Master's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Economics and Management
Department of International Business

Øistein Strøm Røvde
Iver Høegh Krohn Viddal

Towards an understanding of factors affecting mobile wallet adoption: Evidence from Norway

Applying PLS-SEM and PLS-MGA to measure behavioral factors affecting mobile wallet adoption

Master's thesis in International Business and Marketing
Supervisor: Ahmad Amine Loutfi & Ghulam Mustafa
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Abstract

Smart phones have changed the way we communicate with one another and will in the future changing the way we pay for goods and services both online and at point of sale. Mobile wallets are the driving force behind the changing payment behavior and will in the long run change the payment norm in Norway. Knowing that mobile wallet adoption still is in an early phase, this thesis aims to determine which factors that is affecting the adoption of a mobile wallets as a substitute for physical wallet.

To investigate the acceptance of new payment norms we have investigated the environmental factors and behavioral factors affecting mobile wallet adoption. The environmental factors are related to the contingency factors describing that consumers behavior is dependent on the availability of technology and its supportive infrastructure to adopt a mobile wallet. Furthermore, to measure the behavioral factors, we have created a conceptual research model (modified TAM) which is combining constructs from psychology, sociology and behavioral research together with constructs obtained from IS and IT related theories. The conceptual research model incorporates the constructs *actual behavior, behavioral intention, attitude towards behavior, subjective norm, perceived behavioral control, perceived usefulness, perceived ease of use, perceived enjoyment* and *trust* as factors determining mobile wallet adoption.

The conceptual research model was tested using empirical data from 323 respondents which were analyzed using the PLS-SEM method. To determine the constructs predictive ability the structural model was assessed based on the size and significance of the path coefficient and the three criterions measuring 1) explained variance (R^2), 2) the effect size (f^2) and 3) the predictive relevance (Q^2). The findings from the PLS-SEM analysis indicates that the conceptual research model indicates a significant result in 12 of 17 hypothesis. The path model explains 27,2% of the adjusted R^2 in the construct *actual behavior* and 66% of the adjusted R^2 in the construct *behavioral intention*. Furthermore, a PLS-MGA was performed to identify significant differences among subgroups within the dataset. The analysis indicated that there exist significant differences between age groups (under 35/over 35) related to the adoption of mobile wallets. The findings presented in this study have practical and theoretical relevance for researchers, system designers and engineers who wish to gain a better understanding of which factors that affect the adoption mobile wallets.

Sammendrag

Smarttelefoner har endret måten vi kommuniserer med hverandre på, og vil i fremtiden endre måten vi betaler for varer og tjenester både online og i butikk. Mobile lommebøker er drivkraften bak den endrede betalingsadferden, og de vil på sikt endre betalingsnormen i Norge. Siden vi vet at adopsjon av mobile lommebøker fremdeles er i en tidlig fase, tar denne oppgaven sikte på å fastsette hvilke faktorer som påvirker adopsjonen av mobile lommebøker som erstatning for en fysisk lommebok.

For å undersøke mottagelsen av nye betalingsnormer har vi undersøkt miljøfaktorer og adferdsfaktorer som påvirker den mobile lommebokadopsjonen. Miljøfaktorene er relatert til betingelsesfaktorene som beskriver at forbrukernes adferd er avhengig av tilgjengeligheten av teknologi og dens støttende infrastruktur for å adoptere en mobil lommebok. Videre har vi laget en konseptuell forskningsmodell (modifisert TAM) for å måle adferdsfaktorene hentet fra psykologi, sosiologi og adferdsforskning kombinert med faktorer hentet fra IS og IT relaterte teorier. Den konseptuelle forskningsmodellen inkorporerer faktorene faktisk adferd, intensjon om adferd, holdning til adferd, subjektiv norm, opplevd adferdskontroll, opplevd nytte, opplevd brukervennlighet, opplevd glede og tillit som faktorer som bestemmer adopsjon av mobile lommebøker.

Den konseptuelle forskningsmodellen ble testet ved å bruke empiriske data fra 323 respondenter som ble analysert ved bruk av PLS-SEM-metoden. For å bestemme faktorenes prediktive evne ble den strukturelle modellen vurdert ut fra størrelsen og betydningen av stikoeffisienten og tre kriteriene som henholdsvis måler 1) forklart varians (R^2), 2) effektstørrelsen (f^2) og 3) den prediktive relevansen (Q^2). Funnene fra PLS-SEM-analysen indikerer at den konseptuelle forskningsmodellen indikerer et signifikant resultat i 12 av 17 hypoteser. Stimodellen forklarer 27,2% av justert R^2 i faktoren faktiske adferd og 66% av justert R^2 i faktoren intensjon om adferd. Videre utførte vi en PLS-MGA for å identifisere signifikante forskjeller mellom undergrupper i datasettet. Analysen indikerte at det eksisterer signifikante forskjeller mellom aldersgrupper (under 35 / over 35) relatert til adopsjon av mobile lommebøker. Funnene presentert i denne studien har praktisk og teoretisk relevans for forskere, systemdesignere og ingeniører som ønsker å få en bedre forståelse av hvilke faktorer som påvirker adopsjonen av mobile lommebøker.

Preface

This thesis was written by Øistein Strøm Røvde and Iver Høegh Krohn Viddal as part of the Master of Science in International Business and Marketing at the Norwegian University of Science and Technology (NTNU).

The cooperation between us and our interest in the area of research started after a successful summer internship in 2019 where we worked with changes in the banking industry in relation to the use of technology in finance, regulation, competition and changing consumer behaviors in an international perspective. The work took place at the TEFT-lab, which is a hub for research and development in service innovation, entrepreneurship, finance and technology operated by NTNU and Sparebanken Møre. This thesis is an extension of the summer internship and was suggested as an area of interest by Ahmad Amine Loutfi.

We would like to thank our supervisors Ahmad Amine Loutfi and Ghulam Mustafa for their valuable feedback. Their feedback gave us motivation, affirmation and security throughout the process. We would also take this opportunity to thank Tove Margrete Bjørkavåg and Bjørn Petter Haugen at Sparebanken Møre, and Øivind Strand at NTNU for introducing us to this exiting area of research. Finally, we would like to thank all respondents who have taken time to answer the questionnaire.

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List of abbreviation

3DS	3D Secure	PCI SSC	Payment Card Industry Security Standards Council
ATU	Attitude towards behavior	PE	Perceived enjoyment
AVE	Average variance extracted	PEOU	Perceived ease of use
BI	Behavioral intention	PLS	Partial least squares
CR	Composite reliability	PLS-MGA	Partial Least Square Multigroup Analysis
DOI	Diffusion of innovations	PLS-SEM	Partial Least Square Structural Equation Modeling
EBA	European Banking Authority	POS	Point of sale
EEA	European Economic Area	PSD2	Revised Payment Services Directive
EU	European Union	PU	Perceived usefulness
f_2	Effect size	Q_2	Predictive relevance
FinTech	Financial technology	QR-code	Quick Response code
FHI	The Norwegian Institute of Public Health	R_2	Explained variance
GDPR	General Data Protection Regulation	RTS	Regulatory Technical Standards
GPS	Global positioning system	SCA	Strong Customer Authentication
HTMT	Heterotrait-monotrait ratio	SDT	Self-determination theory
IS	Information systems	SN	Social norm
IT	Information technology	SSE	Sum of the squared prediction errors
MM	Motivational model	SSO	Sum of the squared observations
NFC	near field communication	TAM	Technology Acceptance Model
NSD	Norwegian Centre for Research Data	TRA	Theory of Reasoned Action
NTNU	Norwegian University of Science and Technology	TPB	Theory of Planned Behavior
P2P	Person-to-person payments	UTAUT	Unified theory of acceptance and use of technology diffusion
PBC	Perceived behavioral control		

1. Introduction

Telecommunication has been profoundly transformed by smart phones, and we believe smart phones also will change how we perform economic transactions in the future. Today's smart phones are filled with value added features such as multimedia functionality (music, photo, video), internet connectivity, e-mail, calendar, global positioning system (GPS), mobile banking and mobile payment services. What's really interesting is how the development of mobile payment services have enabled consumers to use smart phones as a method of payment anywhere and at anytime (Leong, et al., 2013). Some researchers have gone so far as to describe the smart phone as the "consumer's new wallet" (Regjeringen, 2016; Shin, 2009).

Historically the development of payment services has evolved from bartering of goods to utilizing coins and cash as means of payments. This was sequentially followed by the invention of credit and debit cards and lately by digital currencies embedded by blockchain distributed technologies. The technological revolution smart phones have created within the payment industry has led to the introduction of new business models. The revolution has further changed the payment market, and a wealth of new products and services are currently under development all around the world. One example of such a development is the mobile wallet. A mobile wallet is defined in the literature as *"a much-advanced versatile application that includes elements of mobile transactions[1], as well as other items one may find in a wallet, such as membership cards, loyalty cards and travel cards"* (Shin, 2009, p. 1343).

A study from 2019 revealed that 99% of the population of Norway possesses an ordinary mobile phone. 95% of these uses a smart phone on a daily basis (Statistisk sentralbyrå, 2020). The usage of smart phones has exceeded any other technical device because of the functionality and relevance of the services it delivers (Dahlberg, et al., 2008). In the last couple of decades the rise of smart phones and internet services have led to an increasing number of digital transactions[2] and provided a basis for change in the payment industry (Haare & Solheim, 2011). Globally, the payment industry has evolved significantly the past 15 years. The Capgemini's World Payment Report of 2019 stated that the digital transaction volumes were the highest they have measured in the past two decades, reaching 539 billion and a growth of 12% from 2015

[1] Mobile transactions also referred to as mobile payments is defined as *"payments for goods, services, and bills using a mobile device using wireless and other communication technologies"* (Yang, et al., 2012)

[2] Digital transactions are defined to include all non-cash transaction volumes (Capgemini Research Institute, 2019).

to 2017 (Capgemini Research Institute, 2019). Especially Asia contributed to the high growth rate with an increase of 32% in global digital transaction volumes. On a global level the trends of growth drivers include 1) adoption of mobile payment services, 2) a widespread implementation of mobile wallets, 3) a further acceptance of contactless technology and 4) other digital innovations (Capgemini Research Institute, 2019). All of these trends are directly tied to the use of smart phones as the *"consumers new wallet".*

Despite the fact that Norway ranks as number one when per-inhabitant digital transactions is measured (Capgemini Research Institute, 2019), the use of mobile wallets to enable payments is very low. A survey conducted by the central bank of Norway showed that contactless payments (tap and pay) made with mobile wallets accounted for only 2,1 % of all physical payments (Norges Bank, 2020). Our motivation for the thesis is to try to understand the slow adoption of a mobile wallets in a country that is world leading in its use of digital transactions, and also have one of the best payment infrastructures in the world (Nicolaisen, 2019).

1.1 Research question

Within information systems research (IS) and information technology research (IT), the topic of technology adoption is popular and seems especially important in the emerging area of mobile payment research (Dahlberg, et al., 2008). There has been a number of competing and complementary theoretical perspectives for studying adoption and behavior since the 1960's. An example is Martin Fishbein and Icek Ajzens (1967) Theory of reasoned action (TRA), Ajzens (1985) Theory of planned behavior (TPB), and Davis' (1989) Technology acceptance model (TAM). These theories are some of the most cited models when adoption, *behavioral intention* or *actual behavior* are measured. In this thesis we have adopted constructs from all of the mentioned theories and additionally included other external factors to measure intrinsic motivation and trust.

To achieve the goal of understanding adoption we have developed a conceptual research model for studying the topic based on previous research on technology adoption. The lack of a single, unified theory that allows measuring extrinsic and intrinsic motivation, *behavioral intention* and *actual behavior*, supported the development of the conceptual research model. Based on our literature review (Chapter 2.2) on adoption of mobile wallets, our research question investigated the behavior of consumers and their willingness to adopt mobile wallets. Our

research question is based on the literature of TRA, TPB, TAM, MM (motivational model) and trust theories, and seek to find the answer to the following question: **Which factors affect the adoption of a mobile wallet as a substitute for the physical wallet?** We will take a closer look at consumers *extrinsic motivation (perceived usefulness and perceived ease of use)* and *intrinsic motivation (perceived enjoyment)*, as well as factors such as *behavioral intention, attitude towards behavior, subjective norm, perceived behavior control* and *trust* to measure *actual behavior*.

1.2 Theoretical and practical contribution

Given the current state of research on mobile payments and mobile wallets, the objective of this thesis is to empirically test a theoretically grounded model of adoption that integrates behavioral beliefs, social factors and personal characteristics. From a theoretical perspective, this thesis will primarily contribute to a better theoretical understanding of the factors influencing the adoption of mobile wallets in a highly developed country existing in the western market. We would argue that it also compliments the research performed in the eastern markets. From a practical standpoint, this thesis incorporates constructs that captures the behavior of mobile wallet users, and it will give researchers, system designers and engineers a better understanding of which factors that affects the adoption a mobile wallet to build a better user experience.

1.3 Thesis outline

Chapter 2 includes literature review and a thorough explanation of mobile wallets and the belonging contingency factors affecting adoption. Chapter 3 offers a comprehensive review and critique of the most relevant theories that provides basis for the development of testable hypotheses and laid the ground for the creation of the conceptual research model used in this study. Chapter 4 includes a discussion of our research methodology and a thorough description of the research design and how we collected data to test our hypothesis. It also includes a description of the data analysis and the chosen statistical technique. Chapter 5 includes descriptive statistics of the findings and an assessment of the measurement model including validity and reliability analysis. We will also in this chapter evaluate the structural models' strength, relevance and predictive power together with an assessment of the size and significance of the path coefficients. Chapter 6 includes an interpretation of the research findings, provides a discussion of implications, outlines the study limitations, and offers a comprehensive summary and conclusion of the main findings.

2. Literature review and contextualization

In this chapter we will shortly present some important findings from previous literature and define important concepts used throughout this thesis. Furthermore, in an attempt to contextualize this thesis, we will present contingency factors which describes current environmental factors affecting mobile wallet adoption

2.1 Introduction

New business models and technological concepts provides a basis for new research within the field of financial technology (FinTech). Changes in the global environment has increased the internet-based economy and created new user patterns for mobile devices while at the same time decreased the reluctance of paying digitally with, for example, a mobile wallet (Gomber, et al., 2017).

2.1.1 Defining financial technology

FinTech is described to be the use of technology in finance (Knudsen, 2019). Although such a definition is widely used, it says little about why FinTech is an interesting research topic. Another commonly used definition is that FinTech consist of all new products, services and business models that is technology-driven and exist within the financial sector (Knudsen, 2019). While this definition better captures the complexity of what makes FinTech interesting, it also excludes all innovations driven by different changes in the environment, other than technology, such as regulatory, demographic, political and socio-economic changes, where technology is part of the solution rather than the dominant driver (Knudsen, 2019). FinTech is about combining insights from platform theory, innovative business models, emerging data technology, rules and regulations, psychology, behavior theory and finance (Knudsen, 2019). Lastly, at the same time that the FinTech industry have evolved, the academic research on mobile payment services have developed in parallel, making it an exciting research area for further research, due to constant changes in the environment and in consumer behavior.

2.1.2 Defining mobile payments

Since the late 90's the innovations within FinTech have paved the way for new forms of mobile payment solutions. There are three main reasons for this development: 1) The demand for mobile payments has increased because of the rise of online banking and online shopping (Gomber, et al., 2017). 2) Lower transaction costs compared to traditional payment methods

such as cheques and credit cards (Gomber, et al., 2017). 3) The use of smartphones as the *"consumers new wallet"* (Shin, 2009).

Mobile payments are defined as *"payments for goods, services, and bills using a mobile device using wireless and other communication technologies"* (Yang, et al., 2012). Mobile payment services also include peer-to-peer[3] payments, mobile wallets payments and e-payments. The literature related to mobile payments and especially its subcategory of mobile wallets research is of particular interest. Existing research studying the adoption of mobile payment services such as mobile wallets, is mainly focusing on constructs inherited from TAM, Unified theory of acceptance and use of technology diffusion (UTAUT) and of innovation theory. Most of the mobile payment research focuses on the adoption of a mobile payment system and user behavior (Dahlberg, et al., 2008). The findings of these studies illustrate that *perceived ease of use, perceived usefulness, trust* and *risk* acts as the most important factors affecting the *behavior intention* and *actual behavior*. Other important factors affecting *behavioral intention* are demographic, security, compatibility, social influence, and cost (Dahlberg, et al., 2008; Dahlberg, et al., 2015; Gomber, et al., 2017).

Our analysis of the previous literature suggests that few researchers have combined constructs from psychology, sociology and behavioral research (TRA and TPB) together with IS and IT related theories (TAM, MM) and applied them in a mobile wallet context (Dahlberg, et al., 2008; Dahlberg, et al., 2015; Gomber, et al., 2017). The rationale behind combining constructs from psychology, sociology and behavioral research together with IS and IT related theories is because we want to identify factors that can add to the prediction of *behavioral intention* and *actual behavior*. The combination enables us to study people's behavior relating technology adoption more accurately. Furthermore, we could not find any research paper that measures intrinsic motivation in combination with IS and IT related theories within our research area. By including intrinsic motivation to our conceptual research model, we will gain a more holistic view of factors affecting mobile wallet adoption, since previous studies (such as Shin (2009)) have included factors measuring extrinsic motivation with great success.

[3] Peer to peer payments is defined *"Person-to-person payments (P2P) is an online technology that allows customers to transfer funds from their bank account or credit card to another individual's account via the Internet or a mobile phone"* (Inveting Answers Inc., 2019)

2.2 Introduction to mobile wallets and contingency factors

As mentioned in the introduction, a mobile wallet is defined in the literature as *"a much-advanced versatile application that includes elements of mobile transactions, as well as other items one may find in a wallet, such as membership cards, loyalty cards and travel cards"* (Shin, 2009). In this thesis a mobile wallet is described to be a mobile application stored on a smart phone that can handle information about payment card(s), loyalty card(s) and other ID documents. A mobile wallet can also handle information related to the transactions, such as purchase confirmations and receipts (Kenton, 2019).

Mobile wallet payments typically fall into two payment categories: 1) daily purchases or 2) peer to peer payments. When it comes to daily purchases mobile wallet payments complement and/or compete with traditional payment methods including cash, cheques and payment cards (Dahlberg, et al., 2008). Peer to peer payments funds can be transferred between two individuals through an intermediary such as Vipps, Apple Pay or Google Pay. Furthermore, a mobile wallet can be used in a variety of different payment scenarios both online, in mobile applications and at POS (Dahlberg, et al., 2008). When the mobile wallet is used at point of sale (POS), it is typically used in combination with either near field communication (NFC) or Quick Response code (QR-code) to complete the mobile payment. According to BankAxept, the mobile wallet payment method is nine seconds faster than traditional payment solutions where the PIN code must be entered (Heir, 2018). When a mobile wallet is used online or in mobile applications, the consumer chooses to pay with for example Apple Pay or Vipps instead of traditional payment methods with payment cards. The benefits of adopting mobile wallets are many, including faster payment methods, less wear on the terminals and increased security, because the PIN-code is not exposed as frequently (Heir, 2018). Lastly, payment of bills can also be done through mobile wallets since it typically provides access to account-based payment instruments (Dahlberg, et al., 2008).

2.2.1 International payment market size

In the last decade the hottest and most innovative area of FinTech have been the payment industry. Allied Market Research (2018) valuated the mobile payment market at $601 billion in 2016. They further estimated the annual growth rate to be 33,4% and thus reaching $4574 billion by 2023 (Allied Market Research, 2018). The rise in demand for effective and convenient payment solution has created a mobile payment market with an increasing number

of payment service providers. Alipay, Apple Pay, Google Pay and PayPal are all international providers of mobile wallet solution that have gained customer trust (Hernæs, 2020). In Norway the national competition is led by Vipps and Coopay, creating a research context for looking into the consumers preferences of mobile wallet providers.

2.2.2 Contingency factors influencing adoption of mobile wallets

Dahlberg, et al., (2008) has created a framework that can be used as a meta framework to explore the various factors that affect mobile wallet adoption. The framework uses the *generic contingency theory* which emerged from the work of Fiedler (1964), Thompson (1967) and Lawrence & Lorsch (1967). The contingency theory is a behavioral theory which highlights that there is no best way to manage or organize, instead the behavior is contingent (dependent) on the environmental influence and the situational context (Lawrence & Lorsch, 1967). The four contingency factors inherited from Dahlberg, et al., (2008) are: 1) changes in legal, regulatory and standardization environment, 2) changes in the payment environment, 3) changes in the technological environment and 4) changes in social and the cultural environment.

The contingency factors describe that consumer behavior is dependent on the environmental influence from available technology and its supportive infrastructure. The adoption of mobile wallets is accordingly dependent on environmental influence from factors which can be hard to measure in a consumer centric research. The framework is therefore mainly used to contextualize this study. The framework is not part of the conceptual research model, since the objective of this thesis is to empirically test behavioral factors affecting adoption and not to empirically test the contingency factors affecting adoption. The contextualization argument makes sense given the differences in cultural, institutional, and technological environment between countries. We therefore argue that the contingency factors directly and indirectly affect mobile wallets adoption since they can be interpreted as boundary conditions or constraints necessary for the individual's adoption decision.

2.2.2.1 Legal, regulatory and standardization environment

Dahlberg, et al., (2008, p. 172) stated that *"Changes in the legal, regulatory and standardization environment deal with evolving jurisdiction, regulations and other norms with requirements to comply. These contingency items may trigger needs for new or enhanced payment services, and drive or hinder the development of mobile payments."*

In Europe the Revised Payment Services Directive (PSD2) was implemented with an aim to establish an easy, efficient and secure payment service across the European Union (EU) (including European Economic Area (EEA)) (European Commission, 2018). The directive regulates the European payment market and includes new and existing payment service providers such as banks, FinTech companies and global tech giants. The European Commission stated that the key objective of PSD2 where to: 1) Contribute to a more integrated and efficient payments market, 2) level the playing field for payment service providers, 3) make payments more secure and 4) protect consumers (European Commission, 2018). The EU directive ultimately reduce complexity and facilitate development of mobile payment services (Dahlberg, et al., 2008) and hence affect the adoption of mobile wallets.

The standardization of the European payment market includes the Regulatory Technical Standards (RTS)[4], including Strong Customer Authentication (SCA) and 3D Secure (3DS) (European Commission, 2017), but also standardizations relating payment terminals which is defined by the Payment Card Industry Security Standards Council (PCI SSC). SCAs main objective is to reduce fraud and make electronic payments more secure, it therefore follows the new European regulatory requirement affecting security when performing a transaction online or at POS. To perform an electronical payment the consumer has to authenticate themselves with two separate elements out of these three: 1) something you own (e.g. a mobile phone or a card), 2) something you know (e.g. a password or a pin code) and 3) something you are (biometrics such as fingerprint or face recognition) (European Commission, 2017). This is also called a two-factor authentication process.

The transactions that are in the scope of SCA are electronic transactions initiated by the consumers (Cocoman & Godement, 2019). To authenticate such transactions the payment industry uses a standard protocol called 3D Secure (3DS). The current version of the software (3DS2) compliments mobile wallets such as Vipps, Apple Pay and Google Pay, which have a built-in authentication layer (biometric or password) to enhance payment flow. 3DS2 also leads to higher authentication rates because it allows the acquirer to send richer transaction data to

[4] The European Banking Authority (EBA) have in cooperation with The European Central Bank (ECB) developed the Regulatory Technical Standards (RTS). The standards key objectives are to ensure customer protection and transaction security. RTS define standards for Strong Customer Authentication (SCA) (European Commission, 2017)

the issuer (Cocoman & Godement, 2019). Visa describes 3DS2 as a fundamental upgrade of the global standard for electronic payment authentication (VISA, 2018).

The latest standardization that is implemented in Norway (January 2020) is regarding all contactless payment solution and apply every POS. The standardization is issued by the PCI SSC which have the primary responsibility for defining the standard for payment solutions globally (PCI SSC, u.d.). This standardization entails that all payment terminals in Norway must support contactless payment, while all cards issued will include contactless payment service. This means that you can pay with your mobile phone, wearable or contactless cards anywhere (Johansen, 2018).

The legal, regulatory and standardization framework mentioned in this chapter is likely to affect *perceived usefulness, perceived ease of use* and *trust* mentioned in the literature review. SCA and 3DS2 are especially important for the *perceived ease of use* which can be affected by trust and security. There is assumed to be a tradeoff level of security and *perceived ease of use* (Dahlberg, et al., 2008).

2.2.2.2 Payment environment

The payment environment, also called the payment infrastructure, includes the changes and improvements of the existing payment systems and the financial and telecommunication infrastructure (mobile coverage) to support better flow of payments. The payment systems used in Norway includes the international payment system, with players as Visa, Mastercard and the national payment system operated by BankAxept (Norwegian Competition Authority, 2018).

The Norwegian payment infrastructure is described to be one of the best in the world, and the central bank of Norway has for many years had the task of providing an efficient and secure payment system. In the latest Central Bank Act it is clearly specified how the central bank of Norway should operate the payment settlement system and supervise the interbank payment systems in order to improve the already well functioning Norwegian payment infrastructure (Nicolaisen, 2019). A well-functioning payment infrastructure is considered to be user friendly, cost efficient and stable (Bits AS, u.d.). On the other hand, the international payment system consists of players such as the international banks, the national central banks, global finance institutions and other payment providers such as Visa or MasterCard. They form the first layer

in the international payment system, a system for processing transactions and settlements between market players.

The choice of payment system will happen automatically and are normally dependent on location, payment method, functionality and price (Norwegian Competition Authority, 2018). For consumers the price of using only the international payment system will ultimately increase the cost of goods compared to the cheaper national solution operated by BankAxcept. The national solution cost between 0,12-0,24 NOK depending on transaction volume at the individual stores (Hautemanière, 2019) while Visa and Mastercard charge an interchange fee off 0,2%, per transaction (VISA, 2018; Mastercard, 2020). With an average transaction amount of 382 NOK (Norges Bank, 2019), the interchange fee, charged by the international payment system is between 3,2-6,4 times more costly, compared to the national payment system and thus increase consumer prices online and at POS. International mobile wallet providers exclusively uses the international payment system, thus the cost of goods will increase due to higher cost levels. Previous research states that increased cost would negatively affect adoption (Dahlberg, et al., 2008; Dahlberg, et al., 2015).

