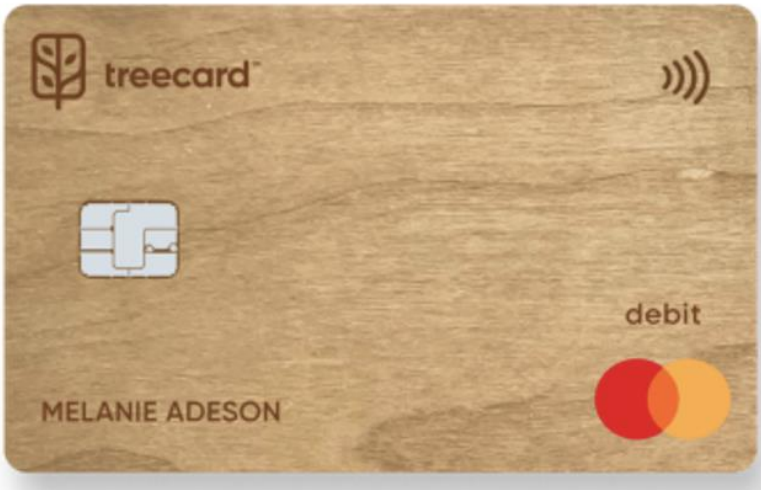
2. **Carbon Offsetting Solutions:** Some Fintech applications enable users to calculate their carbon footprint and offset it by investing in projects that absorb or remove carbon

emissions. For example, the "Tred" app allows users to invest in third-party verified eco-friendly projects that suit their budget and interest to balance out their individual emissions.



3. **Green neobanks:** These neobanks provide their customers with the same basic features other mainstream neobanks would offer, such as current account, IBAN, and debit card… but with some uniqueness. For instance, they offer wooden cards, provide sustainable investment recommendations, and invest a percentage of the interchange earned on transactions in carbon offsetting projects.

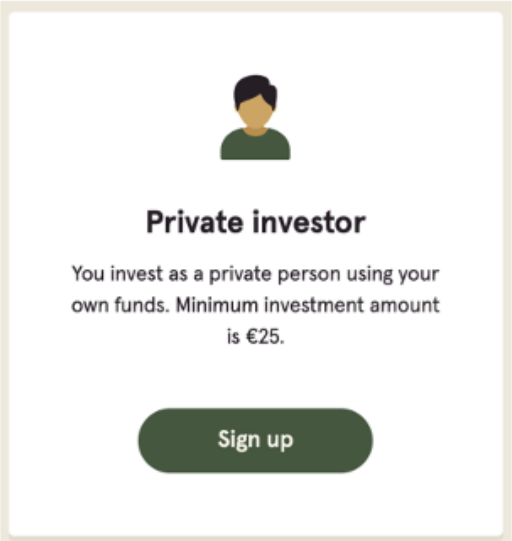
For example, Treecard offers debit cards from sustainably sourced wood and recycled plastic bottles and uses 80% of its profits from card interchange fees to plant trees.



4. **Sustainable Supply Chain Financing:** Some Green Fintech platforms allow users to scan a product's barcode or QR code to retrieve detailed information about its journey, including its origin, manufacturing processes, materials used, and environmental certifications obtained. Users can then verify if the product aligns with its claimed sustainability attributes.

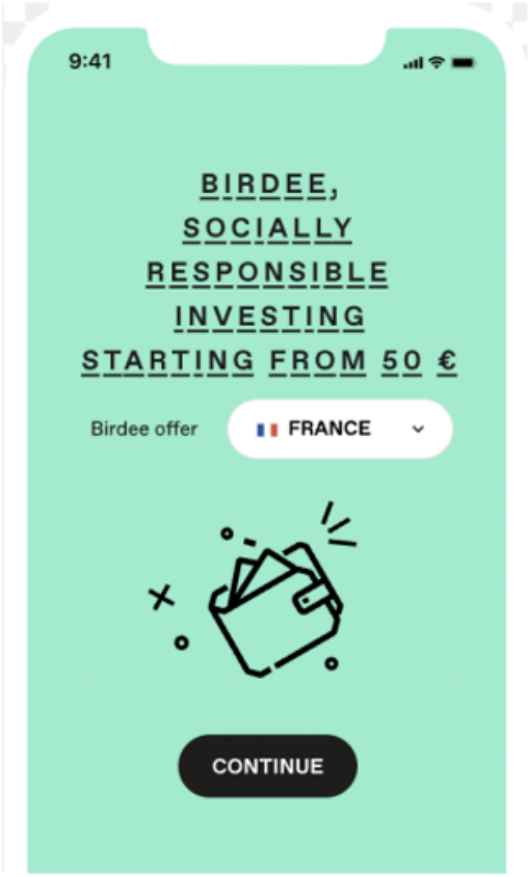
For example, IBM Food Trust allows retail consumers to use blockchain to share the origin and production process of food products with consumers. Products will have a QR code that shoppers can scan to see where the products come from, view certification and testing documentation, and learn about the traditional processes involved in making the products.