The latest years the payment industry have changed dramatically, and without fast, inexpensive and secure payments solutions, consumers are fast to adopt more convenient services to process payments more efficient. Most consumers have no knowledge of which payment infrastructure that is connected to their chosen payment solution. Price, functionality, availability, ease of use, and benefits regarding the payment solution is the driving force in how customers choose to conduct their payments (Norwegian Competition Authority, 2018). To illustrate this trend the Retail payment services report from 2019 (Norges Bank, 2020) illustrates the drift from one payment service to another. The growth in contactless payments rose by 438% in 2019 accounting for 16% of all payments made with card. 2.1 % of these were mobile wallet payments (Norges Bank, 2020).

One of the barriers in the adoption of mobile wallets today is the lockout that is created between the consumers bank connection and some of the major mobile wallet providers, such as Apple Pay and Google Pay. Only four traditional banks operating in Norway support Apple Pay (Apple, 2020), and only seven support Google Pay (Google, u.d.). On the other hand, Vipps is supported by all Norwegian banks and is used by 2,6 million consumers (Vipps AS, u.d.). The adoption of mobile wallets might therefore accelerate when Vipps launch their own mobile

wallet app later this year (Trumpy, 2020). Appendix 1 provide an overview over big Norwegian banks and their compatibility with NFC based payment providers.

2.2.2.3 Technological environment

Dahlberg, et al., (2008, p. 171) stated that *"Technological environment consists of wireless and other related technologies which are used to develop and produce mobile payment services. Continuous development of technologies facilitates more reliable, user friendly, versatile, and functionally rich mobile payment services."*

The speed of technological environmental varies according to the type and nature of technology. For example, the speed of change in the underlying network infrastructure such as the change from 4G to 5G are close to 10 years (Dahlberg, et al., 2015). Other technologies, such as POS terminals, changes every three to seven years, while the average lifecycle of a smart phone is between six months and two years (Dahlberg, et al., 2015). All these technologies need to complement each other to achieve a successful adoption.

Among the technological innovations used to develop mobile payment services are Near Field Communication (NFC) microchips and Quick Response code QR-Code. NFC is explained to be a wireless transmission method that allows an NFC device to communicate with other NFC devices in a quick and efficient manner. Unlike Bluetooth and Wi-Fi, it does not work over longer distances. The devices need to be within a few centimeters or less to work together (Teknisk Ukeblad Media AS, 2012). Furthermore, NFC is not suitable for transferring large amounts of data since the data rate is not higher than just over 400 kbps. Furthermore, NFC is perceived as a secure communication method and can therefore be used in a wide variety of settings, such as payments, keycard, buss card and in smart homes (Teknisk Ukeblad Media AS, 2012). It's important to note that NFC payments are not secure alone, but with a combination of encryption and authorization processes one can reach a sufficient level of security. Apple Pay and Google Pay are two of the major players providing NFC based applications to the consumers.

A Quick Response code (QR-code) is a two-dimensional barcode that contains information in a horizontal and vertical direction. The QR-code consists of a white background and multiple black squares arranged in a grid which can be interpreted by a scanning device such as a mobile camera or a barcode scanner (Albert, 2018). One of the advantages of QR-codes is the

simplicity in terms of infrastructure. There is no need for credit cards, payment networks or payment terminals, and the users can perform contactless payments by scanning the QR-code at POS (Albert, 2018). The QR-codes are widely used in developing countries such as China because it makes the payment process easier for both individuals and businesses. WeChat Pay and Alipay are two of the major players that use QR-codes for electronical payments between stores and customers. In Norway, Coopay offers a QR based payment solution in their stores and Vipps are planning to launch their QR based mobile wallets in 2020 (Trumpy, 2020).

2.2.2.4 Social and cultural environment

The differences in the social and cultural environment changes peoples consumption habits, buying behavior, and thus affect the innovation for new payment services (Dahlberg, et al., 2008). An example of differences in payment culture is the account centric cultures of Scandinavia, the cash-centric culture of Japan and the wide use of cheques in the USA (Bohle & Krueger, 2001). Another difference in the social and cultural environment is between the bank centric financial systems and market centric financial system. In a bank centric system, the bank has a dominating role since most people have a bank account and transactions are typically transfers between accounts. While in the market centric system, the banks have a less dominant role and the capital markets are of importance (Dahlberg, et al., 2008).

Mahmood, et al., (2004) argued that the adoption rate of mobile wallets was affected by the social and cultural characteristics between countries, but also the demographic characteristics in between groups of people. Other social and cultural environmental factors that affect adoption is the debate of the use of QR-codes or NFC-chips. The choice of technological system has become a *"war"* between the eastern and western market, where QR-codes dominate the eastern markets and the NFC-chips dominate the western markets (Hernæs, 2020). In Norway the adoption of mobile wallets is at such an early stage that the consumer choice of technological system is still undecided. Hernæs (2020) states that it is difficult to change payment habits once they are formed. To conclude, the adoption of new mobile payment services will be different between cultures and demographics, and current research on mobile wallets is mostly concerned with the Asian market (Baptista & Oliveira, 2016; Madan & Yadav, 2016; Shin, 2009; Yang, et al., 2012). This thesis will therefore be an addition to the existing literature since it considers the adoption of mobile wallets in Norway.

3. The theoretical foundation of the conceptual research model

In this chapter, there will be a discussion of the theoretical foundation that forms the basis for our conceptual research model. The theoretical foundation includes five theoretical models, with roots from psychology, sociology, IS and IT research. There is also included constructs obtained from other relevant literature to best measure the adoption of mobile wallets. The primary objective of the theoretical foundation is to investigate theoretical models used to measure consumers adoption rate and factors explaining technology adoption. This chapter covers the following theories and models; 1) the Theory of Reasoned Action (TRA) (Fishbein, 1967; Fishbein & Ajzen, 1975), 2) the Theory of Planned Behavior (TPB) (Ajzen, 1985; Ajzen, 1991), 3) the Technology Acceptance Model (TAM) (Davis, 1989), 4) Augmented Technology Acceptance Model (Taylor & Todd, 1995a) and 5) Motivational model (MM) (Davis, et al., 1992; Venkatesh, et al., 2003). The subchapters describe constructs measured in our conceptual research model and includes relevant hypothesis and their positive or negative impact on the adoption of mobile wallets. Lastly, the conceptual research model is constructed based on the theoretical foundation and the hypothesis development from the existing literature.

3.1 Theory of Reasoned Action (TRA)

The Theory of Reasoned Action (TRA) was first developed in 1967 and derives from the research field of psychology and sociology. TRA was designed to explain, predict or influence the relationship between attitudes and behavior (Charness & Boot, 2016). In its original form the purpose of the framework was to explain the relationship between the independent variables *attitude towards behavior* and *subjective norm*, and how these variables affected the independent variable *behavioral intention.* By examining *attitude towards behavior* and *subjective norms*, researchers gained an understanding of whether or not the *behavioral intention* lead to *actual behavior* (Fishbein & Ajzen, 1975).

TRA has since the 1960s been modified into numerous new theories with the intention to better explain IS and IT usage, but also to better explain technology acceptance and identify possible barriers of technology acceptance. Both TPB and TAM are examples of modified theories which have originated from TRA (Davis, 1989) and the similarity between these theories is found in their shared use of the reasoned action perspective. "*According to this perspective, people's attitude follow spontaneously and consistently from beliefs in memory and then guide*

corresponding behavior" (Ajzen & Fishbein, 2000, p. 1). This relationship is present in both TAM and TBP where it is used in the buildup of the conceptual research model.

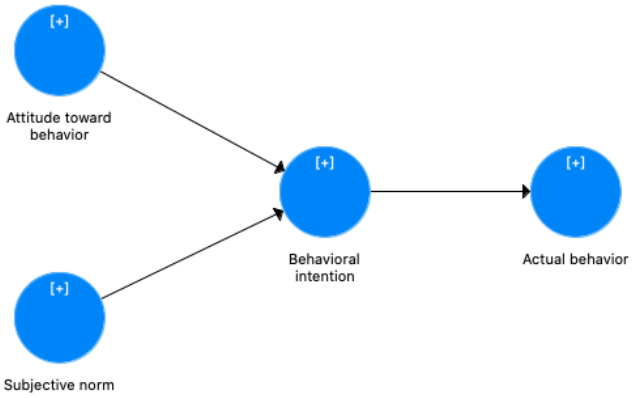

Figure 1 Theory of Reasoned Action (TRA)

3.1.1 Actual behavior and behavioral intention

TRA describes the relationship between *actual behavior* (B) as a function of *behavioral intention* (BI). In its simplest form, BI can be expressed by one's *attitude towards behavior* (A), which reflects emotions of favorability or unfavourability towards performing a behavior and *subjective norm* (SN), which refers to the degree of perceived social pressure to perform the behavior (Fishbein & Ajzen, 1975; Taylor & Todd, 1995b). Figure 1 show the relationship between the independent variables *attitude towards behavior*, *subjective norm* and *behavioral intention* and their effect on the dependent variable *actual behavior*. More formally, *behavior intention* is a weighted function of *attitude towards behavior* and *subjective norm* (Taylor & Todd, 1995b).

$$B = f(BI)$$

$$BI = w_1A + w_2SN$$

The relationship between *behavioral intention* and *actual behavior* is comprehensively described in the TRA (Fishbein, 1967; Fishbein & Ajzen, 1975), and TPB (Ajzen, 1985; Ajzen, 1991). Furthermore, researcher that have applied TRA and TAM in their studies have illustrated high correlation between *behavioral intention* and *actual behavior* (Szajna, 1996). Empirical evidence alongside TRA's rationale suggest that there should be a positive relationship between *behavioral intention* to adopt mobile wallets, and *actual behavior* of adoption of mobile wallets.

Also, empirical findings focusing on recency within our research area supports the positive relationship between *behavioral intention* and *actual behavior*. Baptista & Oliveira (2016), Leong, et al., (2013) and Leong, et al., (2020) all found a positive significant effect between the mentioned variables. The following hypothesis were therefore developed:

H1: Behavioral intention is positively related to the actual behavior of adopting mobile wallets

3.1.2 Attitude towards behavior

Attitude towards behavior are one of the key variables of TRA and is defined as *"an individuals positive or negative feelings (evaluative affect) about performing the target behavior"* (Fishbein & Ajzen, 1975, p. 216). The *attitude towards behavior* is influenced by two factors *behavioral beliefs* and *evaluation of outcome*. *Behavioral beliefs* are about whether or not the result is likely, and the *evaluation of outcome* is about whether or not the result is positive or negative (Venkatesh, et al., 2003). The underlying relationship of *attitude towards behavior* (A) is calculated by the weighted *behavioral beliefs* (b_i), which explains that performing a behavior will result in a specific outcome, and the weighted *evaluation of outcome* (e_i) which explains the desirability of that outcome (e_i) (Taylor & Todd, 1995b). For example, an individual may believe that using a mobile wallet will result in faster and more efficient payments (b_i) and may consider this as a highly desirable outcome (e_i).

$$A = \sum wb_i\, we_i$$

It seems to exist a consensus that evaluation is the primary component of the attitude responses. The role of beliefs towards the evaluative attitude, follow an automatic process, where the *attitude towards behavior* is guided by an individual's subjective view, motivation or capacity. Since the behavior is assumed to happen spontaneously when the individual is confronted and must react, the individuals circumstance or mood can affect the *attitude towards behavior* and influences the response (Ajzen & Fishbein, 2000). An example in social psychology research has found individual *attitude towards behavior* to be a significant predictor of *behavior intention* (Mathieson, 1991).

The relationship between *attitude towards behavior* and *behavioral intention* is described in TRA and TPB to be a positive relationship (Ajzen, 1985; Ajzen, 1991; Fishbein, 1967; Fishbein & Ajzen, 1975). Empirical evidence suggests a positive relationship between *attitude towards*

behavior of adopting mobile wallets and *behavioral intention* of adopting mobile wallets (Davis, et al., 1989). Also, empirical findings focusing on recency supports the positive relationship between *attitude towards behavior* and *behavioral intention.* In line with previous research illustrating a significant effect (Baptista & Oliveira, 2016; de Luna, et al., 2019; Shin, 2009) we purpose the following hypothesis:

H2: Attitude towards behavior is positively related to the behavioral intention of adopting mobile wallets

3.1.3 Subjective norm

Subjective norm are the other key variable of TRA and is defined as *"the persons perception that most people who are important to him think he should or should not perform the behavior in question"* (Fishbein & Ajzen, 1975, p. 302). *Subjective norm* refers to the degree of perceived social pressure to perform the behavior (Mathieson, 1991). Determining the perceived social pressure is useful in understanding and predicting the motivational influence that affects the individuals behavior (Maskari, 2018). Furthermore, subjective norm is also influenced by two factors: *normative beliefs* and *motivation to comply. Normative beliefs* are about whether or not certain behaviors are acceptable. The *motivation to comply* addresses the fact that individuals can choose to comply with subjective norms (Fishbein & Ajzen, 1975). The underlying relationship of *subjective norm* is calculated as the sum of the weighted *normative beliefs* (nb_j) and the weighted *motivation to comply* (mc_j) (Taylor & Todd, 1995b). For example, an individual may believe that their significant others want them to use a mobile wallet (nb_j), and that complying with these wishes is relatively important (mc_j).

$$SN = \sum wnb_j \, wmc_j$$

Recent empirical inquiries studying mobile payments hypothesized a positive relationship between *subjective norm* and *behavioral intention* (de Luna, et al., 2019; Madan & Yadav, 2016; Shin, 2009). The relationship is also described as positive in the theoretical models TRA and TPB (Ajzen, 1985; Ajzen, 1991; Fishbein, 1967; Fishbein & Ajzen, 1975). The following hypothesis were developed to measure *subjective norm* and its impact on *behavioral intention*:

H3: Subjective norm is positively related to the behavioral intention of adopting mobile wallets

3.1.4 Limitation and critique (TRA)

Schwartz and Tessler (1972) argued that moral obligations of right or wrong influences the individual's intention (Schwartz & Tessler, 1972). They were critical to how the social culture affected the behavior. Furthermore, Terry et al. (1993) pointed out that one of the major problems with TRA is the lack of knowledge of the links between individuals, especially the social relations, as well as the broader social culture in which they operate (Terry, et al., 1993). TRA is limited to take an individual's perception of a social phenomenon into consideration and is also criticized to be ambiguous, since it only measures two variables (*attitude towards behavior* and *subjective norm*). It can't therefore measure an individuals behavior intention or actual behavior.

3.2 Theory of Planned Behavior (TPB)

The Theory of Planned Behavior (TPB) is an expanded version of the TRA with the same overall objective, which is to explain, predict or influence individuals behavior (Ajzen & Fishbein, 1980; Charness & Boot, 2016). Fishbein & Ajzen included the variables *attitude towards behavior* and *subjective norm* in the original framework. TPB include a third factor, which is called *perceived behavioral control.* The reason Ajzen included *perceived behavioral control* was to improve the predictive power of the framework and to measure individuals control beliefs[5] (Ajzen, 1991).

In TPB, an individual's behavior is assumed to be a spontaneously act, arriving from a combination of three types of beliefs: *behavior beliefs, normative beliefs,* and *control beliefs*. These beliefs belong respectively with *attitude towards behavior, subjective norm* and *perceived behavioral control. "(…)behavioral beliefs produce a favorable or unfavorable attitude toward the behavior; normative beliefs result in perceived social pressure or subjective norm; and control beliefs give rise to perceived behavioral control."* (Ajzen, 2006, p. 1). The relationship between the independent variables *attitude towards behavior, subjective norm* and *perceived behavioral control* and their effect on *behavioral intention* which subsequently affected the dependent variable *actual behavior,* is shown in Figure 2.

[5] Control beliefs are factors that may facilitate or obstruct performance of the individual's behavior (Ajzen, 2002) and are described as contingency factors in this thesis.

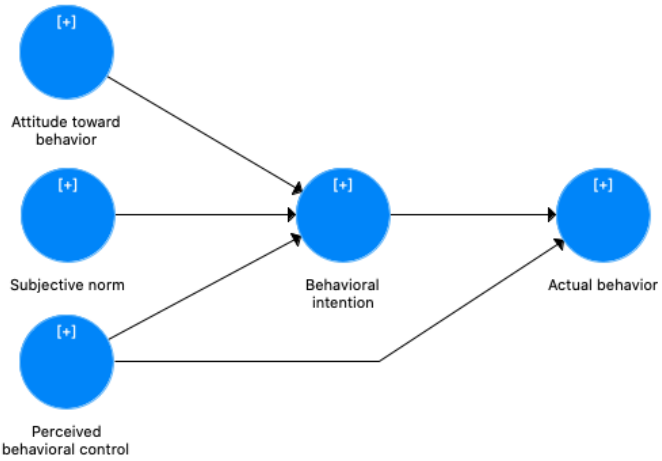

Figure 2 Theory of Planned Behavior (TPB)

TPB is an extension of TRA, and the mathematical functions derived in Chapter 3.1.1, 3.1.2 and 3.1.3 will be expanded to include *perceived behavioral control* accordingly. The equation that measures *behavior* (B) is a direct function of *behavioral intention* (BI) and *perceived behavioral* control (PBC) which reflects perceptions of internal and external constraints on behavior. The relationship can be expressed by the following mathematical functions:

$$B = w_1BI + w_2PBC$$

Behavioral intention (BI) is expanded to include *perceived behavioral control* (PCB), but does also include *attitude towards behavior* (A), and *subjective norm* (SN), which originates from TRA. *Perceived behavioral control* reflects perceptions of internal and external constraints on behavior and is determined by an underlying belief referred to as *control beliefs*. More formally, *behavior intention* can be illustrated as a weighted function of *attitude towards behavior*, *subjective norm* and *perceived behavioral control* (Taylor & Todd, 1995b).

$$BI = w_3A + w_4SN + w_5PCB$$

3.2.1 Perceived Behavior Control

Ajzen (Ajzen, 1991) introduced *perceived behavioral control* as a third predictor of *behavioral intention* and a second predictor of *actual behavior*. In IS and IT research, *perceived behavioral control* is defined to be the *"perceptions of internal and external constraints on behavior"* (Taylor & Todd, 1995b, p. 149). The underlying relationship of *perceived behavioral control* is calculated by the weighted *self-efficacy* (se_k) and by the weighted *perceived power* (pp_k)

(referred to as controllability in this thesis) (Taylor & Todd, 1995b). For example, an individual may think that he or she has the necessary skill to use a mobile wallet (se_k) and their *perceived power* is important in determining usage of a mobile wallet (pp_k) (Taylor & Todd, 1995b).

$$PBC = \sum wse_k \, wpp_k$$

3.2.1.1 Self-efficacy

The internal factor determining *perceived behavioral control* is referred to as *self-efficacy*, which is defined as "*A persons belief in his or her ability to effect change in his or her life, achieve goals, or produce desired results* (Oxford University Press, 2019d). According to the theory of *self-efficacy*, the individual's beliefs about their capabilities, is impacted by previous experiences, abilities to face difficulties and adapt to mistakes, and lastly by their control beliefs (Bandura, 1994). The level of *self-efficacy* is changing throughout life, and in periods where individuals usually experience success of some sort, the *self-efficacy* level is high. Furthermore, individual with a high level of *self-efficacy* are more likely to engage in new activates, because they believe in their own ability to master the task (Bandura, 1994). Demographics relating to the structure of populations can change with age and gender and can thus affect the *self-efficacy* level.

3.2.1.2 Controllability (perceived power)

The external factor that measures *perceived behavioral control* is *controllability,* which addresses the individuals *perceived power* over their own behavior (Ajzen, 2006). *Controllability* is therefore defined as *"beliefs about the extent to which performing the behavior is up to the actor"* (Ajzen, 2002, p. 672). Adoption can typically be split into a voluntarily and an involuntarily setting. In a voluntarily setting the consumer is viewed to have the *perceived power* to decide to adopt a technology or not. On the other hand, in involuntarily settings organizations or governments decides that all their employees or citizens shall adopt a technology even if they don't want to (Sun & Zhang, 2006).

3.2.1.3 Perceived Behavior Control – hypothesis

Research within IS and IT literature have demonstrated a positive relationship between *perceived behavioral control* and *behavioral intention,* and between *perceived behavioral control* and *actual behavior* (Taylor & Todd, 1995b). The classic TPB literature does also

described the relationship as positive (Ajzen, 1985; Ajzen, 1991). Recent literature within the area of mobile payment also supports a positive relationship between the variables (Madan & Yadav, 2016; Shin, 2009) and hence the following hypothesis were developed:

H4: Perceived behavioral control is positively related to the behavioral intention of adopting mobile wallets

H5: Perceived behavioral control is positively related the actual behavior of adopting mobile wallets

3.2.2 Limitation and critique

The theory is criticized because it ignores the individuals need prior to engaging in a certain action and thus ignores Maslow's theory of hierarchy of needs. According to Maslow's hierarchy of needs it seeks to identify basic needs that can explain our behavior and motivation (Maslow, 1943). Furthermore, an experimental study by Sussman & Gifford (2019) challenges the assumption that *behavioral intentions* and *actual behavior* are simply consequences of the independent variables: *attitudes toward behavior, subjective norm,* and *perceived behavioral control.* The authors identified that if individuals were asked to support an environmental organization, the independent variables shifted after the intention was formed. Their findings suggest that the relationship between the independent variables *attitudes toward behavior, subjective norms,* and *perceived behavioral control* is bi-directional to *behavioral intentions* and *actual behavior*, since individuals became more likely to report positive attitudes towards the chosen environmental organization after the incident (Sussman & Gifford, 2019).

3.3 Technology acceptance model (TAM)

The Technology Acceptance Model (TAM) was developed by Davis (1989) to explain the acceptance and usage of technology. TAM has become one of the most important extensions of the TRA and most cited models within the field of technology adoption (Charness & Boot, 2016). TAM was initially designed with a focus on adoption of work-related technologies on an organizational level (Davis, 1989; Venkatesh & Davis, 2000), but the model also reflects individuals attitude towards a specific technology through the construct of *perceived usefulness* and *perceived ease of use* (Taylor & Todd, 1995a). The frameworks objective is to explain the relationship between the independent variables *perceived usefulness* and *perceived ease of use*

and how these variables affected the independent variable *attitude towards behavior* inherited from TRA. Furthermore, *attitude towards behavior* subsequently affect *behavioral intention* which again affect the dependent variable *actual behavior* (Fishbein, 1967), as illustrated in Figure 3.

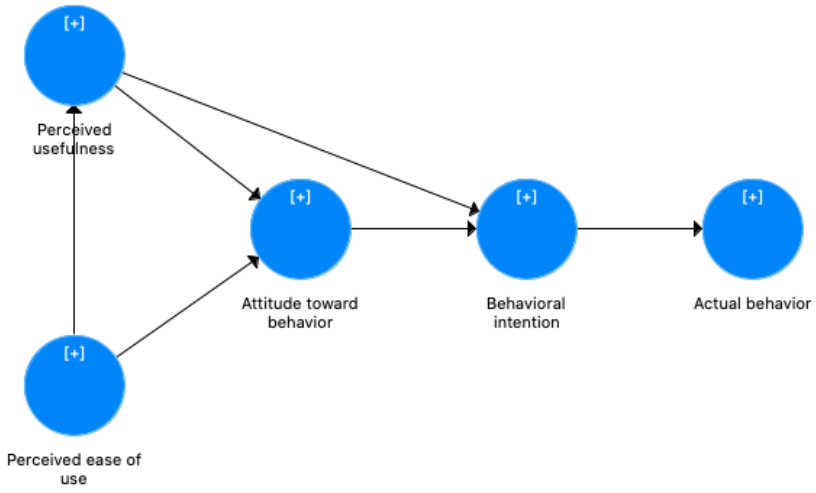

Figure 3 Technology Acceptance Model (TAM)

Also, TAM can be derived mathematically to explain the relationship between the dependent and independent variables. TAM is demonstrating *behavior* (B) as a direct function of *behavioral intention* (BI). BI is defined as a weighted function of *attitude towards usage* (A), which reflects the feelings of favorability or unfavourability towards the use of mobile wallets and *perceived usefulness* (P), which reflects the belief that using a mobile wallet will improve performance (Taylor & Todd, 1995b). Furthermore, *attitude towards behavior* (A) is determined by *perceived usefulness* (U) and *perceived ease of use* (E), and lastly, *perceived ease of use* is a determinant of *perceived usefulness* (Taylor & Todd, 1995b).

$$B = f(BI)$$
$$BI = w_1A + w_2U$$
$$A = w_3U + w_4E$$
$$U = w_5E.$$

TAM is a model that is simple and easy to understand, and the practical contribution of the model is of high value to system designers and engineers. The data collected about *perceived usefulness* and *perceived ease of use* can be used to add more relevant attributes to increase

usefulness and to improve the system interface or functionality (Davis, 1989). Another advantage the diverse set of context TAM could be applied in (Venkatesh, et al., 2003).

3.3.1 External constructs of TAM

TAM is popular within IS and IT research because it is empirically sound and focuses on measurement constructs improving system features (Pavlou, 2003). TAM argues that the external constructs *perceived usefulness* and *perceived ease of use* affect the acceptance of technology, which in the context of this thesis is defined to be mobile wallets.

3.3.1.1 Perceived usefulness

Perceived usefulness is defined as "*the degree to which a person believes that using a particular system would enhance his or her job performance*" (Davis, 1989, p. 320). The theoretical foundation for the relationship between *perceived usefulness* and performance, assumes that individuals only uses a technology to increase their performance. This means that users primarily adopt technologies based on their function rather than how easy they are to use. Previous studies have stated that there is a positive relationship between *perceived usefulness* and *attitude towards behavior* and a positive relationship between *perceived usefulness* and *behavioral intention* (Davis, 1989). Both relationships are extensively studied, and empirical evidence suggests a significant relationship between the variables (Pavlou, 2003; Venkatesh & Davis, 2000). Also, empirical findings focusing on recency supports the positive relationship (de Luna, et al., 2019; Leong, et al., 2013; Shin, 2009). The following hypothesis were therefore developed:

H6: Perceived usefulness is positively related to behavioral intention of adopting mobile wallets

H7: Perceived usefulness is positively related to attitude toward the adoption of mobile wallets

3.3.1.2 Perceived ease of use

Perceived ease of use refers to "*the degree to which a person believes that using a particular system would be free of effort*" (Davis, 1989, p. 320). The less effort a person needs to allocate towards setting up and use a technology, the more likely it is that they accept the technology. The construct of *perceived ease of use* hence positively affect the construct named *attitude*

towards behavior (Davis, 1989). Furthermore, previous studies have found a positive significant relationship between *perceived ease of use* and *perceived usefulness* (Venkatesh & Davis, 2000). Users evaluation of the relationship between *perceived ease of use* and *perceived usefulness* results in an automatic and spontaneous decision to reject or accept technology based on its utility. Thus, a person is likely to perceive the technology as more useful if they find it easy, making *perceived ease of use* a positive determinant of *perceived usefulness* (Taylor & Todd, 1995a). In accordance with recent literature within area of mobile payment, a positive relationship is illustrated between the variables (de Luna, et al., 2019; Leong, et al., 2013; Shin, 2009) and thus the following hypothesis are developed:

H8: Perceived ease of use is positively related to perceived usefulness of adopting mobile wallets

H9: Perceived ease of use is positively related to attitude toward the adoption of mobile wallets

3.3.2 Limitation and critique

Bagozzi (2007) has criticized TAM and pointed out that the models theoretical foundations are weak. He argues that the theoretical premise in the link between *behavioral intention* and *actual behavior* is fragile, and that *behavioral intention* is not representative for *actual behavior*. This can be explained since *behavioral intention* are made prior to *actual behavior* and the individual can therefore be affected by other factors. According to Bagozzi (2007), the deterministic nature of the model is unrealistic. Furthermore, the most widely used method of data collection in TAM studies are self-reporting of usage rather than measuring actual usage. This is a subjective assessment done by individuals and thus cannot be considered a reliable measure of use (Yousafza, et al., 2007).

3.4 Augmented TAM

In Taylor & Todds' research from 1995 they created a hybrid model based on the research by Davis TAM and Fishbein & Ajzen TPB, which they labelled Augmented TAM (Taylor & Todd, 1995a). The model includes the independent variables *perceived usefulness* and *perceived ease of use,* both stemming from TAM, and was further modified to include *Attitude towards behavior, subjective norm* and *perceived behavior control* inherited from Fishbein & Ajzen TPB. The additional factors included in this model have shown to be important determinants of

behavior (Ajzen, 1991). By focusing on specific beliefs included in the model it becomes relevant and could point to specific factors that may influence intention and behavior. The model is more complex since it introduces a large number of factors, but it should also provide a more complete understanding of user behavior (Taylor & Todd, 1995b).

Results from the research by Taylor & Todd (1995a) suggest that the Augmented TAM can be used to understand the behavior of both experienced and inexperienced users. Furthermore, their findings noted that both experienced and unexperienced users place a different importance on the determinants of behavioral intention and actual behavior. Lastly, unexperienced users focus primary on *perceived usefulness* and is placing less emphasis on *perceived behavioral control,* which has implications for technology designing and implementation (Taylor & Todd, 1995a).

Actual behavior (B) is a direct function of *behavioral intention* (BI) and *perceived behavior control* (PCB). The determinants of *behavioral intention* are *perceived usefulness, Attitude towards behavior, subjective norm* and *perceived behavior control.* This modification gave the model the ability *"to predict subsequent usage behavior prior to users having any hands-on experience with a system*" (Taylor & Todd, 1995a, p. 565). *Attitude towards behavior* is determined by *perceived usefulness* (U) and *perceived ease of use* (E) where U is a function of E. The underlying relationship of *subjective norm* is calculated as the sum of *normative belief* (nb_j) and the weighted *motivation to comply* (mc_j) (Taylor & Todd, 1995b). Lastly, the relationship of *perceived behavioral control* is calculated as the sum of *self-efficacy* (se_k) and by the weighted *perceived power* (pp_k) (Taylor & Todd, 1995b). Figure 4 illustrates the relationship in model named Augmented TAM.

$$B = w_1BI + w_2PBC$$
$$BI = w_3A + w_4U + w_5SN + w_6PCB$$
$$A = w_7U + w_8E$$
$$U = w_9E.$$
$$SN = \sum wnb_j\, wmc_j$$
$$PBC = \sum wse_k\, wpp_k$$

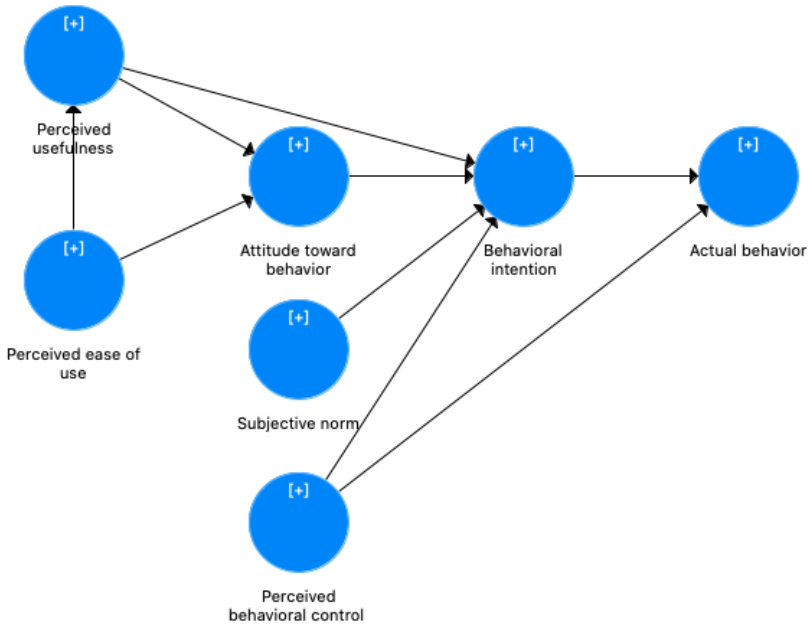

Figure 4 Augmented TAM

3.4.1 Limitation and critique

On a general level the theories mentioned above have been criticized because they have often been applied on students, and it has been pointed out that students are not like other sections of the population as these may be driven by other motivational factors. Findings from these studies are therefore difficult to generalize to a wider population (Venkatesh, et al., 2003). Furthermore, Venkatesh et al., (2003) found that the participants acceptance or rejection decision was conducted after the adoption of the technology. Lastly, Venkatesh et al., (2003, p. 471) stated that *"future research should focus on identifying constructs that can add to the prediction of intention and behavior over and above what is already known and understood."* We therefore include additional constructs to our conceptual research model that measures intrinsic motivation providing a more holistic view.

3.5 Additional constructs and theories

3.5.1 Self-determination theory (SDT)

Self-determination theory (STD) is defined "*as a psychological macro-theory that focuses to a substantial extent on the effects of social-contextual factors on human motivation, behavior, and personality"* (Deci & Ryan, 2012, p. 433). STD assumes that individuals are active intrinsically motivated, and spontaneous. The theory further distinguishes motivation on a scale from high autonomy (autonomous motives) to low autonomy (controlling motives). Within the

scale Deci & Ryan classified motivation in three categories: 1) *amotivation*, 2) *extrinsic motivation* and 3) *intrinsic motivation*. *Amotivation* refers the individuals lack of intention to act and is therefore a subject to low or no autonomy (Deci & Ryan, 1985). *Extrinsic motivation* refers to the behavior that is driven by external factors, such as reward and benefits and is therefore subject to medium autonomy (Deci & Ryan, 1985). *Intrinsic motivation* is defined as a behavior that is driven by internal factors, such as satisfaction, joy and fulfilment (Gagne & Deci, 2005). *Intrinsic motivation* is therefore a subject to high autonomy.

3.5.2 Motivational model (MM)

General motivational theories such as SDT are used as an explanation for behavior and have explained a significant body of research within the area of psychology (Venkatesh, et al., 2003). Many inquiries that have studied motivational theory have adapted it to fit a specific context. In technology adoption, motivation has been identified as a significant factor (Huang, 2016), and pioneers such as Davis, et al., (1992) applied motivational theory to understand new technology adoption. The motivational model used in the theoretical foundation of this thesis is based on Davis, et al., (1992) article.

In IS and IT research Venkatesh, et al., (2003, p. 456) defined *intrinsic motivation* to be *"the perception that users will want to perform an activity for no apparent reinforcement other than the process of performing the activity per se."* The construct taps into an individuals liking and enjoyment of using a technology. Venkatesh, et al., (2003, p. 448) also defined *extrinsic motivation* to be *"the perception that users will want users to perform an activity because it is perceived to be instrumental in achieving valued outcomes that are distinct from the activity itself, such as improved job performance, pay, or promotions."* The construct of *extrinsic motivation* taps into improved performance, increased productivity and *perceived usefulness* of the technology.

3.5.2.1 Perceived Enjoyment

Both the *extrinsic motivation* construct and *intrinsic motivation* construct have many parallels with previously theorized concepts in this thesis. For example, the *extrinsic motivation* has a connection with the construct named *perceived usefulness* and *perceived ease of use* from TAM. This relationship is also acknowledged in the literature (Davis, et al., 1989; Davis, et al., 1992).

Furthermore, *intrinsic motivation* has a connection with the construct named *perceived enjoyment* inherited from Davis, et al., article from 1992. *Perceived enjoyment* refers to *"the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated"* (Lee, et al., 2005, p. 1099). In technology adoption research the construct *perceived enjoyment* is used as an intrinsic measure for motivation (Lee, et al., 2005; Rouibah, et al., 2016; Teo, et al., 1999; Zhou, 2013). This implies that individuals may adopt technology because they find it fun or enjoyable. The concept have previously been used in IT and IS research, and they have (Rouibah, et al., 2016) found that *perceived enjoyment* has a significant effect on intention to adopt a new technology. The constructs mathematical relationship is illustrated below where P is *perceived enjoyment.*

$$B = f(BI)$$

$$BI = w_1U + w_2A + w_3P$$

$$A = w_4U + w_5E + w_6P$$

$$U = w_7E.$$

$$P = w_8E$$

Lastly, Figure 5 shows the relationship between the independent variables *perceived usefulness, perceived ease of use, perceived enjoyment, attitude towards behavior* and *behavioral intention*, and their effect on the dependent variable *actual behavior.*

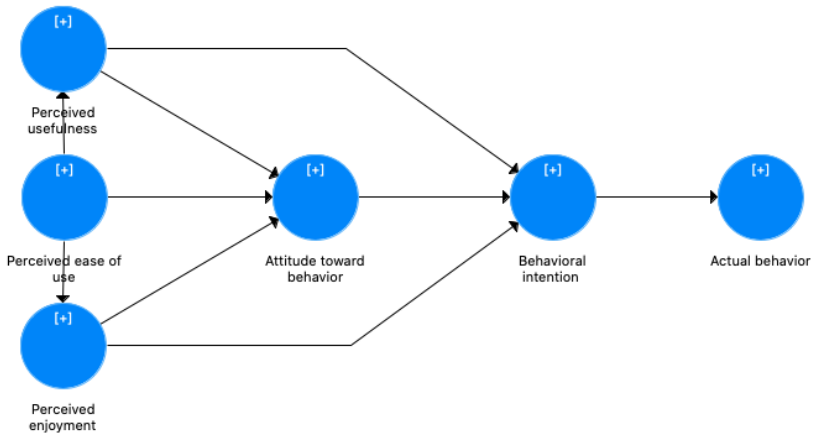

Figure 5 Motivational model (MM)

TRA, TPB and TAM first and foremost include constructs that reflect a rational cognitive process while the construct named *perceived enjoyment* (inherited from MM) reflects a fun and enjoyable experience of using innovative technology. Koenig-Lewis, et al., (2015) stated that individuals adopt new technology because it enhances performance and because it's fun and could be a source of enjoyment. Both Koenig-Lewis, et al., (2015) and Venkatesh, et al., (2012) provides empirical support for the incorporation of *perceived enjoyment,* and the construct is found to be a positive significant predictor of consumers' technology acceptance. The construct does also have theoretical support for incorporation into TAM (Davis, et al., 1992). Previous literature illustrated how *perceived ease of use* positively affects *perceived enjoyment* and how *perceived enjoyment* positively affects both *attitude towards behavior* and *behavioral intention* (Davis, et al., 1992; Dickinger, et al., 2008; Koenig-Lewis, et al., 2015; van der Heijden, 2003; Venkatesh, et al., 2012). The impact of the relationships was all significant and hence the following hypothesis were developed:

H10: Perceived ease of use is positively related to perceived enjoyment of adopting mobile wallets

H11: Perceived enjoyment is positively related to attitude toward the adoption of mobile wallets

H12: Perceived enjoyment is positively related to behavioral intention of adopting mobile wallets

3.5.3 Trust

Trust can be defined as *"the belief that the other party will behave in a socially responsible manner, and, by so doing, will fulfill the trusting partys expectations without taking advantage of its vulnerabilities"* (Pavlou, 2003, p. 106). Practically all transactions require an element of *trust,* since *trust* is an important factor in influencing technology acceptance and consumer behavior. Furthermore, lack of trust is viewed as an important factor for consumers not engaging in adoption of new technology (Pavlou, 2003). In the context of IS and IT research *trust* is an important construct, and Dahlberg, et al., (2003) suggested that *trust* should be augmented into technology adoption models to measure the level of trust related to the measured technology acceptance. Other researchers have also emphasized the importance of *trust* and its effect of users intention to adopt technology (Rouibah, et al., 2016; Shaw, 2014; Shin, 2009; Talwar, et al., 2020).

In this thesis *subjective norm* is considered to be a determinant of *trust*, since prior research have found significant positive link between the constructs (Chaouali, et al., 2016; Li, et al., 2008). Li, et al., (2008) findings imply that when consumers adopt unknown systems they may rely on other consumers opinion, especially if the opinion comes from someone important to them. The confidence in a system develops accordingly, and *subjective norm* thus have a positive effect on *trust*. Furthermore, Pavlou (Pavlou, 2003) found the positive relationship between *trust* and *behavioral intention* to be significant and specified that trust create positive attitude towards adoption by reducing uncertainty, and thus positively influence the relationship between *trust* and *behavioral intention*. Lastly, the relationship between *trust* and *actual behavior* is viewed to be important since trust plays a significant role in adoption of mobile wallets. Previous studies have found trust to be *"an indicator that plays an important role in examining the actual behavior of the consumer"* (Rehman, et al., 2019, p. 7). Therefore, the following hypothesis were developed:

H13: Subjective norm is positively related to trust of adopting mobile wallets

H14: Trust is positively related to behavioral intention of adopting mobile wallets

H15: Trust is positively related to actual behavior of adopting mobile wallets

3.6 Conceptual research model for adoption of mobile wallets

The theory presented has provided us with a starting point for understanding the underlying mechanisms that could affect consumers adoption of a mobile wallets. The theories used to create the conceptual research model have previously been applied to measure adoption of different technologies under different circumstances, with different moderators and control variables proving their robustness through several iterations. This thesis incorporates constructs from TRA, TPB, TAM, MM and trust theories to predict consumers motivation for adopting mobile wallets. To achieve the goal of understanding the factors affecting adoption, we have developed a conceptual research model for studying the concept based on previous research of mobile payment services and technology adoption. As stated in the literature review, our findings suggest that few researchers have combined constructs from psychology-, sociology- and behavioral research together with IS and IT related theories and applied them in a mobile wallet context (Dahlberg, et al., 2008; Dahlberg, et al., 2015; Gomber, et al., 2017). We have

found no research that measures intrinsic motivation in combination with IS and IT related theories within our research area, which creates a research gap that this thesis aims to fill.

The proposed conceptual research model (modified TAM) brings together existing research to measure the acceptance of mobile wallets. The constructs that is integrated in the modified TAM model are *actual behavior, behavioral intention, Attitude towards behavior, subjective norm, perceived behavioral control, perceived usefulness, perceived ease of use, perceived enjoyment* and *trust.* The model incorporates constructs that captures the behavior of mobile wallet users, and offer researchers, system designers and engineers a better understanding of how consumers generate motivation to adopt a mobile wallet. Furthermore, the combined view of TRA, TPB, TAM, MM and trust theories may collectively provide a more comprehensive understanding of the cognitive processes and behaviors related to adoption than each theory considered by themselves.

The rationale for the choice of conceptual research model is among other things based on the fact that TAM is one of the most used models for studying technology adoption (Shin, 2009). Other well know theories (such as DOI) highlights different themes within adoption theory focusing on diffusion mechanisms or highlight differences between macro and micro levels of adoption (Shin, 2009). These themes are not within the scope of this thesis. Shin further states that if TAM was modified properly, it is one of the most effective models for determining adoption focusing on social influences, cognitive processes and behaviors related to adoption. Another reason for the choice of TAM is the model's validity in IS and IT research, and the possibility to incorporate variables fitting the research and hence modify it to the research context.

The modification of TAM is based on limitations and critics found in previous research. For example, Malhotra & Galletta (1999) criticized TAM for neglecting the social context in which a technology is being adopted, and hence neglecting subjective norm and perceived behavioral control as important behavioral explanation factors. Furthermore, Venkatesh (2000) states that TAM does not explicitly include intrinsic motivation in their models. For these reasons, this thesis has integrated new constructs to increase the model's ability to predict user behavior in a technological environment and increase predictive power of adoption such as Taylor & Todd did in their Augmented TAM model (Taylor & Todd, 1995a).

The modified TAM model aims to explain consumers adoption of mobile wallets. The theory uses *behavioral intention, Attitude towards behavior, subjective norm, perceived behavioral control, perceived usefulness, perceived ease of use, perceived enjoyment* and *trust* to determine *behavioral intention.* Also, control variables are added to account for Covid 19 and to measure the effect of age, gender, familiarity and mobile wallet provider preference on the dependent variables. The modified TAM will therefore enable a better explanation of mobile wallet adoption. Figure 6 illustrates our final conceptual research model with belonging hypothesis.

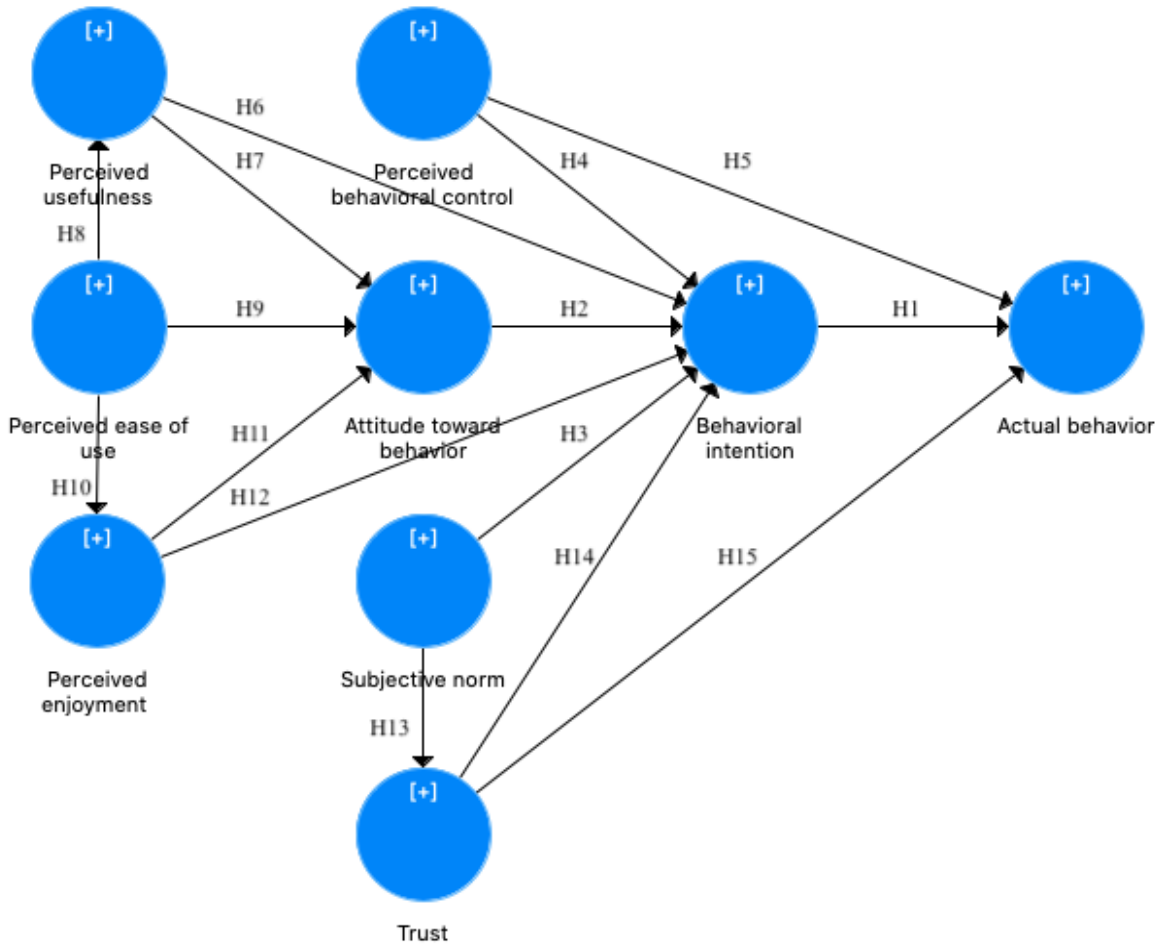

Figure 6 Conceptual research model

4. Methodology and research design

In this chapter we will present and explain the choices we have made throughout this thesis regarding the research design and research methodology. Firstly, the research methodology will be presented together with the philosophical view. Secondly, a thorough description of the research design is provided which includes methods, strategies and techniques for collecting data together with a detailed description of the approach to ensure a rigour[6] research process. Lastly, an overview of the statistical technique is presented as part of the research process.

4.1 Research methodology and the philosophical view

Research methodology is defined as *"the theory of how research should be undertaken, including the theoretical and philosophical assumptions upon which research is based and the implications of these for the method or methods adopted"* (Saunders, et al., 2009, p. 595). In this thesis we have chosen to use a *positivistic research approach* which is defined to describe *"what actually exists"* (Jacobsen, 2015, p. 25). Relating the ontological and epistemological view there are three central views linked to the *positivistic research approach* that we have embraced. 1) There is an objective world regulated by laws outside ourselves, 2) the objective reality can be studied in an objective way and 3) we can build up a cumulative knowledge of the objective world (Jacobsen, 2015). Lastly, as part of the *positivistic research approach* we have used the following attributes in our research design and research methodology to collect data and form new knowledge. Firstly, we have used a *deductive reasoning approach* as opposed to *indictive reasoning approach* and secondly, we have used a *quantitative data collection method* as opposed to *quantitative data collection method*. The mentioned attributes facilitate replication and rigour and ensure a highly structured methodological view (Jacobsen, 2015; Saunders, et al., 2009).

4.1.1 Deductive or inductive

A *deductive reasoning* is a method of reasoning that implies that the researcher is moving from theory to empiricism (reality), that is, searching for empiricism should be guided by theoretical assumptions (Jacobsen, 2015). In the *deductive reasoning* a researcher seeks to test the durability of a theory built on an inductive process by breaking down the idea into a hypothesis that can be tested (Selnes, 1999). On the other hand, *inductive reasoning* is a method of

[6] Rigour is defined as the *"The quality of being extremely thorough and careful."* (Oxford University Press, 2019a)

reasoning that implies that the researcher is moving from empiricism (reality) to theory, that is, all theory should be grounded in reality. In *inductive reasoning* the researcher is looking for regularities, tendencies and relationships in observations, which then can be generalized to cases that so far not have been observed (Jacobsen, 2015).

In this thesis we will use a deductive approach, also known as the top-down approach to investigate the research question. The research question is therefore approached by testing empirical data against existing theory and the durability and accuracy of the theory will also be assessed. Furthermore, we will test the hypotheses presented and describe the relationships between the concepts in our model since this is part of the deductive research approach. Sander (2017a) states that a deductive research approach reduces the risk of uncertainty and improves clarity of the research question compared to an inductive approach, and thus is advantageous to use in our research context. A practical consideration of choosing a deductive approach is that it is less time consuming and can be generalized through empirical data collection (Sander, 2017a).

4.1.2 Quantitative or qualitative

There are two main strategies to data collection named *quantitative* and *qualitative* methods. *Quantitative* and *qualitative* methods are commonly used in business and management studies to differentiate between research methods and data analysis procedures. One way to differentiate between the two approaches is to focus on the numeric (numbers) or non-numeric (words) data belonging to the methods (Saunders, et al., 2009). *Quantitative data* is defined as the *"Numerical data or data that have been quantified"* (Saunders, et al., 2009, p. 598). The approach enables the researcher to measure the research question by using methods and instruments that can give information in form of numbers and statistics. On the other hand, *Qualitative data* is defined as the *"Non-numerical data or data that have not been quantified"* (Saunders, et al., 2009, p. 598). A qualitative data collection approach enables the researcher to gather information in form of words that captures a more nuanced picture of the research topic.

Since we are collecting empirical data in form of numbers it means that we can study the phenomenon with great precision. In addition, statistical methods can help us to handle large amounts of numeric information, which increases the possibility of knowledge aggregation and also enables the knowledge to be generalized (Jacobsen, 2015). Since we want to quantify data to test our hypotheses, it will be natural to choose a *quantitative method* for data collection.

Quantitative studies are often used to measure social phenomena and individual's intention and behavior and is sensibly expressed by numbers and statistical representations (Jacobsen, 2015).

4.2 Research design

The choice of research design is largely governed by the purpose of the thesis. The research question sets the framework for how the research is conducted and dictates which theories, models and methods that is used in the different phases of the research and what conclusions we can draw from the results we arrive at (Sander, 2017b). Furthermore, the *research design* can be described as an overall plan for how the research question should be answered. The *research design* is used as a guide for collecting and analyzing data, and therefore say something about which strategy and techniques one should use to gather information (Saunders, et al., 2009; Selnes, 1999). The *research design* can be divided into three categories based on the nature of the problem: *exploratory research design, descriptive research design* and *explanatory research design* (Jacobsen, 2015; Saunders, et al., 2009; Selnes, 1999). Since the nature of our problem is closest to a *descriptive design,* we have chosen to design our research accordingly.

A *descriptive research design* is chosen when the problem is rather structured in relation to theory and methodology and is used since we have a basic understanding of the phenomenon and a clear understanding of which variables that explains the phenomenon. The design is therefore used when we want to describe or find the relationship between one or more variables and is therefore well suited to describe the characteristics and correlations of what is being studied and to test hypothesis obtained from theory. Furthermore, the descriptive design provides a detailed description of the phenomenon and is used to quantify data that is collected (Jacobsen, 2015; Saunders, et al., 2009; Selnes, 1999). To be able to use a *descriptive design*, it is a prerequisite that we have a clearly defined research question (Chapter 1.1), knowledge of which variables that explain the phenomenon we are researching (Chapter 3) and hypothesis on how the independent variables affect each other and the dependent variable (Chapter 3) (Sander, 2017a).