5. **Green Project Investment Platforms:** Green Fintech platforms allow users to invest in renewable energy projects, such as solar or wind farms. These investments encourage the transition to clean energy, providing financial returns while supporting sustainable energy solutions.
Trine FinTech, for example, allows customers to create accounts online and participate in solar projects through loans. Each loan is unique in terms of its impact, location, magnitude, and risk. Users can invest as little as €25 or as much as they like to fully fund the loan. When the loan is fully funded, the money from the users is transferred to the borrower. It is now their responsibility to sell and distribute solar items to its clients. Users will receive their invested funds plus interest after the borrower begins repaying the loan.



6. **Eco-Friendly Investment Portfolios**: Green Fintech firms offer investment portfolios that focus on companies supporting environmentally sustainable practices. Users can align their investments with their values by supporting businesses committed to reducing their ecological footprint.

For example, Birdee fintech offers to open an account using the mobile app in 15 minutes, invest from €50, and choose from 14 sustainable portfolios consisting of eco-friendly companies.



End of Block: Background information about the concept of Green Fintech

Start of Block: PART A

Part A. This portion of the questionnaire relates to your perceptions of potential benefits and barriers to the use of Green Fintech. Please select ***only one answer*** for each of the following questions.

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)
People who are important to me would think that I should use Green FinTech. (1)	○	○	○	○	○	○	○
People who influence my behaviour would think that I should use Green FinTech. (2)	○	○	○	○	○	○	○
People whose opinions I value would prefer that I use Green FinTech. (3)	○	○	○	○	○	○	○
Using Green FinTech is associated with a high level of risk. (4)	○	○	○	○	○	○	○
There is a high level of uncertainty using Green FinTech. (5)	○	○	○	○	○	○	○
Overall, I think that there is little benefit to using Green FinTech compared to traditional financial services. (6)	○	○	○	○	○	○	○

Green Fintech would have adequate features to protect my security (7)	○	○	○	○	○	○	○
Green Fintech would keep my financial information secure (8)	○	○	○	○	○	○	○
Green Fintech would have adequate features to protect my privacy (9)	○	○	○	○	○	○	○
Green Fintech would keep my personal data safe (10)	○	○	○	○	○	○	○
Green Fintech is trustworthy (11)	○	○	○	○	○	○	○
I think that using Green Fintech would enable me to accomplish my green activities more quickly (12)	○	○	○	○	○	○	○
I think that using Green Fintech would make it easier for me to carry out my green activities (13)	○	○	○	○	○	○	○

I think Green Fintech is useful (14)	○	○	○	○	○	○	○
Overall, I think that using Green Fintech is advantageous (15)	○	○	○	○	○	○	○
Using Green Fintech is a good idea to accomplish my green activities (16)	○	○	○	○	○	○	○
I have a positive view toward using Green Fintech for monitoring carbon emissions (17)	○	○	○	○	○	○	○
I think using Green Fintech is beneficial for protecting the environment. (18)	○	○	○	○	○	○	○
Using Green Fintech is convenient to accomplish my green activities (19)	○	○	○	○	○	○	○
I have the resources and the knowledge and the ability to make use of Green Fintech (20)	○	○	○	○	○	○	○

I think I would be able to use Green Fintech (21)	○	○	○	○	○	○	○
I think that learning to use Green Fintech would be easy (22)	○	○	○	○	○	○	○
I think that interaction with Green Fintech would not require a lot of mental effort (23)	○	○	○	○	○	○	○
I think that it would be easy to use Green Fintech to accomplish my green activities (24)	○	○	○	○	○	○	○
I intend to adopt Green FinTech in the future (25)	○	○	○	○	○	○	○
I predict that I will frequently use Green FinTech in the future (26)	○	○	○	○	○	○	○
I will strongly recommend others to use Green FinTech (27)	○	○	○	○	○	○	○

End of Block: PART A

Part B. This portion of the questionnaire collects some basic demographic information and background information about you. Please select ***only one answer*** for each of the following questions.