4.2.1 Research method

A research method is defined as *"The techniques and procedures used to obtain and analyze research data, including for example questionnaires, observation, interviews, and statistical*

and non-statistical techniques" (Saunders, et al., 2009, p. 595). The chosen research methods are therefore a vital part of the research design, and we will describe the methods and techniques used to collect data in this chapter. Pallant (2016) state that it is important to choose a research method that underpins the research question since the choice is dependent on the research design, the research strategy and data collection method and ultimately affect the data analysis process. Other important elements to consider before choosing a research method is existing knowledge, available time frame and other resources (such as financial resources) (Saunders, et al., 2009). In this thesis a survey method was chosen as the main research method.

The survey method was chosen because it firstly can be systemized and standardized to analyze many individuals at the same time and hence compliment a quantitative research design. Secondly, because the survey method offers a stronger foundation for generalization, facilitates replicability and strengthen the of statistical power of the findings (Jacobsen, 2015). Thirdly, surveys is considered to be an effective and practical way of distributing and collecting data and give us the opportunity to reach a large and geographically disperse group of individuals fast and inexpensive (Saunders, et al., 2009). Fourthly, the data gathered using surveys can be used to suggest relationships between variables and to generate models of these relations (Saunders, et al., 2009). Fifthly, descriptive research, such as the one we are conducting make use of surveys to define and explain the variation in a phenomenon (Saunders, et al., 2009). Sixthly, a cross-sectional survey design was selected to collect data at a single point in time as opposed to longitudinal studies which involves repeated data collection of the same variables over time. Naturally a cross-sectional survey fits better with the time frame of the master thesis. And lastly, survey and case studies have been the dominant approaches in research on technology adoption (Choudrie & Dwivedi, 2005).

4.2.2 Questionnaire design

A variety of considerations have been taken into account when designing the questionnaire to ensure reliability and validity (Dillman, 2007; Jacobsen, 2015; MacKenzie & Podsakoff, 2012; Pallant, 2016; Saunders, et al., 2009). There exist several types of questionnaire designs, but we have opted for a self-administrated questionnaire format (as opposed to interviewer administrated) which is distributed online to test the relationship between the variables.

The design of the questionnaire consists in total of 14 pages and is built up of a covering letter (page 1), demographic questions (page 2), an information page about mobile wallets (page 3),

before the hypotheses are tested with items adopted from the existing literature (page 4-14). The items that are included in the questionnaire where originally developed in English based on the theoretical framework described in Chapter 3. Since Norwegian is the official language of Norway the questionnaire was translated[7] using the *direct translation technique* suggested by Usunier (1998), cited in Saunders et al (2009). The English version of the questionnaire can be found in Appendix 2.

All of the questions in the questionnaire are classified as close-ended questions. Close-ended question have the advantage of being easy to convert into numerical variables and thereafter be analyzed statistically (Pallant, 2016). Moreover, the questions are measured on a dichotomous or an ordinal scale to capture the intensity of similarity and dissimilarity between the respondent's opinion on an item (Jacobsen, 2015). In most of the questions the respondents were asked to rate to which extent they agreed or disagreed with the statements on a Likert scale from 1 (Strongly disagree) to 7 (Strongly agree). The closed questions are pre-coded to facilitate data input and analysis.

A number of trade-offs where made in relation to the structure of the questionnaire in order to avoid potential sources of bias. The structure of the questionnaire refers to the study length, how the items were grouped, how many items that is provided per page and how the items are ordered. Regarding the length of the study a compromise was made between the survey length and total amount of items per construct to avoid questionnaire fatigue. Hinkin (1995) suggested that a minimum of three items should be included in each construct to achieve adequate internal consistency (Hinkin, 1995). We therefore included 4 items per construct to account for misinterpreted questions and loading errors. The questionnaire is not counterbalanced or randomized to avoid *priming effect*[8], we have rather chosen to place the items in a logical order as suggested by Saunders et al (2009) to increase respondent rate. Other means that were used to avoid questionnaire fatigue were to place equal number of items per site to increase flow and predictability.

[7] Norwegian questionnaire translation is available per request.

[8] In psychology, priming or pre-influencing is the phenomenon that small, often unconscious impressions from individual words, pictures or actions that plant expectations of a person and affect what the person remembers. (Jansen & Glover, 2020)

Another common sources of method bias in questioners includes problems with complexity of question, double negatives, double-barreled questions and leading questions to mention a few (Pallant, 2016). To avoid these problems, we have used validated scales from existing literature. The items are modified to fit the research purpose to avoid interpretation errors. Additionally, some researchers propose to include positive and negative worded items (Saunders, et al., 2009), In spite of this, we have chosen to use positive worded questionnaire to avoid creating confusion and in order to increase the respondent rate.

There exist numerous academic papers with empirical evidence of how method bias affects the validity and reliability of constructs (MacKenzie & Podsakoff, 2012). One approach to discover when method bias is an issue is to recognize when respondents are likely to satisfy rather than optimize their response, and thus the design of the questionnaire is designed to account for different types of method biases. MacKenzie & Podsakoff, (2012) states that: "*method bias is more likely to be a problem when factors are present that: (a) undermine the capabilities of the respondent; (b) make the task of responding accurately more difficult; (c) decrease the motivation to respond accurately; and (d) make it easier for respondents to satisfice (i.e., decrease the difficulty of the task of satisficing)"* (MacKenzie & Podsakoff, 2012, p. 544) By following the recommendations of MacKenzie & Podsakoff, (2012) the questionnaire is designed by making use of their suggested remedies to avoid problems related to method biases. Some remedies that was used were the avoidance of item ambiguity, complex an abstract question, length scales and repetitive questions.

Another important part of the questioner design was the *pilot test*[9] that was done on 11 respondents. The aim of the pilot test was to optimize the questionnaire so that the respondents will have no trouble answering the questions in the intended way. The advantage of performing a pilot study is to assess the validity and reliability of the collected data (Saunders, et al., 2009). The pilot test led to several adjustments and changes were made to questions that were unclear or ambiguous, but also structural changes was made to the definition of mobile wallets and

[9] A pilot test is defined as a *"Small-scale study to test a questionnaire, interview checklist or observation schedule, to minimize the likelihood of respondents having problems in answering the questions and of data recording problems as well as to allow some assessment of the questions' validity and the reliability of the data that will be collected"* (Saunders, et al., 2009, p. 597)

layout to improve the *face validity*[10]. Furthermore, the questionnaire was improved to ensure that the scales and items complimented the projected sample.

Lastly, the questionnaire is created in Microsoft Forms, one of Norwegian University of Science and Technology (NTNU) recommended survey providers for collecting survey data online and thereafter distributed though Facebook and LinkedIn which will give us the opportunity to reach a large and geographically disperse group of individuals fast and inexpensive. The complete questionnaire is provided in Appendix 2.

4.2.3 Operationalization of constructs

Operationalization is defined as *"The translation of concepts into tangible indicators of their existence"* (Saunders, et al., 2009, p. 597). An important part of a *deductive approach* is to operationalize the constructs into measurable quantitate data. We have therefore defined items based on previous literature to measure the relationship between the variables before we designed the questionnaire to quantify the data collected as suggested by Ghauri & Grønhaug (2005). The items that we adopted from existing literature are modified from validated scales to fit the research purpose. The items are modified so we can explore the changes in the relationships between the independent variables and the dependent variable.

Three different types of data variables were collected through the questionnaire and the formulation of the question therefore changes depending on the variable in question. The three different variables are *Opinion variables* which describes how the respondent feel and record their beliefs of what's right and wrong, *Behavioral variables* which measure what individuals do and *attribute variables* which measures the respondent's characteristics suggested by Dillman (2007) cited in Saunders et al (2009).

The items that were developed to measure *perceived ease of use, perceived usefulness, attitude towards behavior* and *behavioral intention* were mainly adopted from (Davis, 1989) and (Davis, et al., 1989), but also additional literature such as (Mathieson, 1991; Taylor & Todd, 1995a; Taylor & Todd, 1995b; Venkatesh, 2000; Venkatesh, et al., 2003; Venkatesh, et al., 2012) are used as inspiration. *Social norm* are adopted from (Ajzen, 1991; Davis, et al., 1989;

[10] Face validity is defined as an *"Agreement that a question, scale, or measure appears logically to reflect accurately what it was intended to measure"* (Saunders, et al., 2009, p. 592)

Fishbein & Ajzen, 1975; Mathieson, 1991; Taylor & Todd, 1995a; Taylor & Todd, 1995b; Venkatesh, et al., 2003; Ajzen, 2006) and *perceived behavioral control* are adopted from (Ajzen, 1991; Taylor & Todd, 1995a; Taylor & Todd, 1995b; Venkatesh, et al., 2003; Ajzen, 2006). To address elements of *intrinsic motivation* we have used (Davis, et al., 1992; Lee, et al., 2005; Venkatesh, 2000), and we have addressed *trust* (Gefen & Straub, 2004; Lee, 2009; Pavlou, 2003). There are 32 items related to the measured construct (4 per construct) all of which is presented in tables 1 and 2.

Hair, et al., (2018b) recommended to use a single item to measures to non-phycological constructs such as the direct measurement of *actual behavior*. We therefor used the measurement scale *frequency of use* to measure the "true" score as a direct measure of *actual behavior*. The measure *frequency of use* was used to capture *actual behavior* in an ordinal scale. The question made the respondent chose how frequent they use a mobile wallet for payment with the included Likert scales from 1-7.

Construct	Item		Source
Perceived ease of use (PEOU)	PEOU 1	A mobile wallet is easy to use	(Davis, 1989; Mathieson, 1991; Taylor & Todd, 1995a; Taylor & Todd, 1995b; Venkatesh, 2000; Venkatesh, et al., 2003; Venkatesh, et al., 2012)
	PEOU 2	I can learn how to use a mobile wallet without help	
	PEOU 3	Mobile wallets are easier to use than other payment solutions	
	PEOU 4	It's easy to learn how to use a mobile wallet for payment	
Perceived usefulness (PU)	PU 1	Using a mobile wallet will make execution of payments easier	(Davis, 1989; Mathieson, 1991; Taylor & Todd, 1995a; Taylor & Todd, 1995b; Venkatesh, 2000; Venkatesh, et al., 2003; Venkatesh, et al., 2012)
	PU 2	Using a mobile wallet will increase the efficiency of my payments	
	PU 3	In my everyday life it is useful to use a mobile wallet for payment	
	PU 4	Paying with a mobile wallet will make my life easier	
Attitude towards behavior (ATU)	ATU 1	Using a mobile wallet for payment would be a good idea	(Davis, 1989; Mathieson, 1991; Taylor & Todd, 1995a; Taylor & Todd, 1995b; Venkatesh, 2000; Venkatesh, et al., 2003; Venkatesh, et al., 2012)
	ATU 2	Using a mobile wallet for payment gives me a positive experience	
	ATU 3	It would be valuable for me to use a mobile wallet for payment	
	ATU 4	I would like to use a mobile wallet for payment	
Behavioral intention (BI)	BI 1	I will use a mobile wallet for payment in the near future	(Davis, 1989; Mathieson, 1991; Taylor & Todd, 1995a; Taylor & Todd, 1995b; Venkatesh, 2000; Venkatesh, et al., 2003; Venkatesh, et al., 2012)
	BI 2	I want to use a mobile wallet for payment on a daily basis	
	BI 3	I have a goal of using a mobile wallet to make a payment	
	BI 4	I'd rather choose to use a mobile wallet to pay than other payment methods	

Table 1 Final measurement items

Construct	Item		Source
Social norm (SN)	SN 1	People who influence me think I should use a mobile wallet for payment	(Ajzen, 1991; Davis, et al., 1989; Fishbein & Ajzen, 1975; Mathieson, 1991; Taylor & Todd, 1995a; Taylor & Todd, 1995b; Venkatesh, et al., 2003; Ajzen, 2006)
	SN 2	It is expected that I use a mobile wallet for payment	
	SN 3	People who are important to me think I should use a mobile wallet for payment	
	SN 4	When it comes to using mobile wallets, I want to do the same as those in my social circle	
Perceived behavioral control (PBC)	PBC $1_{cont.}$	It's up to me whether I want to use a mobile wallet to pay or not	(Ajzen, 1991; Taylor & Todd, 1995a; Taylor & Todd, 1995b; Venkatesh, et al., 2003; Ajzen, 2006)
	PBC $2_{cont.}$	It's up to me to choose which type of mobile wallets I want to use	
	PBC $3_{s.e.}$	I have the knowledge needed to use a mobile wallet for payment	
	PBC $4_{s.e.}$	I have the skills needed to use a mobile wallet for payment	
Perceived enjoyment (PE)	PE 1	I enjoy using new payment solutions like a mobile wallet	(Davis, et al., 1992; Lee, et al., 2005; Venkatesh, 2000)
	PE 2	I find it very interesting to make payments using a mobile wallet	
	PE 3	I find the process of paying with a mobile wallet very satisfying	
	PE 4	I think it is more fun to pay with a mobile wallet, compared to other payment methods such as cards and cash	
Trust (Tr)	Tr 1	Based on my perception of mobile wallets, I have confidence in the products	(Gefen & Straub, 2004; Lee, 2009; Pavlou, 2003)
	Tr 2	It is safe to use mobile wallets for payment	
	Tr 3	I trust mobile wallets more than other payment solutions (such as card and cash)	
	Tr 4	Based on my opinion of mobile wallets, I believe they are reliable	

Table 2 Final measurement items

4.2.4 Validity and reliability of the research design

In the choice of research design, the validity and reliability of the study was emphasized. The validity is "*the extent to which data collection method or methods accurately measure what they were intended to measure"* (Saunders, et al., 2009, p. 603) and reliability is *"the extent to which data collection technique or techniques will yield consistent findings, similar observations would be made or conclusions reached by other researchers or there is transparency in how sense was made from the raw data"* (Saunders, et al., 2009, p. 600). The validity and reliability of a study depends on the design of the study, the quality of the constructs in the questionnaire and the rigour of the pilot testing. A legitim questionnaire will allow for the gathering of accurate and robust data (Saunders, et al., 2009). Related to the different stages in the data collection process there are multiple threats to the validity and reliability where we have adjusted the research design according to theory (Jacobsen, 2015; Pallant, 2016; Saunders, et al., 2009; Selnes, 1999).

4.2.4.1 Validity of research design

Researchers often refer to content validity, criterion validity and construct validity when they discuss the validity of the research design (Pallant, 2016; Saunders, et al., 2009). *Content validity* also known as *face validity* is defined as the: *"Agreement that a question, scale, or measure appears logically to reflect accurately what it was intended to measure."* (Saunders, et al., 2009, p. 592). In the design of the questionnaire the scales and the items were designed to measure all facets of a given construct. For example, after the pilot study we made multiple changes to the wordings and flow of the questionnaire to avoid response bias.

The *criterion validity* also known as predictive validity is defined as the *"Ability of a statistical test to make accurate predictions."* (Saunders, et al., 2009, p. 590). The criterion validity is concerned with the relationship between the constructs and the scale scores and is treated carefully thought-out the process to avoid measurement errors.

Lastly, the *construct validity* is defined as the: *"extent to which the measurement questions actually measure the presence of those constructs you intended them to measure."* (Saunders, et al., 2009, p. 589). In the process of ensuring a valid research design the construct validity was examined and altered to better capture the correspondence between the theoretical phenomena and operational definitions of the constructs. Furthermore, the examination of the construct validity included the testing of the theoretically derived hypotheses against the

collected data to explore the relationship between measurement scales and the constructs. This included an examination of the proposed theoretical framework to investigate relationship between other construct both related to convergent validity (measures if theoretically related constructs actually are related) and discriminant validity (measures if theoretically unrelated constructs actually are unrelated) (Pallant, 2016).

4.2.4.2 Reliability of research design

To assess the reliability different sources of error have been accounted for to improve the robustness of the questionnaire and research design. Robson (2002) cited in Saunders, et al., (2009) argued that there are four threats to reliability 1) respondent error, 2) respondent bias, 3) observer error 4) observer bias. In the event of *respondent errors* there will be factors that influence the respondent to respond in a special or incorrect way. To avoid these errors the questionnaire and research design is optimized to reduce threats to the reliability. For instance, the questioner was shared online to counter respondent error since the respondents then could choose when they wanted answer. Saunders, et al., (2009) stated that *respondent bias* can be avoided if the questionnaire is anonymous. We therefore created the questionnaire to be completely anonymous and are therefore less likely to contaminate the respondent's answers. Furthermore, *observer error* is prevented with a research design and research philosophy that distance the researchers from the study and lastly, *observer bias* is avoided with pre-coded questionnaire design.

4.3 Sampling and data collection

4.3.1 Unit of analysis

The unit of analysis is defined to be the most important source of data that you are investigating in a study (Trochim, 2020), in our case the most important source of data is the individual. In this study we have used an *individualistic research approach* where knowledge is established through the study of a single individual and their behaviors in the situation in question. The *individualistic research approach* is also favorable when one wants to understand the individual's intention and behavior. In this thesis an approach called *methodological individualism* is used to further understand the individual's opinions. The benefit of using the *methodological individualism* approach is that it aggregates individual's opinions to further understand groups or societies and hence is a good approach to understand factors influencing

adoption of mobile wallets. The individuals that are being studied in this thesis is drawn from a selected population explained in the next chapter.

4.3.2 Population

It is important to define the population from which the sample is drawn from and to select a research design that fit the research question and overall objective of the study (Saunders, et al., 2009). By focusing on target groups that fits the overall objective of the study we can reduce the amount of data we need to collect. The defined population of interest in this study is individuals that uses a smart phone. A study from 2019 indicated that 95% of the population of Norway uses a smart phone on a daily basis (Statistisk sentralbyrå, 2020). Since owning and using a smart phone is a prerequisite for the adoption of mobile wallets its natural to consider active smart phone users as the population.

4.3.3 Selecting samples

According to Saunders, et al., (2009) sampling techniques can be divided into two types 1) probability sampling and 2) non-probability sampling. *Probability sampling* is defined as the "*Selection of sampling techniques in which the chance, or probability, of each case being selected from the population is known and is not zero"* (Saunders, et al., 2009, p. 598) while *non-probability sampling* is defined as the *"Selection of sampling techniques in which the chance or probability of each case being selected is not known"* (Saunders, et al., 2009, p. 596).

In this master thesis the non-probability sampling technique is used, and it is therefore not possible to assess the extent to which the sample is a representative of the population. The sampling technique is categorized as *non-probability sampling method* since some respondents belonging to the population have a no chance of being surveyed as opposed to the *probability sampling method* where everyone in the population are selected. Thus, the results and conclusion that is provided in this thesis is generalizable only to theory rather than the population. The logical relationship between the sample and the purpose of the research is therefore of importance. Within the non-probability sampling methods, the *self-selection sampling technique*[11] was chosen. This is a practical, quick and cheap technique to collect information form respondents (Selnes, 1999).

[11] Self-selection sampling is defined as the "*Non-probability sampling procedure in which the case, usually an individual, is allowed to identify their desire to be part of the sample"* (Saunders, et al., 2009).

The self-selection sampling technique is often used in combination with online surveys where respondents can choose to conduct the survey or not. Thus, the method is likely to result in random and systematic errors (Selnes, 1999), but is chosen because of the research purpose time frame and financial aspects regarding the research design. Our selection can be considered a self-selection sample because the survey is distributed using social media channels such as Facebook and LinkedIn. The main advantage of using the self-selection sampling technique is the opportunity to collecting data from a large and geographically disperse group of individuals fast and inexpensive, while the main disadvantage of using the technique is that the probability of having a representative sample is small which indicates that the study will have weak external validity.

4.3.4 Screening of sample size

The sample consist of 349 respondents and was collected in the period of 9th of April to 30th of April 2020 (3 weeks). After the survey was closed, the data was exported from Microsoft Forms to the statistical program, SPSS as pre-coded variables. During the time period the questionnaire was available online, multiple people shared the questionnaire within their network creating a virtual snowball. The virtual *snowball sampling technique*[12] increased the sample size and Baltar & Brunet (2012) stated that this technique would enhance the representativeness and expand the geographical extent and thus improve the reliability and validity.

Garson (2016) recommend a sample size of at least 10 cases per measured variable when used in combination with partial least square structural equation modeling (PLS-SEM) which is our chosen statistical technique. In our theoretical framework we use eight independent variables to measure the behavior towards adoption of mobile wallets. The framework therefore consists of eight independent variable and one dependent variable forcing the minimum threshold of valid cases to be 90 (Garson, 2016). As per usual researchers recommend a larger sample size to achieve better strength of the relationship between variables (Pallant, 2016).

[12] Snowball sampling is defined as the *"Non-probability sampling procedure in which subsequent respondents are obtained from information provided by initial respondents*" (Saunders, et al., 2009)

Statistical analysis techniques such as PLS-SEM can be sensitive to *outliers*[13] and can ultimately lead to type I and type II errors (Tabachnick & Fidell, 2007) so part of the initial data screening process was to check for outliers an errors in the data set and remove cases with *extreme outliers*.[14] Also, respondent errors and respondent biases were considered and archival screening methods where used to improve validity and reliability of the collected data (DeSimon, et al., 2015). The *archival screening methods* is the *"examination of patterns of response behavior over the course of a survey"* (DeSimon, et al., 2015) and are intended to screen respondents who "*Respond inconsistently across similar items, respond inconsistently across dissimilar items, respond too quickly and respond the same way to all items"* (DeSimon, et al., 2015).

SPSS and archival screening were used to identify extreme outliers, respondent errors, and respondent biases resulting in the removal of 26 cases. To decide the minimum amount of time needed to respond accurately we choose a cutoff time of 180 seconds (3 minutes). Average response time was eight minutes and 37 seconds while the median time was six minutes. The cut off time led to the removal of six cases. Furthermore, archival screening revealed seven cases of lengthy strings of invariant responses[15] and four cases of inconsistent response. The remaining nine cases were removed since they were considered extreme outliers according to the boxplot output provided in SPSS. The remaining 323 cases are considered suitable for further analysis and should increase the confidence in the findings.

According to Kraemer & Thieman 1987 cited in Jacobsen (2015) the error margin of a sample consisting of 300 cases and maximal spread of 50% in response distribution is 4,9% given a confidence level of 90%, 5,8% given a confidence level of 95% and 7,6% given a confidence level of 99% (Jacobsen, 2015).

[13] An outlier is defined as: *"a case with such an extreme value on one variable (a univariate outlier) or such a strange combination of scores on two or more variables (multivariate outlier) that it distorts statistics"* (Tabachnick & Fidell, 2007)

[14] SPSS identifies outliers and extreme outliers *"if they extend more than 1.5 box-lengths from the edge of the box. Extreme points (indicated with an asterisk, *) are those that extend more than three box-lengths from the edge of the box"* (Pallant, 2016)

[15] i.e., the same choice being selected repeatedly

4.4 Statistical technique

4.4.1 Partial Least Square Structural Equation Modeling (PLS-SEM)

Partial Least Square Structural Equation Modeling (PLS-SEM) is used as the main statistical analyzing technique in this thesis. The statistical model belongs to a family of statistical techniques that seeks to explain the relationship among multiple variables simultaneously (Hair, et al., 2018b). The technique is useful for analyzing complex structural models such as the one provided in this thesis. When we defined the research objectives and selected scales, theory was used as a systematic way of illustrating relationships between constructs. These structural relationships were tested along with hypotheses to explain the adoption of mobile wallets.

PLS-SEM primary statistical objective is to maximize the explained variance (R^2) in the dependent variable. It does that by measuring two statistical models named the *measurement model*[16] also referred to as the *outer model* and the *structural model*[17] also referred to as the *inner model* (Hair, et al., 2018b). The final scores of the *measurement model* and the *structural model* is calculated in three stages. The first stage iterates the construct scores and the structural path relationship to determines the inner loadings. In the second and third stage the PLS-SEM algorithm calculates the outer loadings of the *reflective measurement model* (Mode A)[18] where the final latent variable scores is used as input before a series of ordinary least square regressions is performed. Lastly, the final path coefficient is calculated (Hair, et al., 2018b).

The final output includes R^2 statistics which explains how much of the variance in the dependent variable that is explained by the independent variables, f^2 statistics which measures the effect size of the independent variable on a dependent variable and Q^2 statistics which measures the models predictive power (Hair, et al., 2018b). We use the measurement model to assess the construct reliability, the convergent validity and the discriminant validity and then structural model to assess the predictive ability of the model as a measure of R^2, f^2 and Q^2.

[16] The measurement model is defined as *"a component of a theoretical path model that contains the indicators and their relationship with the constructs; also called the outer model in PLS-SEM"* (Hair, et al., 2018b, p. 762)

[17] The structural model is defined as "the theoretical or conceptual components of a path model. The structural model (also called inner model in PLS-SEM) includes the latent variables/constructs and their path relationships (Hair, et al., 2018b, p. 763)

[18] Hair, et al., (2018b, p. 762) states that *"Mode A uses bivariate correlation between the item and the construct to determine the outer loading."*

4.4.1.1 Reasons for the choice of statistical techniques

When it comes to the choice of statistical techniques the following was discussed to ensure that PLS-SEM was suitable to answer the research question. 1) Metric vs nonmetric data. PLS-SEM is a non-parametric statistical technique[19] (Garson, 2016; Hair, et al., 2018b) allowing us to use metric variables (ratio or interval) and nonmetric variables (nominal and ordinal) to analyze the phenomena in question. 2) Since we have defined our data to be a non-normal Chapter 5.1, a non-parametric statistical technique such as PLS-SEM is considered to be a good analyzing method. PLS-SEM is also a good solution when heteroscedastic is present (Garson, 2016; Hair, et al., 2018b). 3) PLS-SEM is considered to be suitable to analyze data form questionnaires (Garson, 2016; Hair, et al., 2018b). 4) PLS-SEM is considered to be suitable when the sample size is >100 (Hair, et al., 2018b) 5) PLS-SEM supports *reflective measurement models*[20] (Garson, 2016; Hair, et al., 2018b) and 6) PLS-SEM is useful when the primary research objective is to explain the variance in the dependent variable (Hair, et al., 2012).

PLS-SEM have been criticized for overestimating the *measurement model* and for underestimating the *structural model*, this is referred to as PLS-SEM bias (Hair, et al., 2018b). Other researchers have demonstrated that the bias is small in absolute terms (Reinartz, et al., 2009). Furthermore, the statistical model is subject to measurement errors which is the difference between the value obtained by the measurement and the true value of the variable.

The PLS-SEM is viewed as a good method to analyze our research question. To perform a PLS-SEM analysis the software name SmartPLS 3.3.2 was used. SmartPLS combines state of the art statistical analyzing software with an easy to use graphical interface. The software can test hypothesis from empirically collected data and test the relationships between dependent and independent variables through an algorithm measuring R^2, f^2 and Q^2.

4.4.1.2 Validity and reliability of research findings

In the statistical analysis the validity and reliability measures were assessed by an inspection of the measurement model included in the output of the chosen statistical method Partial Least

[19] Non-parametric statistic is defined as *"Statistic designed to be used when data are not normally distributed."* (Saunders, et al., 2009, p. 596)

[20] Reflective measurement is defined as *"a type of measurement model setup in which indicators represent the effects (or manifestations) of an underlying construct"* (Hair, et al., 2018b, p. 763)

Square Structural Equation Modeling (PLS-SEM). The validity and reliability of the measurement scales were confirmed by a post hoc analysis of the *indicator loadings, construct reliability, convergent validity* and *discriminant validity* all described in chapter 5.2.1.

4.5 Ethical challenges

Saunders, et al., (2009, p. 184) stated that *"Research ethics (…) relates to questions about how we formulate and clarify our research topic, design our research and gain access, collect data, process and store our data, analyze data and write up our research findings in a moral and responsible way"*. The ethical challenges are included to ensure a valid and reliable data collection process and data analyzing process. The research process is made to not provoke, embarrass or harm any of the respondent or other researchers work in any way and include the insurance of a morally defendable research process. On a general basis is the ethical challenges related to a quantitative research design and are considered to have fewer ethical challenges than qualitative research designs since they explore the aim of the research more in depth (Saunders, et al., 2009). Even though quantitative research design has less ethical challenges than qualitative research designs, we still have considered a number of key ethical challenges such as in transparency, privacy, integrity, anonymity and accountability in relevance to our research process.

Regarding questions of privacy, personal data and General Data Protection Regulation (GDPR) there was no need to apply to Norwegian Centre for Research Data (NSD) to obtain personally identifiable information since the data collected cannot directly or indirectly identify a natural person. The data collected regarding age, gender and county are considered aggregated data and are used in a scientific research purpose to produce statistical results (General Data Protection Regulation, 2018). No IP addresses or other type of person identifiable data such as names, addresses, e-mails, and more was collected, and the respondents are therefore classified as anonymous since the data subject is not identifiable (General Data Protection Regulation, 2018). Among the measures we have made to create an ethical research process was to ensure the complete anonymity and privacy of the respondents. To do this we contacted NTNUs representative for the Faculty of Economics and Management relating topics within the area of privacy, personal data and GDPR. He assured us that we have treated the data collection process and data analyze process in accordance with the Personal Data Act (2018). Furthermore, we have included limitations and implications relating the research process.

5. Data analysis and result

In this chapter the results are presented for our conceptual research model. Firstly, an investigation of the descriptive statistics is made on the categorical and continuous variables. Secondly, an interpretation of the results related to the statistical technique partial least square structural equation modeling (PLS-SEM) was performed in three steps, and finally a multigroup analysis was performed to assess observed heterogeneity between groups.

5.1 Descriptive statistics

In research that involve human respondents it is useful to collect descriptive statistics to describe the characteristics of the sample to see if it defines the actual population. In this thesis we have collected data to check the distribution scores across the measured items to assess normality, linearity and homoscedasticity. Furthermore, descriptive statistics can be used to check the assumptions of the chosen statistical technique (Pallant, 2016). To test these assumptions we have calculated frequency, percent and cumulative percent for the categorical variables while mean, median, minimum score and maximum score, standard deviation, kurtosis and skewness are calculated for the continuous variable.

5.1.1 The categorical variables

The categorical variables include gender, age, county, previous knowledge, preferred payment provider and two question about intrinsic and extrinsic motivation in relation to Covid 19. The descriptive statistic table with relevant calculation are provided in the Table 3 and Table 4 while some statistics also are visually represented below.

Across the demographic variables measured in this thesis there is a noticeable abnormality between the scales. There is a dissimilarity in the scales measuring men and women (55,7% woman) and a substantial higher amount of lower age groups compared to older (Figure 7). There is also an overrepresentation of two counties - Møre og Romsdal and Trøndelag (Figure 8). The explanation behind these numbers are that the cases in the sample mostly consist of respondents in the same age group as the authors. Furthermore, the overrepresentation of respondents from Møre og Romsdal and Trøndelag can be explained by the authors network to those specific counties. Still the sample technique is considered to be a self-selection sampling technique since the respondents voluntarily chose to participate and be part of the sample. We

therefor chose to define the sampling technique as self-selection sampling technique which sits between *convenience sample*[21] and snowball sampling.

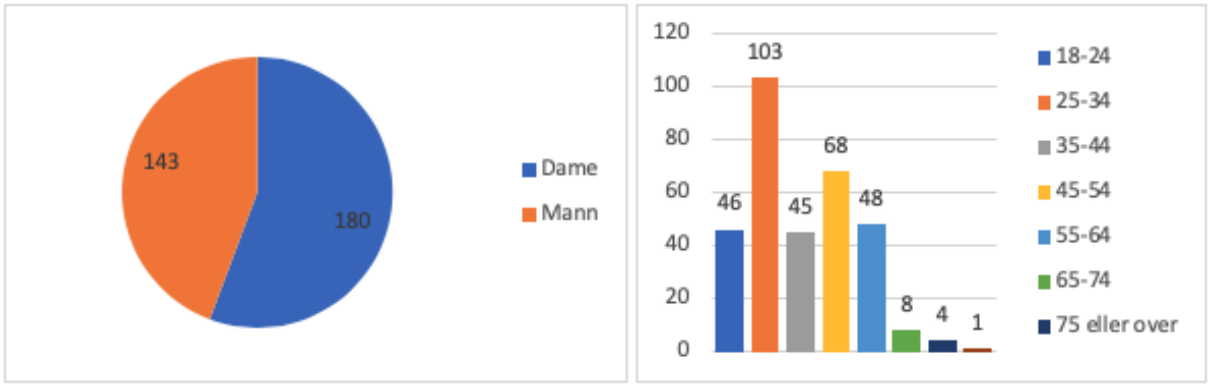

Figure 7 Gender and age distribution

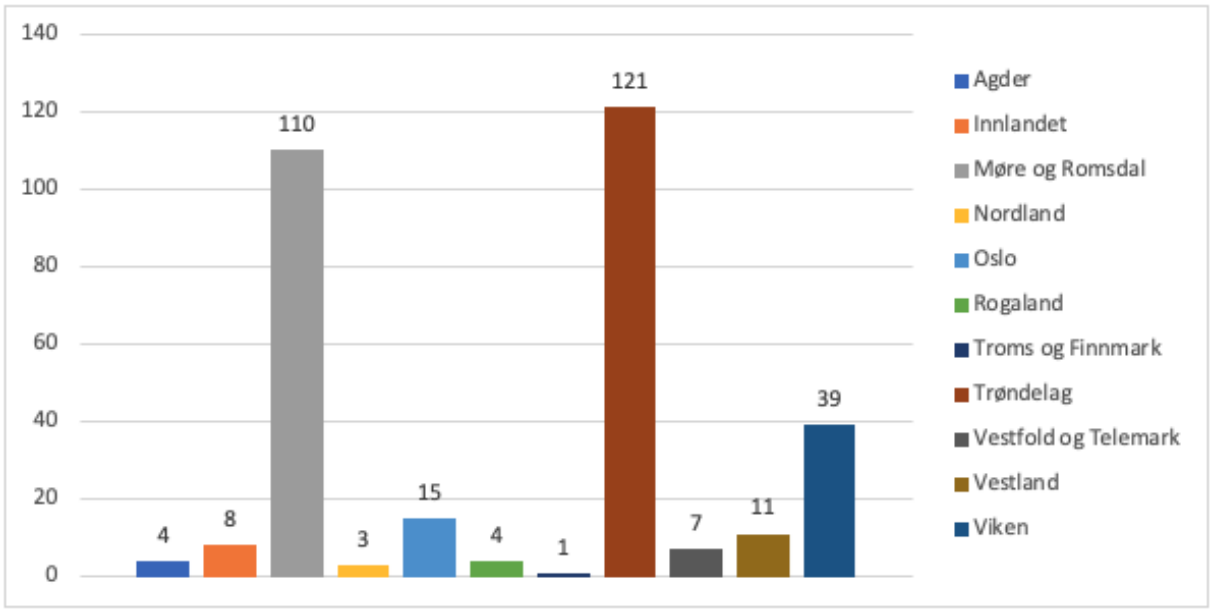

Figure 8 County distribution

[21] *Convenience sampling is defined as the "Non-probability sampling procedure in which cases are selected haphazardly on the basis that they are easiest to obtain"* (Saunders, et al., 2009).

The other categorical variables measure research specific cases such as previous knowledge, preferred payment provider and two context specific question related to Covid 19. 90,7% of the respondents was familiar with mobile wallets before they conducted the survey (Figure 9). Furthermore, 60,4% want to use a mobile wallet for payment instead of other payment solutions (such as cards and cash) due to the danger of infection by the Corona virus and 66,3% feel safe using a mobile wallet instead of other payment solutions (such as cards and cash) because of the danger of infection by the Corona virus. Lastly, a total of 40,9% prefer a national payment provider such as Vipps and 34,4% preferer Norwegian providers over international providers such as Apple Pay. Added together this accounts for 75,3% of the total scale and indicates strong feelings toward national payment providers. This finding support previous findings in the area of trust toward personal banking services (Finans Norge, 2018).

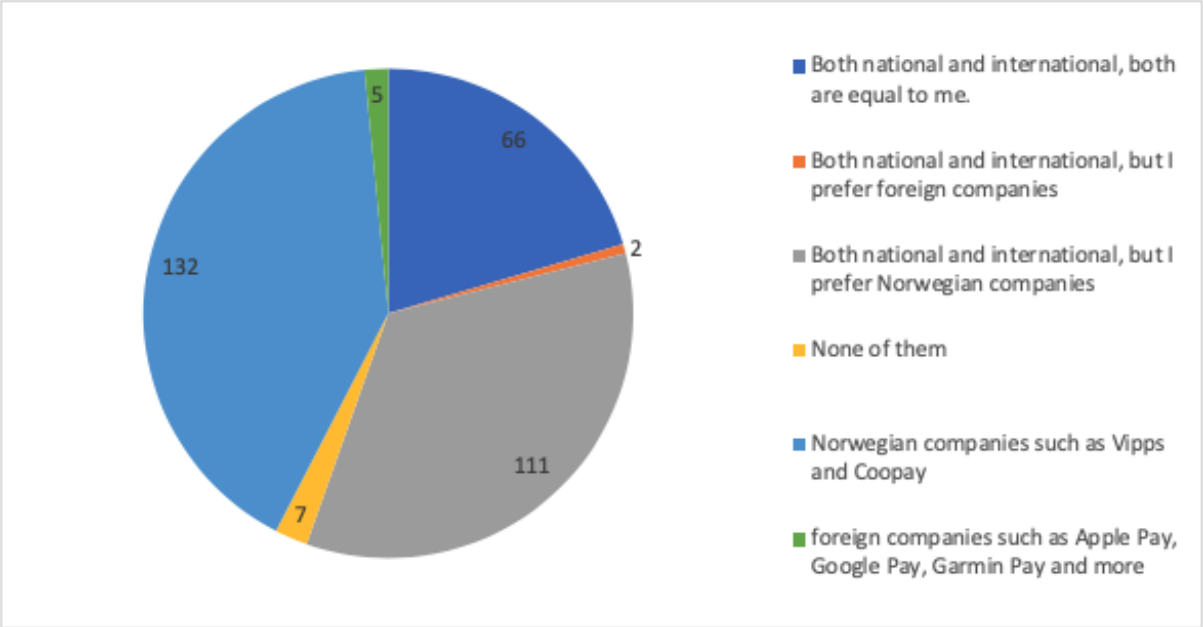

Figure 9 Distribution of preferred payment provider

Table 3 Descriptive statistics of the categorical variables

Variable	Frequency	Percent	Cumulative percent	Kolmogorov–Smirnov test
Gender				0,000*
Male	143	44,3	44,3	
Female	180	55,7	100	
Total	323	100		
Age				0,000*
Under 18	1	0,3	0,3	
18-24	46	14,2	14,6	
25-34	103	31,9	46,4	
35-44	45	13,9	60,4	
45-54	68	21,1	81,4	
55-64	48	14,9	96,3	
65-74	8	2,5	98,3	
75 or older	4	1,2	100	
Total	323	100		
County				0,000*
Agder	4	1,2	1,2	
Innlandet	8	2,5	3,7	
Møre og Romsdal	110	34,1	37,8	
Nordland	3	0,9	38,7	
Oslo	15	4,6	43,3	
Rogaland	4	1,2	44,6	
Vestfold og Telemark	7	2,2	46,7	
Troms og Finnmark	1	0,3	47,1	
Trøndelag	121	37,5	84,5	
Vestland	11	3,4	87,9	
Viken	39	12,1	100	
Total	323	100		
Previous knowledge				0,000*
Yes	293	90,7	90,7	
No	30	9,3	100	
Total	323	100		

** Significant values of more than 0,05 indicates normality.*

Table 4 Descriptive statistics of the categorical variables

Variable	Frequency	Percent	Cumulative percent	Kolmogorov–Smirnov test
Payment provider				0,000*
Norwegian companies such as Vipps and Coopay	132	40,9	40,9	
foreign companies such as Apple Pay, Google Pay, Garmin Pay and more	5	1,5	42,4	
None of them	7	2,2	44,6	
Both national and international, both are equal to me.	66	20,4	65	
Both national and international, but I prefer Norwegian companies	111	34,4	99,4	
Both national and international, but I prefer foreign companies	2	0,6	100	
Total	323	100		
Covid 19 Extrinsic motivation				0,000*
Yes	195	60,4	60,4	
No	128	39,6	100	
Total	323	100		
Covid 19 Intrinsic motivation				0,000*
Yes	214	66,3	66,3	
No	109	33,7	100	
Total	323	100		

** Significant values of more than 0,05 indicates normality.*

5.1.2 The continuous variables

The continuous variables (e.g. *behavioral intention, attitude towards behavior* and more) are measured on a Likert scale from 1 (Strongly disagree) to 7 (Strongly agree) to measure ratings of how strongly the responded agrees or disagrees with a statement. The data set was evaluated for errors and was further inspected for high and low mean values and maximum and minimum values out of range (1-7). Also, the *skewness*[22] and *kurtosis*[23] values were evaluated while

[22] Positive skewness values indicate that the distribution of scores are clustered to the left, with a tail to the right while negative skewness values indicate that the distribution of scores are clustered to the right, with a tail to the left (Pallant, 2016).

[23] The distribution is defined as peaked if the kurtosis value is positive and the values are clustered close to the middle while the distribution is defined as flat if the kurtosis value is negative there are too many cases in the extremes (Pallant, 2016).

screening continuous variables for normality. Skewness describes the symmetry of the distribution while kurtosis describes the "peakedness" of a distribution (Tabachnick & Fidell, 2007). A perfect distribution (normality) would imply that the skewness and kurtosis value is zero (Tabachnick & Fidell, 2007). Lastly, the Kolmogorov-Smirnov tests of normality was included to test for normality. A significant value of more than 0,05 indicates normality (Pallant, 2016).

The mean value of a Likert scale with normal distribution should theoretically be 3,5 however this is not always the case in social science and an literature illustrates that many studies have higher mean values than 3,5. Most items load above the mean and only five out of 33 items have mean values below 3,5. Four out of five are related to the construct of social norm (SN). Furthermore, the highest mean scores are related to the item PEOU 2 with a score of 6.130. Four out of five items with the highest mean score are related to the construct perceived behavioral control (PBC).

The kurtosis values are evenly distributed in the dataset with 16 negative values and 17 positive values. On the other hand, we have 29 negative skewness values and 4 positive skewness values. To test skewness and kurtosis for normality we calculate the z-scores. If either of the calculated z-scores exceeds the critical values of ± 2,58 (0,01 significant level) or ± 1,96 (0,05 significant level) the distribution is considered non normal (Hair, et al., 2018b). None of the measured items fell outside of the critical values leading us to use the Kolmogorov-Smirnov test for normality. The result form the Kolmogorov-Smirnov test indicates a non-significant result of normality in all items meaning all of the items where non-normal. This led us to inspect the geographical plots concluding with a non-normal distribution of all items.

Table 5 Descriptive statistics of the continuous variables

Construct	Mean	Median	Min	Max	Standard Deviation	Kurtosis	Skewness	Kolmogorov–Smirnov test
Frequency of use	2.591	2.000	1.000	7.000	1.544	0.150	0.887	0,000*
BI 1	5.068	5.000	1.000	7.000	1.605	-0.025	-0.801	0,000*
BI 2	4.944	5.000	1.000	7.000	1.592	-0.299	-0.666	0,000*
BI 3	4.693	5.000	1.000	7.000	1.653	-0.434	-0.519	0,000*
BI 4	4.601	5.000	1.000	7.000	1.595	-0.559	-0.290	0,000*
ATU 1	5.523	6.000	2.000	7.000	1.245	0.608	-0.914	0,000*
ATU 2	4.889	5.000	1.000	7.000	1.349	-0.075	-0.282	0,000*
ATU 3	4.941	5.000	1.000	7.000	1.363	0.127	-0.542	0,000*
ATU 4	5.118	5.000	1.000	7.000	1.389	0.444	-0.796	0,000*
PEOU 1	5.489	6.000	2.000	7.000	1.144	-0.386	-0.565	0,000*
PEOU 2	6.130	6.000	3.000	7.000	0.935	1.200	-1.152	0,000*
PEOU 3	4.746	5.000	1.000	7.000	1.360	-0.291	-0.193	0,000*
PEOU 4	5.576	6.000	2.000	7.000	1.114	-0.595	-0.509	0,000*
PU 1	5.074	5.000	1.000	7.000	1.298	0.206	-0.591	0,000*
PU 2	5.053	5.000	1.000	7.000	1.288	0.138	-0.509	0,000*
PU 3	4.935	5.000	1.000	7.000	1.453	-0.031	-0.641	0,000*
PU 4	4.712	5.000	1.000	7.000	1.392	-0.224	-0.312	0,000*
PE 1	4.777	5.000	1.000	7.000	1.388	0.342	-0.650	0,000*
PE 2	4.616	5.000	1.000	7.000	1.441	0.029	-0.486	0,000*
PE 3	4.483	4.000	1.000	7.000	1.404	0.194	-0.336	0,000*
PE 4	4.245	4.000	1.000	7.000	1.476	-0.185	-0.195	0,000*
SN 1	3.455	4.000	1.000	7.000	1.449	-0.203	-0.110	0,000*
SN 2	3.062	3.000	1.000	7.000	1.557	-1.053	0.139	0,000*
SN 3	3.006	4.000	1.000	7.000	1.528	-1.015	0.042	0,000*
SN 4	3.402	4.000	1.000	7.000	1.505	-0.859	-0.154	0,000*
PBC 1	5.994	6.000	3.000	7.000	1.067	1.235	-1.261	0,000*
PBC 2	5.666	6.000	1.000	7.000	1.356	0.906	-1.180	0,000*
PBC 3	5.724	6.000	1.000	7.000	1.393	1.012	-1.260	0,000*
PBC 4	6.093	6.000	3.000	7.000	0.982	1.372	-1.213	0,000*
TR 1	5.207	6.000	1.000	7.000	1.226	0.016	-0.706	0,000*
TR 2	5.164	5.000	1.000	7.000	1.269	0.113	-0.695	0,000*
TR 3	3.650	4.000	1.000	7.000	1.422	-0.065	0.167	0,000*
TR 4	4.981	5.000	1.000	7.000	1.310	0.035	-0.522	0,000*

** Significant values of more than 0,05 indicates normality*

5.2 Estimation of path models using PLS-SEM

Grounded in the adoption literature this thesis uses TRA, TPB, TAM, MM and trust theories to predict consumers motivation for adopting mobile wallets. The theories we have used to create the conceptual research model have previously been applied to measure adoption of different technologies and will together with the hypothesizes be analyzed in this chapter to answer the research question. To achieve the goal of understanding the factors influencing adoption we use the conceptual research model developed in Chapter 3.6 and the statistical technique PLS-SEM presented in Chapter 4.4.1. The relationship between the factors proposed in the conceptual research model was measured and analyzed, and in total we developed 15 hypotheses expected to affect the adoption of mobile wallets.

The primary statistical objective of PLS-SEM is to maximize the explained variance (R^2) in the dependent variable, but it can also be used to measure path coefficients[24] and to examine the *measurement model* validity and reliability and the *structural model* relationship between constructs. To measure the explained variance and path coefficients the statistical technique PLS-SEM needs to be evaluated in two stages. Stage 1 is evaluating the *measurement model* and examines the size and significance of *indicator loadings, construct reliability, convergent validity* and *discriminant validity* (Hair, et al., 2018b). If stage 1 meets the statistical requirements to support a valid and reliable analysis, we proceed to stage 2. In stage 2 we assess the common method bias and perform collinearity tests to evaluate correlation between the variables. Lastly, stage 3 involves the determination of the *structural model* and the relationships between constructs and is determined by R^2, f^2 and Q^2. The structural relationships illustrate if the variable scores are significant and meaningful and if the predictive ability of the theoretical model is acceptable (Hair, et al., 2018b).

5.2.1 Assessment of the reflective measurement model (Stage 1)

Our *reflective measurement model* assume that the latent variables (constructs) is a representative measure of "reality" and that the theoretical determined items presented in Chapter 3 are indicators that representative this "reality" (Garson, 2016). The *reflective measurement model* therefore illustrates that indicators represent an effect on the measured construct (Hair, et al., 2012). To confirm whether the theoretically determined items correctly

[24] Path coefficient is defined as *"estimates of the path relationship in the structural model (i.e., between the constructs in the model), which correspond to standardized betas in regression analysis"* (Hair, et al., 2018b, p. 762)

capture the latent variables (constructs) and the "reality" they attempt to recapture, we have investigated the individual *indicator loadings* and their *construct reliability*. Furthermore, we have tested the internal consistency among the construct in the *reflective measurement model* to determine the *convergent validity*, estimated by the *average variance extracted*. Lastly, the *discriminant validity* is measured by the *heterotrait-monotrait ratio* (HTMT) to ensure that the constructs included in the *reflective measurement model* is empirically unique and dissimilar from other constructs (Hair, et al., 2018b).

5.2.1.1 Indicator loadings

In SmartPLS, individual *indicator loadings* are assessed by examining the statistical result named *outer loadings*. *Indicator loadings* or *outer loadings* should score above 0,708 to be considered reliable. When the loadings are above 0,708 it indicates that the construct explains more than 50% of the indicator 's variance (Hair, et al., 2018b).

Four items have loading below the threshold of 0,708 and was thus inspected to decide if the indicator could be deleted or not. Deleting one indicator from a construct is seen as nonproblematic in a reflective model, since the latent variable will still have the same theoretical meaning (Garson, 2016). Furthermore, the deletion of one item was planned for during the creation of the questioner to account for measurement errors and loading difficulties. The items that were inspected for deletion belonged to the following constructs: one item from *subjective norm* (SN 4), one item from *perceived ease of use* (PEOU 2) and two items from *perceived behavioral control* (PBC 1 and PBC 2).

After inspection of the *indicator loadings*, PEOU 2 with a loading of 0,627 and SN 4 with a loading of 0,640, were deleted from the subsequent analysis. In general, we should drop all construct which has loadings below the threshold but in the case of the extremely low loadings or negative loading, which is the case of PBC 1 (-0,063) and PBC 2 (-0,176), it is advised to carefully review the items before deciding to delete a construct because of multi-dimensionality (Hulland, 1999). *Perceived behavioral control* is by nature multi-dimensional and contains measures which reflects both *self-efficacy* and *controllability*. Previous researchers that encounter the same problem has solved the by splitting the *perceived behavioral control* construct into two subconstruct, one for *self-efficacy* and the other for *controllability* (Armitage & Conner, 2006; Manstead & Van Eekelen, 1998; Terry & O'Leary, 1995; Yzer, 2012). Lastly, the multi-dimensional loadings in the construct may also be a result of item ambiguity (Hulland,

1999) and of method bias which affects the validity and reliability of the constructs (MacKenzie & Podsakoff, 2012). We will not conclude on the cause of the low loading, before assessing the *construct reliability* in Chapter 5.2.1.2. Appendix 3 illustrates all indicator loadings.

5.2.1.2 Construct reliability

After assessing the *indicator loadings*, we will now assess the *constructs reliability* by looking at the *internal consistency* within the construct as suggested by Hair, et al., (2018b). The *internal consistency* is measured by using the *Composite Reliability*[25] (CR), which is a less biased estimate of reliability than Cronbach alpha, since CR weights the individual indicators based on its loadings (Hair, et al., 2018b). We accept CR scores of 0,7 or higher as recommended by Hair, et al., (2018b), since this indicates *internal consistency* and can further be interpreted as a reliable result (Hair, et al., 2018b).