Q13 How old are you?

- 18-24 (1)
- 25-30 (2)
- 31-39 (3)
- >40 (4)

Q14 What sex are you?

- Male (1)
- Female (2)
- Intersex (3)
- Prefer not to say (4)

Q15 What level of education are you pursuing?

- Bachelor's Degree (1)
- Master's Degree (2)
- PhD (3)

Q16 In which faculty or affiliated institution are you currently enrolled?

- Arts (1)
- Engineering (2)
- Environment (3)
- Health (4)
- Mathematics (5)
- Science (6)
- Conrad Grebel University College (7)
- Renison University College (8)
- St. Jerome's University (9)
- United College (10)

Q17 Which statement best describes your level of experience using Green Fintech?

- None (1)
- Beginner (2)
- Intermediate (3)
- Advanced (4)

Q18. Have you ever used Green Fintech?

- Yes (1)
- No (2)

End of Block: Block 5

Start of Block: Block 6

Q18 If you would like to participate in the draw to win a $100 Amazon electronic gift card and would like to receive a copy of the research results, please use the link below.

https://uwaterloo.ca1.qualtrics.com/jfe/form/SV_1Moqi8xL9WGSiQ6

End of Block: Block 6

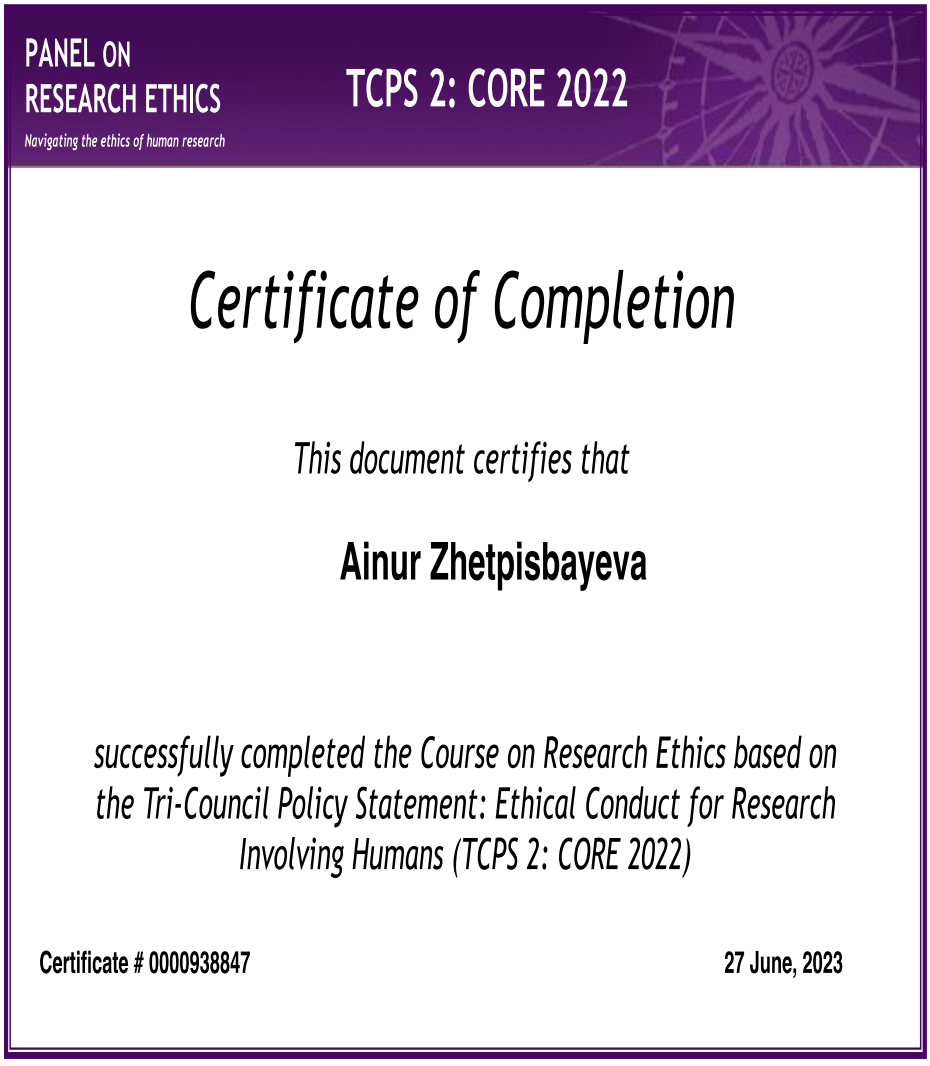
Start of Block: Block 7

Q19 Thank you for participating in the “Green FinTech” survey!
Your feedback is extremely valuable. Once all the data are collected and analyzed for this project, I plan on sharing this information with the research community through my thesis. If you indicated on the survey that you would like a copy of the results, they will be sent to you by email at the address you provided by 07/01/2024.

This study has been reviewed and received ethics clearance through the University of Waterloo Research Ethics Board (REB #45600). If you have questions for the Board, contact the Office of Research Ethics, toll-free at 1-833-643-2379 (Canada and USA), 1-519-888-4440, or reb@uwaterloo.ca. For all other questions, general comments, or questions related to this study, please contact Ainur Zhetpisbayeva, School of Environment, Enterprise, Development (SEED), University of Waterloo, Email: azhetpis@uwaterloo.ca

End of Block: Block 7

Appendix B: Ethics Clearance Certificate



PANEL ON RESEARCH ETHICS

Navigating the ethics of human research

TCPS 2: CORE 2022

Certificate of Completion

This document certifies that

Ainur Zhetpisbayeva

successfully completed the Course on Research Ethics based on the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2: CORE 2022)

Certificate # 0000938847

27 June, 2023

Appendix C: List of measurement items