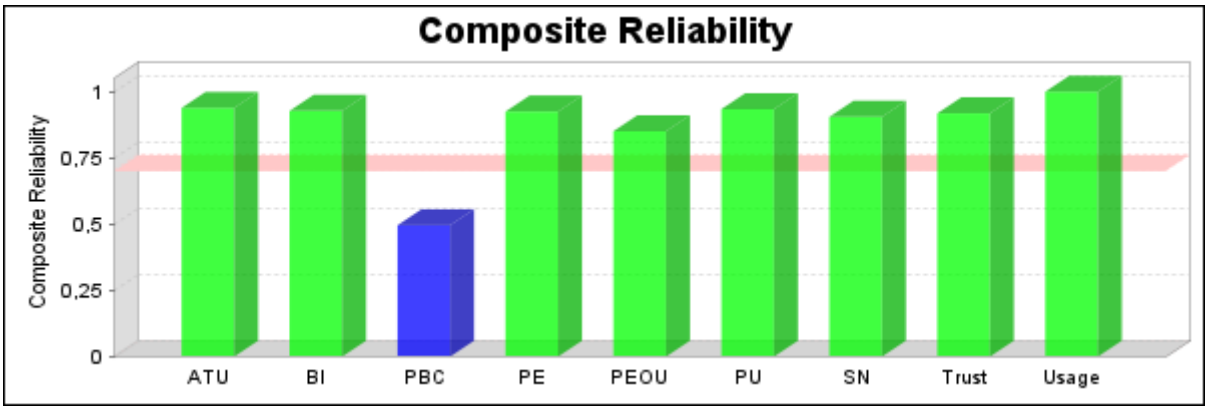

Figure 10 Composite Reliability test for internal reliability (before splitting PBC)

The construct *perceived behavioral control* has a CR score below the threshold of 0,7 (Figure 10). Low internal consistency combined with loadings close to zero indicates that construct is multi-dimensional (Hulland, 1999). In accordance with low *indicator loadings*, low CR score and with previous research (Armitage & Conner, 2006; Manstead & Van Eekelen, 1998; Terry & O'Leary, 1995; Yzer, 2012) we have split the construct *perceived behavioral control* into two subconstruct. The split of *perceived behavioral control* creates two new construct named *self-efficacy* and *controllability* and four new hypothesize. The names of the new construct was inherited from the theory since the underlying relationship of *perceived behavioral control* is

[25] Composite reliability is defined as *"a measure of internal consistency reliability, which, in contrast to Cronbach alpha, does not assume equally weighted indicator loadings. Composite reliability should be above 0,6 in exploratory research, and above 0,70 as a general guideline, but not above 0.95"* (Hair, et al., 2018b, p. 760)

calculated by the weighted *self-efficacy* (se_k) and by the weighted *perceived power* (pp_k) (referred to as controllability in this thesis) (Taylor & Todd, 1995b). Furthermore, the original hypothesis was changed to the following:

H4a: Self-efficacy is positively related to the behavioral intention of adopting mobile wallets.

H4b: Self-efficacy is positively related the actual behavior of adopting mobile wallets.

H5a: Controllability is positively related to the behavioral intention of adopting mobile wallets.

H5b: Controllability is positively related the actual behavior of adopting mobile wallets.

After the split, all of the *indicator loadings* measuring the indicators variance score above 0,708 and thus is considered to have a satisfactory reliability level. *Perceived ease of use* has the lowest CR score of 0,851 and *attitude towards behavior* have the highest CR score of 0,939. Lastly, the construct named *actual behavior* which is measured by the construct measuring how frequent consumers use a mobile wallet for payment have a CR score of 1 since its only measured by one item (frequency of use). The new Composite Reliability after splitting *perceived behavioral control* is shown in Figure 11.

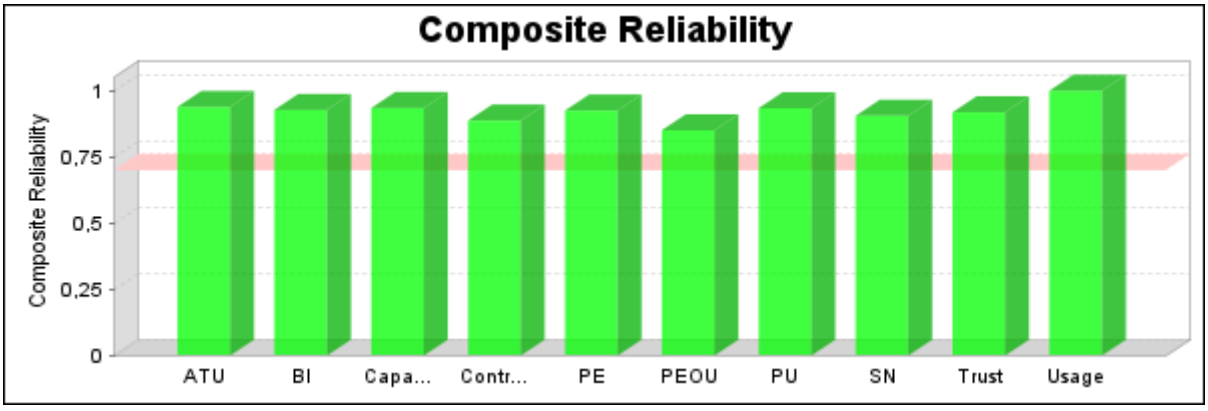

Figure 11 Composite Reliability test for internal reliability (after splitting PBC)

5.2.1.3 Convergent validity

For reflectively measured constructs *convergent validity* is defined as *"the extent to which a latent construct explains the variance of its indicators"* (Hair, et al., 2018b, p. 760). *Convergent validity* is by many referred to as communality and is measured in PLS-SEM by the statistical

technique named *average variance extracted* (AVE). AVE is defined as *"the average (mean) of the square loading of all indicators associated with a particular construct"* (Hair, et al., 2018b, p. 775). AVE values above 0,5 are acceptable and indicates that 50% or more of the variance in a construct is explained by the construct's indicators (Hair, et al., 2018b). All the constructs in the *reflective measurement model* is above the threshold (AVE > 0,5). The AVE range from a score of 0,656 for *perceived ease of use* to a score of 0,877 for *attitude towards behavior*. Overall, the AVE result suggests that items retained at this point are evidence of *convergent validity*. Figure 12 illustrate AVE scores.

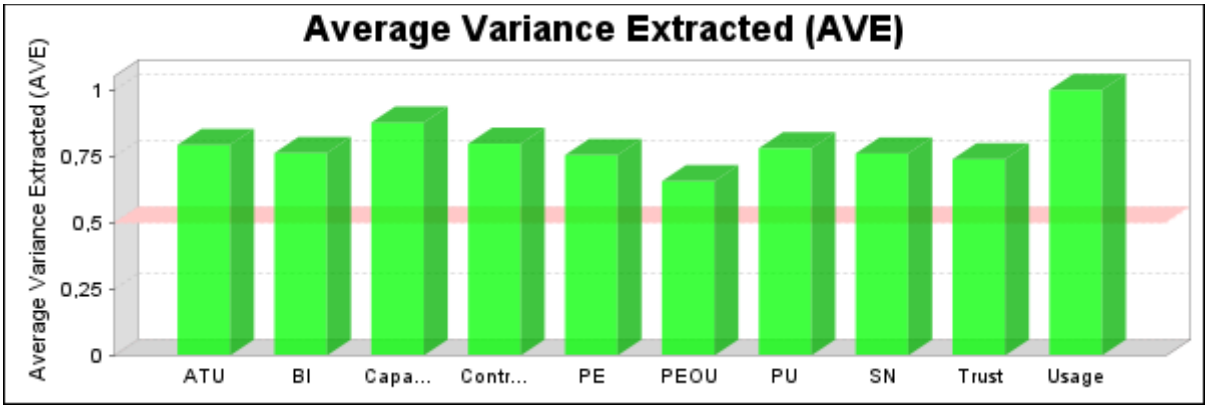

Figure 12 Result for Average Variance Extracted (AVE)

5.2.1.4 Discriminate Validity

The final stage in assessing the *reflective measurement model's* validity and reliability is to assess the *discriminant validity*. *Discriminant validity* is defined as *"the extent to which a construct is distinct from other constructs in a theoretical structural model. It is measured based on how much it correlates with other constructs in the theoretical model, compared to how much indicators represent only a single construct"* (Hair, et al., 2018b, p. 761). The *discriminant validity* must be established to be empirical unique and representative for a phenomenon that other constructs in the measurement model do not capture (Henseler, et al., 2015).

In PLS-SEM, *heterotrait-monotrait ratio* (HTMT) for correlation (Henseler, et al., 2015) is the recommended method for assessing *discriminant validity* for a reflective models (Hair, et al., 2018b). HTMT ratio is defined as *"the average of the heterotrait-heteromethod correlations (i.e., the correlations of indicators across constructs measuring different phenomena), relative to the average of the monotrait-heteromethod correlations (i.e., the correlations of indicators*

within the same construct) (Henseler, et al., 2015, p. 121). Meaning that HTMT estimate the true correlation, if both constructs where perfectly reliable and empirically unique. A HTMT value of 0,9 or above indicates a lack of *discriminate validity*, which means that constructs are not empirically unique but conceptually similar (Hair, et al., 2018b). Another method that is used in this thesis to measure *discriminant validity* is to assess if the constructs is significantly different from one (1.0) based on the confidence intervals of the HTMT value (Hair, et al., 2018b).

According to the result in Table 6, none of the ratios are above the threshold of 0,9. *Behavior intention* and *attitude towards behavior* has the highest HTMT value of 0,881 meaning that the all of the constructs do have *discriminant validity* and thus all constructs distinguish themselves from other constructs. Lastly, to test if the HTMT values are significant, we have run a complete PLS bootstrapping[26] with 5000 subsamples[27]. From the bias corrected confidence interval in Appendix 4, none of the values (e.i, 2,5% or 97.5%) contains the value one (1,0) which means all the constructs are found be empirically unique and conceptually dissimilar. Overall, the HTMT values support *discriminant validity* between the construct and thereby establishing sufficient proof of *discriminant validity* for this measurement model.

Table 6 Results of HTMT Discriminant Validity

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Actual behavior (1)										
Attitude towards behavior (2)	0.386									
Behavioral intention (3)	0.493	0.881								
Controllability (4)	0.158	0.068	0.090							
Perceived ease of use (5)	0.517	0.669	0.633	0.165						
Perceived enjoyment (6)	0.288	0.752	0.663	0.047	0.539					
Perceived usefulness (7)	0.358	0.846	0.726	0.055	0.814	0.689				
Self-efficacy (8)	0.296	0.280	0.300	0.240	0.449	0.175	0.226			
Subjective norm (9)	0.285	0.380	0.421	0.167	0.414	0.370	0.483	0.102		
Trust (10)	0.400	0.699	0.656	0.022	0.627	0.640	0.610	0.293	0.360	

[26] Bootstrapping is defined as *"a resampling technique that randomly withdraws a large number of subsamples from the original data (with replacement) and estimates models from each subsample. It is used to determine the standard errors of coefficients to determine their statistical significance without applying distributional assumptions"* (Hair, et al., 2018b, p. 760)

[27] Generally, 1000 bootstrap samples are recommended as minimum (Hair, et al., 2018b) but Hair, et al., (2017) recommended 5,000 bootstrap samples are recommended for statistical significance.

5.2.1.5 Summary of the assessment of the reflective measurement model (stage 1)

The assessment of the *reflective measurement model* involved inspecting and estimating of the *indicator loadings, construct reliability, convergent validity* and *discriminant validity*. The findings are presented in table 7, where the *indicator loadings* above 0,708 indicates acceptable loading values. Furthermore, the *construct reliability* is evaluated by the *composite reliability* where the minimum recommended reliability is 0,7 and the *convergent validity* is measured using the *average variance extracted* method where scores above 0,5 are acceptable. Lastly the *discriminant validity* is evaluated using the HTMT method where the guideline is that the construct values should be below 0,9.

The procedure of ensuring a valid and reliable *reflective measurement model* made us delete the indicator named SN 4 and PEOU 2 because of low *indicator loadings*. The construct named *perceived behavioral control* was split into two constructs (*self-efficacy* and *controllability*) based on the multidimensionality in the *indicator loadings* and violation of the recommended *composite reliability* values. The other values did not violate any rule of thumb relating *indicator loadings, construct reliability, convergent validity* or *discriminant validity* and are thus evaluated to be valid and reliable for further analysis. The final construct and items measuring the constructs are presented in table 7.

Table 7 Summary of the assessment of the reflective measurement model

Construct	Composite Reliability	Average Variance Extracted (AVE)	Indicators	Indictor loadings
Actual behavior	1.000	1.000	Actual use	1.000
Attitude towards behavior	0.939	0.793	ATU 1	0.883
			ATU 2	0.877
			ATU 3	0.900
			ATU 4	0.902
Behavioral intention	0.928	0.762	BI 1	0.819
			BI 2	0.911
			BI 3	0.874
			BI 4	0.887
Controllability	0.887	0.797	PBC 1	0.864
			PBC 2	0.921
Perceived ease of use	0.851	0.656	PEOU 1	0.841
			PEOU 3	0.851
			PEOU 4	0.734
Perceived enjoyment	0.925	0.755	PU 1	0.864
			PU 2	0.872
			PU 3	0.872
			PU 4	0.867
Perceived usefulness	0.934	0.780	PE 1	0.878
			PE 2	0.875
			PE 3	0.892
			PE 4	0.888
Self-efficacy	0.935	0.877	PBC 3	0.950
			PBC 4	0.923
Subjective norm	0.905	0.761	SN 1	0.865
			SN 2	0.847
			SN 3	0.904
Trust	0.919	0.740	TR 1	0.899
			TR 2	0.918
			TR 3	0.706
			TR 4	0.901

*CR, composite reliability; α, alpha; AVE, average variance extracted; M, mean; SD, standard deviation. *, p < 0.05; **, p < 0.01; ***, p < 0.001*

5.2.2 Common method bias and collinearity tests (Stage 2)

In the PLS-SEM context, *common method bias* may occur if there exists systematic error variance, created by our measurement technique (Tehseen, et al., 2017). The systematic error variance is often a result of self-reported measures, which is also the chosen strategy for this thesis to capture the respondent's perceptions of theoretically important constructs and how

they affect factors of mobile wallet adoption. Hence, the dataset which relies on self-reported measures, may contain *common method bias*[28] which may cause an inflation in the statistical detected relationship between the latent variables (constructs) (Conway & Lance, 2010). In addition, the cover letter for the questionnaire, or other directional guidance found in the questionnaire, may have influenced the respondents to answer the same way, causing the indicators to share certain amount of *common method variance*[29], that was not intended to be captured (Kock, 2015). To assess the potential existence of common method bias is therefore a critical part of the model assessment, since a systematic error variance may work as a third variable affecting the relationship under investigation and ultimately lead to non-generalizability of the results (Tehseen, et al., 2017).

5.2.2.1 Harman's single-factor Test

To assess the *common method bias*, we first used the Harman's single-factor test (Harman, 1976). The Harman's single-factor test is the most used post hoc analysis for *common method variance* (Tehseen, et al., 2017). The three-step procedure was done using a principal component analysis in SPSS. Where all the item, reflecting the theoretical constructs in the measurement model where forced into one single factor. The unrotated one- factor solution captured only 37,8% of the variance, which is below the threshold of 50% variance for one single-factor. Although the single-factor test indicates that the single-factor do not account for all the covariance among the items (Podsakoff, et al., 2003), sufficient proof of potential method effects are not provided, and additional diagnostics technique must be explored such as *classic collinearity test* and *full collinearity test*.

5.2.2.2 Classic Collinearity test

Before assessing the *structural model,* the collinearity[30] should be examined between the predictor constructs in the path model, since collinearity can create problems interpreting the result (Hair, et al., 2018b). Collinearity among the *outer model,* is not an issue for our *reflective*

[28] Common method bias refers to the *"degree that estimators become inconsistent; i.e., parameter estimates asymptotically converge to values different from their true population value, due to the presence of common method variance (CMV)"* (Siemsen, et al., 2009, p. 457)

[29] Common method variance (CMV) is defined as *"the amount of spurious covariance shared among variables because of the common method used in collecting data"* (Malhotra, et al., 2006, p. 1865)

[30] When two variables are highly correlated, collinearity is present. (Hair, et al., 2018b)

measurement model but can however create problems if it occurs on a structural level since path coefficients are altered by the presence of collinearity among the predictor constructs (Garson, 2016; Hair, et al., 2018b). To examine the extent of collinearity in the *structural model* we used *variance inflations factor* (VIF)[31]. A rule of thumb is that VIF values should be below 5,0 for a well-fitting model (Hair, et al., 2018b). According to the suggested thresholds for *classic collinearity test*, the highest VIF values are between *attitude towards behavior* and *behavioral intention*, with a VIF value of 3,251 (See Appendix 5). Kock & Lynn (2012) suggested to carry out a *full collinearity test* since lateral collinearity[32] still may be present and create misleading interpretations of the results.

5.2.2.3 Full collinearity test

The *full collinearity test* is a procedure purposed by (Kock & Lynn, 2012), as a way of identifying common method bias by checking both vertical and lateral collinearity in the context of PLS-SEM (Kock, 2015). Lateral collinearity is critical to identify, because it may occur when two theoretical constructs hypothesized to have structural relationship, in fact it measures the same phenomenon and cause a misleading result by appearing as a strong casual effect in the *structural model* (Kock & Lynn, 2012).

The *full collinearity test* was conducted in a three-step procedure. The first step was done by extending the dataset with a randomized dummy variable in Excel (N=323). Secondly, a new model was drawn in SmartPLS. This model contained the latent variables (constructs) from the *reflective measurement model*, which all points at the newly created randomized dummy variable (Appendix 6). The third step was to analyze the collinearity among constructs by using the threshold indicating VIF values above 5,0. Since no VIF values is found above the threshold we can conclude that collinearity is not likely to contaminate the interpretations of the result found using the statistical technique PLS-SEM. In table 8, result from the *full collinearity test* are presented.

[31] Variance inflations factor (VIF) is defined as *"a statistic used to evaluate the severity of collinearity (…) between the constructs in a structural model"* (Hair, et al., 2018b, p. 763)

[32] *"Lateral collinearity is defined as a predictor-criterion phenomenon, whereby a predictor variable measures the same underlying construct, or a facet of such construct, as a variable to which it points in a model"* (Kock, 2015, p. 7).

Table 8 Full collinearity Test

	ATU	BI	SE	Cont.	PE	PEOU	PU	SN	Trust	AB
RDV	3.967	3.197	1.202	1.045	2.050	1.248	2.589	1.236	1.916	1.363

RDV; Randomized dummy variable, Cont.; controllability, SE; self-efficacy, AB; actual behavior

5.2.3 Assessment of the structural model (Stage 3)

The *structural model* represents predefined relationships between constructs derived from established theories and previous technology adoption studies and were hypothesized in the (Chapter 3) as part of our conceptual research model. In the *structural model* we seek to test the hypothesis in strength and relevance, to obtain an understanding of the factors that affect the adoption of mobile wallets. To test the hypothesizes we move to stage 2 of the interpretation of PLS-SEM where the results are presented in accordance with the order suggested by Hair, et al., (2017). Hair, et al., (2017) suggested to firstly examine collinearity as illustrated in Chapter 5.2.2., secondly to assess the size and significance of the path coefficients in the *structural model*, thirdly to evaluate the explained variance (R^2), fourthly to examines f^2 statistics which measures the effect size and lastly to assess Q^2 statistics which measures the models predictive power.

5.2.3.1 Assessment of the hypothesis in the structural model

Assessment of the significance and size of the structural *path coefficients* was done by a bootstrapping routine of 5000 subsamples in SmartPLS. Table 9 summarizes the structural relationship, the coefficients, t values, significant levels (p values), 95 percent confidence intervals, and if the analysis found the theoretical relationships statistically significant. Out of a total number of 17 hypothesis, 12 hypotheses were accepted, and four was rejected.

Table 9 Structural Model, Path Coefficients and Significance Testing

Hypothesis	Structural relationship	P.C.	*t* Values	*p* values	C.I. 95%	p<0,05
H1	BI→AB	0.333	6.150	0.000	[0,225; 0.438]	Yes
H2	ATB→BI	0.635	11.526	0.000	[0.524; 0.741]	Yes
H3	SN→BI	0.076	1.806	0.071	[-0.008; 0.157]	No
H4a	SE→BI	0.074	1,942	0.052	[-0.000; 0.151]	No
H4b	SE→AB	0.183	4.421	0.000	[0.102; 0.263]	Yes
H5a	Cont.→BI	-0.072	2.123	0.034	[-0.137; -0.004]	Yes
H5b	Cont.→AB	-0.159	3.164	0.002	[-0.260; -0.068]	Yes
H6	PU→BI	0.042	0.677	0.499	[-0.079; 0.161]	No
H7	PU→ATB	0.537	8.172	0.000	[0.403; 0.661]	Yes
H8	PEOU→PU	0.700	26.763	0.000	[0.647; 0.749]	Yes
H9	PEOU→ATB	0.043	0.949	0.343	[-0.046; 0.137]	No
H10	PEOU→PE	0.457	9.162	0.000	[0.358; 0.551]	Yes
H11	PE→ATB	0.327	5.733	0.000	[0.218; 0.441]	Yes
H12	PE→BI	0.048	1.004	0.315	[-0.040; 0.147]	No
H13	SN→Trust	0.310	6.299	0.000	[0.212; 0.406]	Yes
H14	Trust→BI	0.092	1.971	0.049	[-0.001; 0.181]	Yes
H15	Trust→AB	0.137	2.477	0.013	[0.028; 0.246]	Yes

P.C.; Path Coefficients, 95% C.I.; 95 percent Confidence Intervals, P<0.05; Significance level,

TRA

The results of the analysis of the dataset illustrated that *behavioral intention* to use a mobile wallet has a significant positive direct effect on *actual behavior* of use a mobile wallet (H1: $\beta = 0.333$, $p < 0.000$, two-tailed). Theoretically, *behavioral intention* to use a mobile wallet, is a weighted function of *attitude towards behavior* and the *subjective norm*. The results from the analysis found a positive significant direct effect of *attitude towards behavior* of mobile wallet usage and *behavioral intention* to use a mobile wallet (H2: $\beta = 0.635$, $p < 0.000$, two-tailed). However, we did not find a positive significant direct effect between *subjective norm* and *behavioral intention* to use a mobile wallet (H3: $\beta = 0.076$, $p < 0.063$, two-tailed).

TPB

H4 originally states that: *Perceived behavioral control is positively related to the behavioral intention of adopting mobile wallets* and H5 originally states that: *Perceived behavioral control is positively related the actual behavior of adopting mobile wallets*. Since *perceived behavioral control* is found to be multi-dimensional (Chapter 5.2.1.2) we split *perceived behavioral control* in two subconstructs, *self-efficacy* (H4a and H4b) and *controllability* (H5a and H5b).

The result from the analysis, illustrated that *self-efficacy* did not have a positive significant direct effect on *behavioral intention* to use a mobile wallet (H4a: $\beta = 0.074$, $p < 0.052$, two-tailed) but that the construct did have a positive significant direct effect on *actual behavior* of use of a mobile wallet (H4b: $\beta = 0.183$, $p < 0.000$, two-tailed). *Controllability* on the other hand, is found to have a significant negative direct effect on *behavioral intention* (H5a: $\beta = -0.072$, $p < 0.034$, two-tailed) and to have a significant negative direct effect on *actual behavior* of use a of mobile wallet (H5b: $\beta = -0.159$, $p < 0.002$, two-tailed).

TAM

H7 and H8 were accepted since we found statistical support for *perceived usefulness* to have a positive significant direct effect on *attitude towards behavior* (H7: $\beta = 0.537$, $p < 0.000$, two-tailed) and *perceived ease of use* to have a positive significant direct effect *perceived usefulness* (H8: $\beta = 0.700$, $p < 0.000$, two-tailed). On the other hand H6 and H9 was not accepted since we found no statistical support between the constructs *perceived usefulness* and *behavioral intention* (H6: $\beta = 0.042$, $p < 0.499$, two-tailed) and *perceived ease of use* and no statistical support between the constructs *attitude towards behavior intention* (H9:$\beta = 0.043$, $p < 0.343$, two-tailed).

MM

In the result from the analysis of the dataset we found that *perceived ease of use* has a significant positive direct effect on *perceived enjoyment* (H10: $\beta = 0.457$, $p < 0.000$, two-tailed) and that *perceived enjoyment* has a significant positive direct effect on *attitude towards behavior* (H11: $\beta = 0.327$, $p < 0.000$, two-tailed). We did not find a positive direct effect between *perceived enjoyment* and *behavioral intention* (H12: $\beta = 0.310$, $p < 0.000$, two-tailed).

Trust

According to the thesis theoretical foundation and context, *trust* is societal characteristic, found to be especially strong in Norway, and is in general an important determinant for mobile wallet adoption in an immature market. Our analysis found support for a positive effect between *subjective norm* and *trust* (H13: $\beta = 0.310$, $p < 0.000$, two-tailed). *Trust* was also found to have a significant positive direct effect on *behavioral intention* (H14: $\beta = 0.092$, $p < 0.049$, two-tailed), and *actual behavior* (H15: $\beta = 0.137$, $p < 0.013$, two-tailed).

5.2.3.2 Coefficient of determination (R^2)

PLS-SEM primary statistical objective is to maximize the explained variance (R^2) in the dependent variable. The R^2 values have a range from zero (0,0) indicating no relationship and one (1,0) indicating a perfect relationship (Hair, et al., 2018b). Since the primary statistical objective is to maximize R^2 its intuitive that the higher the R^2 value are the better the prediction of mobile wallet adoption is. R^2 values need to be compared to similar contextual studies since the values usually varies from one social discipline to another. The *structural model's* predictive power was therefore compared to other IS and IT studies and/or studies with similar aim to predict mobile wallet adoption. As a reference point consumer behavior studies with R^2 values of 0,20 are considered high (Hair, et al., 2017).

The results of the estimation of the *structural model* revealed that our conceptual research model explains 28.1% of the dependent variable *actual behavior* indicating substantial high R^2 values. Also, the variable *behavioral intention* is considered to have a high R^2 of 66,8%. In comparison Taylor & Todd (1995a) explained 21% of the variance in *actual behavior* and 43 % in *behavioral intention* when measuring computing resource center. Another IS and IT study we compared our result with where Venkatesh, et al. (2003) which used a similar statistical technique as we do in this thesis. Venkatesh, et al. (2003) used partial least squares (PLS) to examine the reliability and validity of their study and stated that *"UTAUT was able to account for 70 percent of the variance (adjusted R2) in usage intention - a substantial improvement over any of the original eight models and their extensions"* (Venkatesh, et al., 2003, p. 467). The adjusted R^2 in the variable *behavioral intention* is 66% and the result is therefore viewed as solid since our model is less complex than UTAUT. Table 10 presents the proportion of the variance in the dependent and independent variables that is explained by the predictor constructs (Hair, et al., 2018b).

Table 10 Coefficient of determination (R2)

Coefficient of determination	***R Square***	***R Square Adjusted***
Actual behavior	0.281	0.272
Attitude towards behavior	0.661	0.658
Behavioral intention	0.668	0.660
Perceived enjoyment	0.209	0.206
Perceived usefulness	0.490	0.488
Trust	0.096	0.093

5.2.3.3 Effect size (f^2)

The *f^2 effect size*[33] is calculated to determine if removing an independent variable have an impact on the dependent variable and is a criterion to examine effect size (f^2) (Hair, et al., 2018b). The effect size is evaluated by the change in the R^2, when the independent constructs are omitted from the path model (Hair, et al., 2018b). Following the guidelines of f^2 values, a value below 0,02 indicates no effect, a value above 0,02 represent a small effect size, a value above 0,15 represent a medium effect size and a value above 0,35 represent a high effect size on the latent variables (Cohen, 1988). The effect sizes are summarized in Table 11.

The assessment of f^2 values revealed that *perceived ease of use* and its relationship with *perceived usefulness* have the highest effect size (0,960) followed by *attitude towards behavior* and its relationship with *behavioral intention* (0,374). The values indicate the independent variables contribution to the dependent variables R^2 value is high. Three values indicate medium effect (0,338; 0,264; 0,195) and four values indicate low effect (0,106; 0,099; 0,041; 0,034) and lastly seven values indicate no effect. The f^2 values below 0,02 could still be significant meaning that they still have a statically significant relationship but lack the magnitude to establish a practical significance (Ferguson, 2009). This is the case of the relationship between *trust* and *actual behavior*, *trust* and *behavioral intention*, controllability and *behavioral intention* and *self-efficacy* and *behavioral intention*.

Table 11 Effect size (f2)

F^2	1	2	3	4	5	6	7	8	9	10
Actual behavior (1)										
Attitude towards behavior (2)			0.374****							
Behavioral intention (3)	0.099**									
Controllability (4)	0.034**		0.015*							
Perceived ease of use (5)		0.003*				0.264***	0.960****			
Perceived enjoyment (6)		0.195***	0.003*							
Perceived usefulness (7)		0.338***	0.002*							
Self-efficacy (8)	0.041**		0.015*							
Subjective norm (9)			0.014*							0.106**
Trust (10)	0.017*		0.014*							

; no effect, **; small effect, *; medium effect, ****; large effect*

[33] f^2 effect size is defined as *"a measure used to assess the relative impact of a predictor construct on an endogenous construct"* (Hair, et al., 2018b, p. 761)

5.2.3.4 Predictive power (Q^2)

Q-squared values indicates the models out-of-sample *predictive power* and were obtained by conducting a blindfolding[34] procedure in SmartPLS, with an omission distance of 7. Q^2 values where calculated with the cross validated redundancy method, and is the preferred approach for PLS-SEM estimations, since it include path model estimates for the *structural model* and *measurement model* (Hair, et al., 2017). When the difference between the predicted values and the original values are small, the result is a larger Q^2 which indicates that the predictive power of the path model is higher (Hair, et al., 2018b). All of the Q^2 values are larger than 0.0, which indicates that our suggested path model has predictive relevance for the constructs. In the table 12, the sum of the squared observations (SSO) and the sum of the squared prediction errors (SSE) are illustrated tighter with the final Q^2 value.

Table 12 Predictive power (Q2)

Q^2	SSO	SSE	Q^2 (=1-SSE/SSO)
Actual behavior	323.000	238.601	0.261
Attitude towards behavior	1292.000	620.405	0.520
Behavioral intention	1292.000	647.073	0.499
Controllability	646.000	646.000	
Perceived ease of use	969.000	969.000	
Perceived enjoyment	1292.000	1091.889	0.155
Perceived usefulness	1292.000	802.741	0.379
Self-efficacy	646.000	646.000	
Subjective norm	969.000	969.000	
Trust	1292.000	1204.131	0.068

5.2.3.5 Assessment of the R2, f2 and Q2

PLS-SEM is a variance analysis technique, with a primary statistical objective to maximize the explained variance (R^2) in the constructs. To determine the variables predictive ability the structural model where assessed based on three criterions; coefficient of determination (R^2), the effect size (f^2) and predictive relevance (Q^2). The result of the structural model is shown in Table 13. Figure 13 illustrates the conceptual research model with adjusted R^2 values measured in the constructs illustrated in the blue circles together with the p-values illustrated between constructs.

[34] *"Blindfolding is a sample reuse technique that omits every dth data point in the endogenous construct's indicators and estimates the parameter with the remaining data points. The omitted datapoints are considered missing values and treated accordingly when running the PLS-SEM algorithm."* (Hair, et al., 2017, p. 202).

Table 13 Result of the structural model (R2, f2 and Q2)

Construct	R^2	Adj. R^2	Q^2	Predictor	P.C.	F^2
Actual behavior	0.281	0.272	0.261	Controllability	-0,159	0,034
				Self-efficacy	0,183	0,041
				BI	0,333	0,099
				Trust	0,137	0,017
Attitude towards behavior	0.661	0.658	0.520	PU	0,537	0,338
				PEOU	0,043	0,003
				PE	0,327	0,195
Behavioral intention	0.668	0.660	0.499	Controllability	-0,072	0,015
				Self-efficacy	0,074	0,015
				PU	0,042	0,002
				ATU	0,635	0,374
				PE	0,048	0,003
				SN	0,076	0,014
				Trust	0,092	0,014
Perceived enjoyment	0.209	0.206	0.155	PEOU	0,457	0,264
Perceived usefulness	0.490	0.488	0.379	PEOU	0,7	0,96
Trust	0.096	0.093	0.068	SN	0,31	0,106

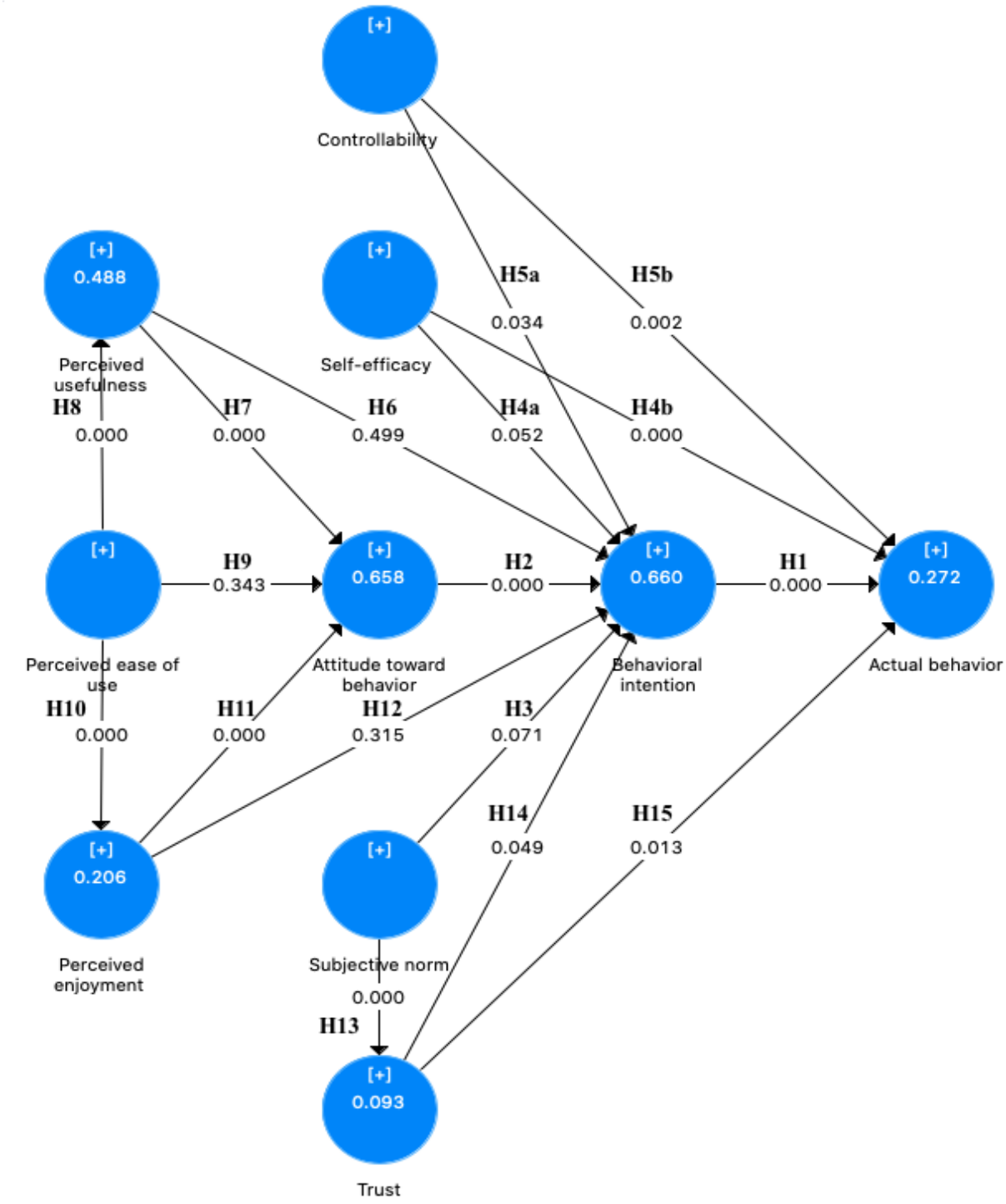

Figure 13 Conceptual research model with adjusted R2 and p-values

5.3 Mediation

The entire conceptual research model is a process model with an inherent theoretical perspective of TRA. Therefore, the formation of individual's beliefs is not directly formed, but instead part of a process which uses intermediate constructs such as *attitude toward behavior* as a translator in the formation of *actual behavior*. Although, we have no hypothesis on mediation, the theoretical origin indicates that testing of mediation[35] is a necessary step in understanding the process that leads to mobile wallet adoption. By evaluating our conceptual research model we was able to run a *multiple mediation analysis* instead of running a *simple mediation analyses,* which is more common (Hair, et al., 2017).

Our findings of *specific indirect effect* which indicate mediation between constructs is summarized in table 14. The findings support the reasoning of TRA that indicates that the formation of beliefs is not directly formed, but part of process where beliefs about user friendliness (*perceived Ease of use*), utility (*perceived usefulness*), and *perceived enjoyment* effects the formation of *attitude towards behavior* (Trafimow, et al., 2002). The formation of *attitude towards behavior* leads to a favorable or unfavorable decision to reject or accept the use of mobile wallets (*actual behavior*). The results show that *perceived ease of use* has the largest significant indirect effect on *actual behavior,* thought the intermediating constructs PE→ATB→BI ($\beta = 0.027$, $p < 0.000$, two-tailed). Likewise, perceived ease of use indirect effect on actual behavior intermediates also trough PU→ATB→BI ($\beta = 0.341$, $p < 0.000$, two-tailed). Further, the result show that *subjective norm* has weak significant indirect effect on actual behavior, by fully mediating trough trust ($\beta = 0.042$, $p < 0.021$, two-tailed). Lastly, controllability (Cont→BI→AB) is significant ($\beta = -0.024$, $p < 0.047$, two-tailed) and self-efficacy (SE→BI→AB) is proven non-significant ($\beta = -0.024$, $p < 0.077$, two-tailed)

[35] Mediation is defined as *"a situation in which one or more mediator variable(s) facilitate the explanation of the relationship(s) between two other variables/constructs"* (Hair, et al., 2018b, p. 762). The mediator variable therefore governs the relationship between the constructs and is described to be an underlying mechanism of the relationship.

Table 14, Indirect effect

Association	*β* Specific Indirect Effects	*t*-Values	*p*-Values
ATB→BI→AB	0.212	5.393	0.000***
Cont→BI→AB	-0.024	1.988	0.047*
PE→ATB→BI	0.027	5.248	0.000***
PE→ATB→BI→AB	0.009	4.063	0.000***
PE→BI→AB	0.150	0.996	0.319ns
PEOU→ATB→BI	0.095	0.975	0.330ns
PEOU→ATB→BI→AB	0.032	0.928	0.353ns
PEOU→PE→ATB	0.022	4.664	0.000***
PEOU→PE→ATB→BI	0.007	4.440	0.000***
PEOU→PE→ATB→BI→AB	0.376	3.615	0.000***
PEOU→PE→BI	0.239	0.957	0.339ns
PEOU→PE→BI→AB	0.080	0.947	0.344ns
PEOU→PU→ATB	0.029	7.760	0.000***
PEOU→PU→ATB→BI	0.010	6.248	0.000***
PEOU→PU→ATB→BI→AB	0.208	4.291	0.000***
PEOU→PU→BI	0.069	0.685	0.493ns
PEOU→PU→BI→AB	0.016	0.675	0.500ns
PU→ATB→BI	0.341	6.511	0.000***
PU→ATB→BI→AB	0.114	4.417	0.000***
PU→BI→AB	0.014	0.677	0.498ns
SE→BI→AB	0.025	1.769	0.077ns
SN→BI→AB	0.025	1.759	0.079ns
SN→Tr→AB	0.042	2.304	0.021*
SN→Tr→BI	0.028	1.912	0.056ns
SN→Tr→BI→AB	0.009	1.840	0.066ns
Tr→BI→AB	0.031	1.872	0.061ns

**, p < 0.05; **, p < 0.01; ***, p < 0.001, ns; Not significant*

5.4 Estimation of differences between groups using PLS-MGA

This chapter identifies the importance of using a multigroup analysis in PLS-SEM to evaluate differences in the latent variables scores between groups of respondents. Partial least square multigroup analysis (PLS-MGA) is an effective way of evaluating moderation across multiple latent variables and offers a more complete picture of the influence of the moderator by examining the group impact on all model relationships simultaneously (Hair, et al., 2017). For example, PLS-MGA can be used for cross-cultural studies, consumers loyalty (high vs low) and consumer behavior (Matthews, 2017). The chapter include a step by step procedure to apply a PLS-MGA to account for observed heterogeneity proposed by Matthews (2017).

5.4.1 Heterogeneity

In the previous part of the PLS-SEM analysis we assumed that our dataset represented a homogenous population. This assumption is often not true since there can be significant differences between two groups of respondents (e.g., males vs females) also called *heterogeneity* (Hair, et al., 2018a). *Heterogeneity* is an issue *"when the responses for two or more groups are significantly different, and therefore produce different model parameters. Heterogeneity can be either observed, such as firm size or gender, or unobserved in which it is not known before a post hoc analysis"*(Hair, et al., 2018b, p. 761). The most common type of heterogeneity for researchers to take into account is observed heterogeneity, which can be assessed is by a *multigroup analysis*[36] (Henseler & Ringle, 2009). If heterogeneity is present and not accounted for it can be a threat to the validity of PLS-SEM results, and it can lead to incorrect conclusions because of data pooling between groups (Hair, et al., 2017).

In this thesis we looked into the four different groups to test for significant differences between the different sets of groups. The groups we are going to test is age, gender, familiarity with mobile wallets and preferences between national and international mobile wallet providers. Previous research within the area of mobile payment has found age to affect the relationship of the latent variables by using age as a moderator (Shin, 2009). A *multigroup analyses* is generally preferred instead of moderators to determine if there are structural differences in the path coefficients between groups (Hair, et al., 2018b; Matthews, 2017).

[36] A *multigroup analysis* can be defined as *"a type of analysis where the categorical (e.g. two categories) potentially affect all relationships in the structural model. The method examines whether parameters differ significantly between groups. The focus is primarily on comparison of path coefficients"* (Hair, et al., 2018b, p. 762).

5.4.2 Steps for Running MGA in PLS-SEM

The steps for ensuring a comparison of the group specific outcomes consist of 3 steps ensuring valid interpretation of data and reduce the chance for interpretation errors (Matthews, 2017). Step 1 involves generating data groups, step 2 contains the procedure to test for invariance and step 3 includes an interpretation of the results.

5.4.2.1 Step 1 – Generate data groups

Step 1 involves the selection of categorical variables of inters (e.g age, gender, familiarity and mobile wallet provider preference) and generate data groups in accordance to the specified groups. Step 1 also include the assurance of large enough sample sizes (groups) for statistical power (Matthews, 2017). The sample size is based on the maximum number of arrows pointing at a latent variable (BI=7) and the minimum R^2 observed in the model (Trust=0,096). Following the table provided by Cohen (1992) for sample size recommendations with R^2 of 0,10 (0,096 ≈0,10) and a significant level of 10% the recommended number of respondents equals a minimum of 136 respondents per group.

The sample size of age is split to measure people older than 34 (N=173) and younger than 35 (N=150) since this is a standard for different prices in the Norwegian banking sector (e.g BSU and house loans etc.). The sample size of age is split to measure male (N=143) and female (N=180). The group measuring familiarity with mobile wallets was divided into yes (N=293) and no (30). This clearly violates the sample size recommendations making us discard the grouping. Lastly, the group measuring preferences between national and international mobile wallet providers was divided into groups only preferring Norwegian providers (N=132) versus all other groups except respondents with no preference (N=184). This grouping was accepted for further analysis since it barely violated the minimum recommended sample size of 136 respondents. We accepted the grouping because of our interest in consumer preferences between national and international providers.

5.4.2.2 Step 2 – Test for invariance

To test for *measurement invariance* the *measurement invariance of composite models* (MICOM) procedure was performed (Henseler, et al., 2016). The MICOM procedure is defined as *"a series of tests to assess invariance of measures (constructs) across multiple groups of data"* (Hair, et al., 2017, p. 321). The procedure test different aspects of *measurement*

invariance[37] in three steps; step 1 - *configural invariance*, step 2 - *compositional invariance* and step 3 - *equality of mean values and variances* (Henseler, et al., 2016).

Step 1 includes the evaluation of following criteria to ensure *configural invariance: "(a) identical indicators per measurement model, (b) identical data treatment, and (c) identical algorithm settings or optimization criteria"* (Matthews, 2017, p. 232). After an assessment of the measurement model and structural model we were able to establish *configural invariance* in all groups after a qualitative evaluation of the latent variables to ensure identical treatment of the criteria's mentioned above.

Step 2 includes the assessment of the compositional invariance which is a problem when the correlation between group A and group B significantly differ from the empirical distribution. The original correlation should be greater than or equal to the 5% quartile to establish *compositional invariance.* To test step 2 a *permutation test* [38] (a multigroup analysis variant) was performed. Appendix 7, 8 and 9 presents the findings between all of the three remaining groups (age, gender and mobile wallet provider preference). All groups have established *compositional invariance.*

Step 3 includes the inspection of *equality of mean values and variances* in the latent variables between groups. Step 3 distinguishes between *full variance* (meaning data can be pooled) and *partial invariance* (meaning data can be compared between groups) (Henseler, et al., 2016). The criteria to asses if the groupings have full invariance or partial invariance follows. 1) The mean *original difference* falls between the 2,5% and 97,5% quantile and 2) the *variance original difference* falls between 2,5% and 97,5% quantile. The group mobile wallet provider preference has full invariance while the grouping of age and gender have partial invariance. Appendix 10, 11 and 12 illustrates the scores of the measurement invariance test.

[37] *"Measurement invariance deals with the comparability of responses to sets of items across groups. Among other things, measurement invariance implies that the categorical moderator variable's effect is restricted to the path coefficients and does not involve group-related differences in the measurement models" (Hair, et al., 2017, p. 321).*

[38] Permutation test is defined as a *"test randomly permutes observations between the groups and reestimates the model to derive a test statistic for the group differences"* (Hair, et al., 2017)

5.4.2.3 Step 3 – Interpretation of permutation result

The interpretation of the permutation results focuses on determination of significant differences in the path coefficients between the tested groups. The only group with significant differences in the permutation's tests p-values is age. The other two groups (gender and familiarity) are therefore excluded since they did not indicate any significant difference between the subgroups.

Age indicated a significant difference between the latent variables *attitude towards behavior* and *behavior intention* (H2: path coefficient difference 0,374 sig. 0,000, two-tailed) and between *perceived usefulness* and *behavioral intention* (H6 path coefficient difference -0,251 sig. 0,042, two-tailed). We inspected the path coefficients belonging to the subgroups and found significant differences in H6. The subgroup over 35 had a path coefficient score of -0,108 while the subgroup below 35 had a path coefficient score of 0,143. The scores indicate that for every 1-unit of change in the predictor variable (*perceived usefulness*) the dependent variable (*behavioral intention*) will increase/decrease by the path coefficient value. Therefore, an increase of 1-unit in *perceived usefulness* will increase *behavioral intention* by 0,143 units in the subgroup below 35 and decrease *behavioral intention* by -0,108 units in the subgroup over 35. In total the significant effects scores offset one another and is not evident in the aggregated data (path coefficient = 0,042).

The interpretation of H2 indicates a significant difference in the path coefficient scores. The subgroup over 35 had a path coefficient score of 0,862 while the subgroup below 35 had a path coefficient score of 0,488. The effect of the difference is indicated in the construct *behavioral intention* and *actual behavior*. Specifically, the finding reveals that respondents belonging to the subgroup under 35 explained 18,6% of adjusted R_2 in the construct *actual behavior* while respondents belonging to the subgroup over 35 explains 40,0% of adjusted R_2 the construct *actual behavior*. The effect of the significant difference between the groups are illustrated in the construct *actual behavior* indicating significant difference with a R_2 permutation p-value of 0,006. The f_2 specifies a significant difference between the groups in the f_2 permutation p-value (0,047) illustrating the relative impact of the relationships. The subgroup over 35 had a f_2 score of 0,635 while the subgroup below 35 had a f_2 score of 0,261 and therefore explains the difference in R_2. We can therefore conclude that the two groups evaluate the importance of the constructs *perceived usefulness, attitude towards behavior* and *behavioral intention* differently which directly affect *actual behavior* and the explained variance in the construct.

6. Discussion

This chapter relates the research question and the conceptual research model together with a discussion of the key findings. The findings are evaluated and inconsistencies in the result will be discussed. Also, the contribution of the research findings will be discussed in a practical and theoretical context, before limitations and further research is proposed.

6.1 Discussing the research findings

The purpose of this thesis was to determine which factors that affect mobile wallet adoption as a substitute for the physical wallet. To determine which factors that affected adoption we combined psychological, sociological, and behavioral research theories together with IS and IT models and created a conceptual research model suited to measure mobile wallet adoption. The conceptual research model was grounded in adoption literature and uses building blocks from TRA, TPB, TAM, MM and trust theories and it was therefore natural to compare our conceptual research model together with the mentioned adoption theories. The model outperformed all of the other models explaining 27,2% of the adjusted R_2 in the dependent variable *actual behavior.* This result make us believe that the conceptual research model is well suited to measure the changing payment norms because the model addresses the evolutionary progression of technology in accordance with similar findings from Shin (2009) and Leonga, et al., (2013).

Findings from the study related to the theoretical perspective of TRA, found that the formation of individuals *behavior intention* are not directly formed from beliefs but mediated through constructs such as, *attitude towards behavior* and *subjective norm* (Trafimow, et al., 2002). The formation is part of a process where the individual form awareness, attitude and intention toward the behavior in question (Fishbein & Ajzen, 1975). The hypothesis describing the formation (H1, H2 and H3) are measured through effect sizes (f_2) determining the relative impact on a dependent variable. The relationship BI→AB indicated a small effect, ATB→BI indicate a large effect and SN→BI indicate no effect on the formation of behavior. The findings of a significant relationship between BI→AB (H1) and ATB→BI (H2) and a non-significant result SN→BI (H3) which all are in accordance with Shin (2009) research findings.

The construct inherited from TPB measures *behavior beliefs, normative beliefs,* and *control beliefs*. Control beliefs are factors that may facilitate or obstruct performance of the individual's behavior (Ajzen, 2002) and are described as contingency factors in this thesis. The construct

measuring control beliefs, *perceived behavioral control*, was spitted into two new constructs *self-efficacy* and *controllability* because of issues with multi-dimensionality. The new construct improved the indicator loadings and construct reliability and thus supported the splitting the variable. The split was also supported by other researchers encountering similar issues (Armitage & Conner, 2006; Manstead & Van Eekelen, 1998; Terry & O'Leary, 1995; Yzer, 2012) and was proven to be multidimensional (Trafimow, et al., 2002).

In all of the four hypotheses related to the new constructs *self-efficacy* (H4a and H4b) and *controllability* (H5a and H5b) we indicated a positive direct effect between the variables. However, the findings revealed unexpected coefficient signs indicating that two of the hypotheses (H5a and H5b) have changed sign from positive to negative. H5a (Cont.→BI) and H5b (Cont.→AB) are both significant. This result is in accordance with Trafimow, et al., (2002) findings suggesting that *controllability* coefficients are negative. Since control beliefs are viewed to facilitate or obstruct performance of the individual's behavior, we can conclude that *controllability* in fact hinder the adoption process. We believe that part of the explanation for the negative effect in fact is a result of barriers of adoption described in the contingency theory.

The contingency factors describe that consumer behavior and adoption of mobile wallets is dependent on the environmental influence from the availability of technology and supportive infrastructure. A lack of supporting infrastructure and an adoption barrier is found in the consumers bank connection since multiple banks does not support the adoption of Apple Pay and Google pay. On the other hand, a lack of infrastructure supporting QR code-based wallets (Vipps and Coopay) also hinder the adoption even though people think that adoption is under their voluntary control.

The research findings which can be related to TAM are criticized by Bagozzi (2007) to be weak. This can be explained by the time between the creation of *attitude towards behavior, behavioral intention* and *actual behavior*. During this creation period other factors and uncertainties may affect a person's decision to adopt a mobile wallet. We could not find a statistically significant result PU→BI (H6) or PEOU→ATB (H9). On the other hand, the link between PU→ATB (H7) and PEOU→PU (H8) are two of the links with the highest relative impact on the primary statistical objective to maximize the explained variance (R_2) in the dependent variables. This finding is in accordance with previous research findings (de Luna, et al., 2019; Shin, 2009).

As discussed in the literature review, we did not find any research papers investigating the effect of extrinsic motivation and intrinsic motivation. This study therefore distinguish itself from previous studies because it measures both extrinsic motivation (*perceived usefulness* and *perceived ease of use*) and intrinsic motivation (*perceived enjoyment*). The link between PEOU→PE (H10) and PE→ATB (H11) are found significant in accordance with Van der Heijden (2003) and Koenig-Lewis, et al., (2015) findings from another research are. Lastly, PE→BI (H12) is found non-significant but is rather mediated through the construct *attitude towards behavior* affecting *behavioral intention.* The mediation effect between PE→ATB→BI is a significant effect ($p < 0.000$, two-tailed).

Based on the importance of trust to mobile wallet payments the construct is viewed to be an important factor influencing mobile wallet adoption and consumer behavior relating new payment systems. All hypothesizes related to *trust* are fond significant but the effect size (f^2) in the relationship Trust→BI (H14) and Trust→AB (H15) are below 0.02 indicating no effect. Ferguson (2009) argued that the such statistically significant relationship lack the magnitude to establish a practical significance in the population. The findings in H13, H14 and H15 is in accordance with Shin (2009) and Leonga, et al., (2013).