List of measurement items

Construct	Items	Source
Social Norms (SN)	SN1: People who are important to me would think that I should use Green FinTech. SN2: People who influence my behaviour would think that I should use Green FinTech. SN3: People whose opinions I value would prefer that I use Green FinTech.	(Venkatesh et al., 2012)
Perceived Risk (PR)	PR1: Using Green FinTech is associated with a high level of risk. PR2: There is a high level of uncertainty using Green FinTech. PR3: Overall, I think that there is little benefit to using Green FinTech compared to traditional financial services	(Kim et al., 2008)
Perceived Trust (PT)	PT1: Green Fintech would have adequate features to protect my security PT2: Green Fintech would keep my financial information secure PT3: Green Fintech would have adequate features to protect my privacy PT4: Green Fintech would keep my personal data safe PT5: Green Fintech is trustworthy	(Shaw, 2014)
Perceived Usefulness (PU)	PU1: I think that using Green Fintech would enable me to accomplish my green activities more quickly PU2: I think that using Green Fintech would make it easier for me to carry out my green activities PU3: I think Green Fintech is useful PU4: Overall, I think that using Green Fintech is advantageous	(Venkatesh et al., 2003)
Attitude towards use (ATU)	ATU1: Using Green Fintech is a good idea to accomplish my green activities ATU2: I have a positive view toward using Green Fintech for monitoring carbon emissions ATU3: I think using Green Fintech is beneficial for protecting the environment.	(Venkatesh et al., 2003) (Chin & Lin, 2016) (Boyko et al., 2011) 13-5-2024 20:23:00
Perceived Behavioural Control (PBC)	PBC1: Using Green Fintech is convenient to accomplish my green activities PBC2: I have the resources and the knowledge and the ability to make use of Green Fintech	(Venkatesh et al., 2003) (Taylor & Todd, 1995) (Zhang et al., 2016)

	PBC3: I think I would be able to use Green Fintech	
Perceived Ease of Use (PEOU)	PEOU1: I think that learning to use Green Fintech would be easy PEOU2: I think that interaction with Green Fintech would not require a lot of mental effort PEOU3: I think that it would be easy to use Green Fintech to accomplish my green activities	(Laksamana et al., 2023)
Intention to use (ITU)	ITU1: I intend to adopt Green FinTech in the future. ITU2: I predict that I will frequently use Green FinTech in the future. ITU3: I will strongly recommend others to use Green FinTech.	(Venkatesh et al., 2012)