Other important findings are the non-significant effect of Covid 19 related questions indicating that Covid 19 did not have any effect on the adoption of mobile wallets. This test was performed with the use of a moderator testing the significant effect on *actual behavior*. Several media articles have stated the practical effect of Covid 19 in relation to payment norms in Norway where contactless payment is the big winner and cash the big loser (Øverbø, 2020). Other technology driven services such as video conferences and online meetings also got a big boost making us argue that the effect of Covid 19 on payment norms still is unknown since behavior are changed over time. Lastly, our findings support the conclusions drawn by Finans Norge (2018) indicating that Norwegian consumers prefer national payment providers such as Vipps and Coopay over international providers such as Apple Pay and Google Pay.

On a general level the findings are consistent with previous research performed in other areas of the world. Even the finding indicating that there are significant differences between age groups and that there are no significant differences between gender groups was supported by Leong, et al., (2013). Furthermore, the findings in this study indicates that there could be universal factors relevant for adoption of mobile wallets due to the similarities in the importance

of *perceived ease of use*, *perceived usefulness*, *trust* and *self-efficacy*. We still think it is too early to conclude if there exist universal factors since the eastern mobile wallet markets are more mature than the Norwegian mobile wallet market.

6.2 Practical, theoretical and methodological implications

The purpose of this thesis has been to investigate factors affecting mobile wallet adoption as a substitute for a physical wallet. The findings provide substantial contribution to mobile wallet adoption literature and the mobile wallet industry.

The empirical findings demonstrate that the modification of TAM provides a better understanding of factors affecting adoption by include additional constructs not previously measured in a mobile wallet context. In our opinion the existing stream of literature have failed to introduce such new knowledge by focusing on constructs that are already known and understood. This study therefore fills a research gap by combing constructs from psychology, sociology and behavioral research together with IS and IT related theories which few researchers have combined before (Dahlberg, et al., 2008; Dahlberg, et al., 2015; Gomber, et al., 2017). Furthermore, the study contributes to an expanded knowledge base where no previous research is found by including extrinsic and intrinsic motivation in combination with IS and IT related theories.

The findings of the modified TAM illustrate the importance of the intrinsic motivation (*perceived enjoyment*) on the model with a significant direct effect and substantial relative impact on *attitude towards behavior*. The construct also had significant mediation effect on *behavioral intention* and *actual behavior* and is therefore viewed as an important factor describing adoption. Other important constructs implemented in the modified TAM are *trust*, *social norm* and *perceived behavioral control* (*self-efficacy* and *controllability*). The psychology, sociology and behavioral constructs all significantly affect *behavioral intention* or *actual behavior* either through mediation or a direct effect demonstrating the theoretical contribution and the expanded understanding of the phenomenon.

From a methodological perspective the findings are verified by applying advanced statistical analysis techniques and operationalized constructs to ensure validity and reliability. Both PLS-SEM and PLS-MGA have illustrated its appropriateness for analyzing complex structural

models and its flexibility of evaluating non-parametric data to further develop the existing theoretical knowledge. The increased popularity of the statistical technique is clearly explained by its utility and functionality. To improve the existing knowledge base on factors affecting mobile wallets an assessment of heterogeneity is of importance since few researchers have considered the topic in their research designs. The PLS-MGA was used to determine differences in model parameters between groups illustrate the importance of assessing heterogeneity. We will recommend researchers to assess heterogeneity in future research since it can be a threat to the validity of research findings.

The practical implications comprise engineers, system designers, managers and policy makers, it also includes FinTech firms, mobile phone manufacturers, the banking industry and governmental institutions. They should all consider the relative impact of *perceived ease of use, perceived usefulness* and *attitude towards behavior* on *behavioral intention*. Davis (1989) stated that the data collected about *perceived usefulness* and *perceived ease of use* can be used to add more relevant attributes to increase usefulness and to improve the system interface and functionality and are thus of practical relevance. Also, *trust* is important factor for adoption and practically all transactions require an element of *trust*, since the transaction involves money and/or personal information important to the individual.

Other practical implications are found in the environmental factors (contingency factors) which appears to have accelerated the adoption of mobile wallet by improving available technology and its supportive infrastructure. The improvement has lowered the difficulty of switching means of payment and is of high relevance for the creation and new digital payment services. The changes create new user patterns for mobile devices while at the same time decrease the reluctance of paying digitally with a mobile wallet. The change creates new payment norms affecting *perceived behavioral control* and *subjective norm*. Especially *subjective norm* will affect the payment norm creating a bandwagon effect illustrating the importance of a useful, easy to use and trustworthy mobile wallet platform.

6.3 Limitation and further research

This study and its research findings have several limitations. Firstly, there can be made no statistical inferences or generalization to other geographical regions than Norway since the study was carried out in a Norwegian context. Moreover, the sample is defined as non-normal

and does therefore not represent the variety of opinions of the full population. This is mainly because a *non-probability sampling method* was used to collect data and the findings are therefore generalizable to theory rather than the population. Furthermore, the sample size of 323 may be disproportionate given the rising popularity and adoption of mobile wallets. Future studies should focus on expanding the sample size and strive for normal distribution to expand the knowledge base.

Secondly, other means that can be used to expand the generalizability are to conduct a cross-culture study or apply other research design such as experiment, case study or field tests to improve the relevance of future research. An in-depth qualitative study could for example contribute to deeper understanding of psychologic, sociologic and behavioral factors found to be significant in this study. Also, future research papers are recommended to introduce new construct such as uncertainty avoidance, complementarity, complexity, convenience of use, and/or technological impulse to expand existing knowledge.

Thirdly, this thesis has several constraints in relation to time of sampling and time of writing a master thesis. The data collection was conducted at a point in time where the respondents was influenced by lockdown rules due to Covid 19. We cannot rule out an effect on the research findings due to the lockdown since the data collection process is a snapshot of time. Further studies are thus recommended to conduct a longitudinal research design to overcome such problems. A study following the individuals adoption process over time would be interesting since the researcher can track changes thought the process and thus gain valuable insight of behavioral beliefs and social factors affecting adoption.

Lastly, we think it would be interesting for further research papers to measure the practical effect of the contingency factors on adoption of mobile wallets. Research on contingency factors are important because they enable academics to describe the environment which are found in a payment ecosystem that lacks a deeper understanding. The research is therefore essential when differences between mobile payment markets in different countries are measured and are also important because of the constant development in the payment environment. We therefore believe further research on contingency factors are beneficial to enlarge the existing knowledge base and to gain an understanding on environmental factors affecting mobile wallet adoption in a more holistic manner.

6.4 Conclusion

This thesis has successfully determined which factors that affect the adoption of a mobile wallets as a substitute for the physical wallet and can therefore tell us something about the impact of people's behavioral changes in relation to their payment norms. The thesis explains both the indirect effect of the environmental factors and direct effect of behavioral factors affecting mobile wallet adoption. To explain the environmental factors we used Dahlberg, et al., (2008) meta framework which included four contingency factors. The contingency factors describe that consumer behavior is dependent on the environmental influence from the availability of technology and supportive infrastructure. To investigate the behavioral factors, we have created a conceptual research model (modified TAM) which is combining constructs from psychology, sociology and behavioral research together with constructs obtained from IS and IT related theories which was tested using empirical data from 323 respondents.

The conceptual research model was tested using the PLS-SEM method to determine the constructs predictive ability of mobile adoption. The method included the evaluation of the validity and reliability of the research finding assessed in measurement model and the estimation of path coefficients the predictive power (R^2), the effect size (f^2) and predictive relevance (Q^2) found in the structural model. The findings from the PLS-SEM analysis indicates that the conceptual research model indicates a significant result in 12 of 17 hypothesis explaining 27,2% of the adjusted R^2 in the construct *actual behavior* and 66% of the adjusted R^2 in the construct *behavioral intention* indicating the predictive power of mobile wallet adoption. The findings from the PLS-SEM analysis found a positive significant direct effect between the constructs; BI→AB, ATB→BI, SE→AB, PU→ATB, PEOU→PU, PEOU→PE, PE→ATB, SN→Trust, Trust→BI and Trust→AB. There was also found a negative significant direct effect between Cont.→BI and Cont.→AB and no significant direct effect between SN→BI, SE→BI, PU→BI, PEOU→ATB and PE→BI.

Lastly, a PLS-MGA was performed to identify significant differences among subgroups within our dataset. The analysis indicated that there exist significant differences between age groups under 35 and over 35. The two groups explain respectively 18,6% and 40,0% of the adjusted R^2 in the dependent variable *actual behavior*. The findings presented in this study have practical and theoretical relevance for researchers, system designers and engineers who wish to gain a better gain a better understanding of which factors that affect the adoption mobile wallets.

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Appendix

Appendix 1

Traditional banks acceptance of mobile wallet proviers	Apple Pay	Google Pay	Fitbit Pay	Garmin Pay	Vipps
DNB	✗	✔	✔	✔	✔
Nordea	✔	✔	✔	✔	✔
Danske Bank	✔	✔	✔	✔	✔
Sbanken	✔	✔	✔	✔	✔
Storebrand Bank	✔	✔	✔	✔	✔
Sparebank Sør	✗	✔	✔	✔	✔
Sparebank Vest	✗	✗	✔	✔	✔
Handelsbanken	✗	✗	✔	✔	✔
Sparebanken 1 Gruppen	✗	✗	✔	✔	✔
Eika Gruppen	✗	✔	✔	✔	✔
Fana Sparebank	✗	✗	✔	✔	✔
BN Bank	✗	✗	✔	✔	✔
Landkreditt Bank	✗	✗	✗	✔	✔

✔; Accept customer access to the provider, ✗; Customer are denied access to use the solution from the provider

Appendix 2 - Complete Survey

Page 1 Survey of the use of mobile wallets

Dear respondent.
This survey is part of our master's thesis at the Norwegian University of Science and Technology (NTNU). The study is about the use of mobile wallets online and in physical stores as a replacement of the physical wallet.

It will take approximately 5 minutes to complete the survey and it is completely anonymous.

If you have any questions about the survey, please contact:
Øistein Strøm Røvde (student) by e-mail
oisteisr@stud.ntnu.no
Iver Høegh Krohn Viddal (student) at e-mail ihvidda@stud.ntnu.no
Amine Ahmad Loutfi (supervisor) e-mail ahmad.a.loutfi@ntnu.no

Thank you in advance!

Page 2

Gender
- Man
- Woman
- Other

Age
- Under 18
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65-74
- 75 or above

Which county do you come from?
- Agder
- Innlandet
- Møre og Romsdal
- Nordland
- Oslo
- Rogaland
- Vestfold og Telemark
- Troms og Finnmark
- Trøndelag
- Vestland
- Viken

Page 3 **Read the text below:**

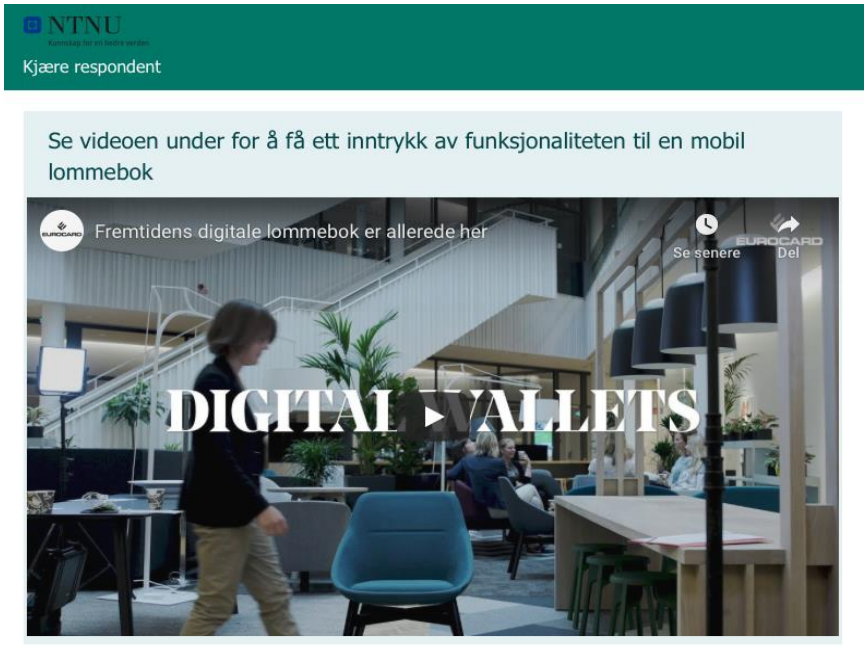
The study is about the use of mobile wallets online store and in physical store as a replacement of the physical wallet.

A mobile wallet is an app on a mobile device such as a smartphone, which can digitally store your card information so you can use your mobile to pay online or in physical stores. In addition, the mobile wallet can store information related to the transactions such as purchase confirmations or receipts.

When answering the questions in this survey, we are interested in learning more about your opinions toward mobile wallets such as Vipps, Coopay, Apple Pay, Google Pay and Garmin Pay and more.

Page 4

Watch the video below to get an idea of the functionality of a mobile wallet



https://www.youtube.com/watch?v=IVpKoSBz2n0&feature=emb_title

Have you heard of mobile wallets before this survey?

- Yes
- No

Page 5	Do you use mobile wallets for payment in a physical store or online store as a substitution for a physical wallet? • Never • Less than once a month • 1-3 times a month • Once a week • 1-3 times a week • 4-6 times a week • Every day

Info to the reader: On question 6 to 13 the respondents were asked to rate to which extent they agreed or disagreed with the statements on a Likert scale from 1 (Strongly disagree) to 7 (Strongly agree).

1. Strongly agree
2. Disagree
3. Slightly disagree
4. Neither agree nor disagree
5. Slightly agree
6. Agree
7. Strongly agree

Page	Question
Page 6	On a scale of 1-7, answer how you agree with the statement (s) below: • I will use a mobile wallet for payment in the near future • I want to use a mobile wallet for payment on a daily basis • I have a goal of using a mobile wallet to make a payment • I'd rather choose to use a mobile wallet to pay than other payment methods
Page 7	On a scale of 1-7, answer how you agree with the statement (s) below: • Using a mobile wallet for payment would be a good idea • Using a mobile wallet for payment gives me a positive experience • It would be valuable for me to use a mobile wallet for payment • I would like to use a mobile wallet for payment
Page 8	On a scale of 1-7, answer how you agree with the statement (s) below: • A mobile wallet is easy to use • I can learn how to use a mobile wallet without help • Mobile wallets are easier to use than other payment solutions • It's easy to learn how to use a mobile wallet for payment
Page 9	On a scale of 1-7, answer how you agree with the statement (s) below: • Using a mobile wallet will make execution of payments easier • Using a mobile wallet will increase the efficiency of my payments • In my everyday life it is useful to use a mobile wallet for payment • Paying with a mobile wallet will make my life easier

Page 10	On a scale of 1-7, answer how you agree with the statement (s) below: • People who influence me think I should use a mobile wallet for payment • It is expected that I use a mobile wallet for payment • People who are important to me think I should use a mobile wallet for payment • When it comes to using mobile wallets, I want to do the same as those in my social circle
Page 11	On a scale of 1-7, answer how you agree with the statement (s) below: • I enjoy using new payment solutions like a mobile wallet • I find it very interesting to make payments using a mobile wallet • I find the process of paying with a mobile wallet very satisfying • I think it is more fun to pay with a mobile wallet, compared to other payment methods such as cards and cash
Page 12	On a scale of 1-7, answer how you agree with the statement (s) below: • It's up to me whether I want to use a mobile wallet to pay or not • It's up to me to choose which type of mobile wallets I want to use • I have the knowledge needed to use a mobile wallet for payment • I have the skills needed to use a mobile wallet for payment
Page 13	On a scale of 1-7, answer how you agree with the statement (s) below: • Based on my perception of mobile wallets, I have confidence in the products • It is safe to use mobile wallets for payment • I trust mobile wallets more than other payment solutions (such as card and cash) • Based on my opinion of mobile wallets, I believe they are reliable

Page	**Questions**
Page 14	I want to use mobile wallets offered by • Norwegian companies such as Vipps and Coopay • Foreign companies such as Apple Pay, Google Pay, Garmin Pay and more • None of them • Both national and international, both are equal to me. • Both national and international, but I prefer Norwegian companies • Both national and international, but I prefer foreign companies I want to use a mobile wallet for payment instead of other payment solutions (such as cards and cash) due to the danger of infection by the Corona virus. • Yes • No I feel safe using a mobile wallet instead of other payment solutions (such as cards and cash) because of the danger of infection by the Corona virus. • Yes • No

Appendix 3 - Indicator loadings

Indicator loadings	AB	ATU	BI	PBC	PEOU	PE	PU	SN	Trust
Frequency of Use	1.000								
ATU_1		0.883							
ATU_2		0.877							
ATU_3		0.900							
ATU_4		0.902							
BI_1			0.818						
BI_2			0.911						
BI_3			0.874						
BI_4			0.887						
PBC_1				-0.063*					
PBC_2				-0.176*					
PBC_3				0.906					
PBC_4				0.868					
PEOU_1					0.829				
PEOU_2					0.627*				
PEOU_3					0.799				
PEOU_4					0.778				
PE_1						0.865			
PE_2						0.872			
PE_3						0.872			
PE_4						0.867			
PU_1							0.877		
PU_2							0.875		
PU_3							0.892		
PU_4							0.888		
SN_1								0.847	
SN_2								0.834	
SN_3								0.899	
SN_4								0.640*	
TR_1									0.898
TR_2									0.917
TR_3									0.708
TR_4									0.901

** items with a loading below the threshold of 0,708*

Appendix 4 - Bias Corrected Confidence Intervals Derived for HTMT Test

Path	OS	SM	Bias	2.5%	97.5%
ATU → AB	0.386	0.386	0.000	0.291	0.471
BI→AB	0.493	0.494	0.001	0.405	0.573
BI→ATU	0.881	0.881	0.000	0.822	0.923
Cont. → AB	0.158	0.158	0.000	0.046	0.286
Cont. → ATU	0.068	0.092	0.024	0.024	0.102
Cont. → BI	0.090	0.108	0.017	0.038	0.149

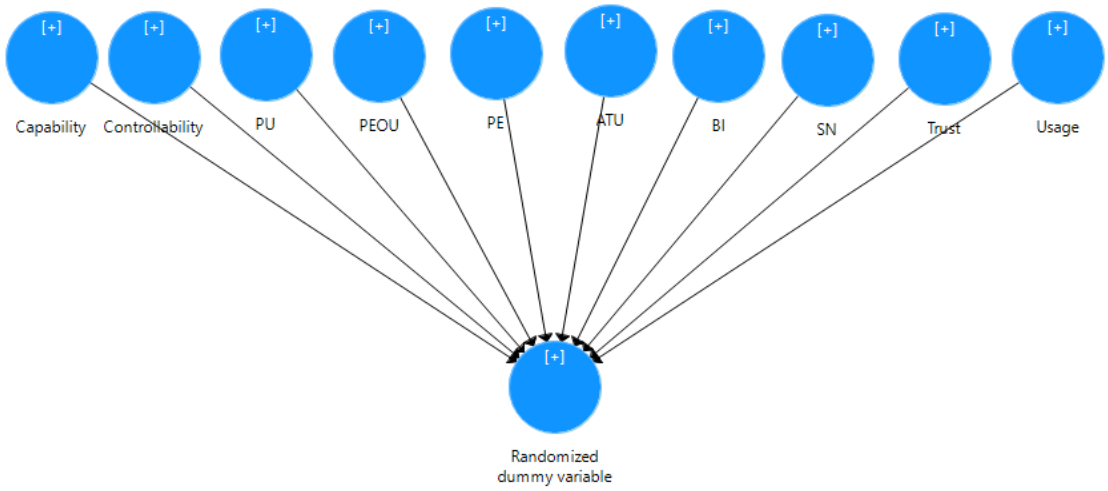
PEOU → AB	0.517	0.516	-0.000	0.409	0.617
PEOU→ATU	0.669	0.669	0.000	0.577	0.748
PEOU→ BI	0.633	0.634	0.000	0.529	0.721
PEOU → Cont.	0.165	0.170	0.005	0.059	0.291
PE → AB	0.288	0.288	0.000	0.172	0.388
PE → ATU	0.752	0.753	0.001	0.646	0.822
PE → BI	0.663	0.664	0.001	0.549	0.751
PE→Cont.	0.047	0.084	0.037	0.018	0.060
PE→ PEOU	0.539	0.539	0.001	0.400	0.646
PU→ AB	0.358	0.358	-0.000	0.259	0.450
PU→ ATU	0.846	0.847	0.000	0.781	0.895
PU→ BI	0.726	0.727	0.000	0.632	0.800
PU→ Cont.	0.055	0.088	0.033	0.025	0.065
PU→ PEOU	0.814	0.815	0.001	0.740	0.878
PU→ PE	0.689	0.690	0.001	0.572	0.775
SE → AB	0.296	0.296	-0.000	0.199	0.381
SE→ ATU	0.280	0.281	0.001	0.162	0.405
SE → BI	0.300	0.301	0.001	0.176	0.423
SE → Cont.	0.240	0.243	0.003	0.112	0.378
SE→ PEOU	0.449	0.449	0.000	0.327	0.557
SE → PE	0.175	0.179	0.004	0.074	0.294
SE → PU	0.226	0.227	0.001	0.105	0.342
SN → AB	0.285	0.286	0.001	0.170	0.391
SN → ATU	0.380	0.381	0.001	0.263	0.483
SN → BI	0.421	0.422	0.000	0.305	0.529
SN → Cont.	0.167	0.183	0.016	0.091	0.239
SN → PEOU	0.414	0.415	0.000	0.293	0.521
SN → PE	0.370	0.371	0.001	0.255	0.475
SN → PU	0.483	0.484	0.000	0.383	0.576
SN → SE	0.102	0.124	0.022	0.033	0.178
Trust → AB	0.400	0.400	-0.000	0.301	0.486
Trust → ATU	0.699	0.699	0.000	0.616	0.767
Trust → BI	0.656	0.656	-0.000	0.563	0.732
Trust → Cont.	0.022	0.073	0.051	0.012	0.016
Trust → PEOU	0.627	0.627	0.000	0.510	0.722
Trust → PE	0.640	0.640	0.000	0.541	0.719
Trust → PU	0.610	0.610	0.000	0.504	0.698
Trust → SE	0.293	0.296	0.002	0.190	0.402
Trust → SN	0.360	0.360	0.001	0.244	0.465

OS, Original sample; SM, Sample mean

Appendix 5 - Variance inflations factor (VIF)

VIF	1	2	3	4	5	6	7	8	9	10
Actual behavior (1)										
Attitude towards behavior (2)			3.251							
Behavioral intention (3)	1.556									
Controllability (4)	1.046		1.050							
Perceived ease of use (5)		1.964				1.000	1.000			
Perceived enjoyment (6)		1.625	2.056							
Perceived usefulness (7)		2.520	2.756							
Self-efficacy (8)	1.141		1.128							
Subjective norm (9)			1.258							1.000
Trust (10)	1.539		1.809							

Appendix 6 - Full collinearity test.



Appendix 7 - compositional invariance - Age

Age	Original Correlation	Correlation Permutation Mean	5.0%	Permutation *p*-Values
Actual behavior	1.000	1.000	1.000	
Attitude towards behavior	1.000	1.000	1.000	0.275
Behavioral intention	1.000	1.000	1.000	0.318
Controllability	0.982	0.962	0.853	0.416
Perceived ease of use	1.000	0.998	0.993	0.873
Perceived enjoyment	1.000	1.000	0.999	0.276
Perceived usefulness	1.000	1.000	1.000	0.660
Self-efficacy	1.000	0.999	0.996	0.861
Subjective norm	0.995	0.998	0.993	0.088
Trust	0.997	0.999	0.997	0.072

Appendix 8 - compositional invariance - Gender

Gender	Original Correlation	Correlation Permutation Mean	5.0%	Permutation *p*-Values
Actual behavior	1.000	1.000	1.000	0.269
Attitude towards behavior	1.000	1.000	1.000	0.233
Behavioral intention	1.000	1.000	1.000	0.964
Controllability	0.997	0.962	0.856	0.734
Perceived ease of use	0.998	0.998	0.993	0.436
Perceived enjoyment	1.000	1.000	0.999	0.290
Perceived usefulness	1.000	1.000	1.000	0.583
Self-efficacy	0.999	0.999	0.996	0.249
Subjective norm	0.996	0.998	0.993	0.132
Trust	1.000	0.999	0.997	0.850

Appendix 9 - compositional invariance - Payment provider

Payment provider	Original Correlation	Correlation Permutation Mean	5.0%	Permutation *p*-Values
Actual behavior	1.000	1.000	1.000	0.477
Attitude towards behavior	1.000	1.000	0.999	0.826
Behavioral intention	1.000	1.000	0.999	0.917
Controllability	0.966	0.872	0.377	0.503
Perceived ease of use	0.999	0.996	0.989	0.778
Perceived enjoyment	1.000	0.999	0.998	0.725
Perceived usefulness	1.000	1.000	0.999	0.875
Self-efficacy	1.000	0.992	0.976	0.773
Subjective norm	1.000	0.997	0.992	0.841
Trust	1.000	0.996	0.985	0.969

Appendix 10 - measurement invariance test – Age

Age	Mean - Original Difference (age – above 35 - Alder - Under 35)	Mean - Permutation Mean Difference (age - above 35 - Alder - Under 35)	2.5%	97.5%	Permutation p-Values
Actual behavior	0.247*	0.001	-0.220	0.215	0.023*
Attitude towards behavior	-0.342*	-0.001	-0.224	0.217	0.003*
Behavioral intention	-0.096	-0.003	-0.219	0.215	0.388
Controllability	-0.063	0.001	-0.213	0.223	0.578
Perceived ease of use	-0.102	-0.001	-0.219	0.218	0.363
Perceived enjoyment	-0.198	-0.002	-0.215	0.210	0.070
Perceived usefulness	-0.184	-0.001	-0.222	0.208	0.095
Self-efficacy	-0.366*	-0.001	-0.218	0.213	0.002*
Subjective norm	0.076	-0.000	-0.216	0.220	0.509
Trust	-0.090	-0.001	-0.228	0.226	0.423

Age	Variance - Original Difference (age - above 35 - Alder - Under 35)	Variance - Permutation Mean Difference (age above - Over 35 - Alder - Under 35)	2.5%	97.5%	Permutation p-Values
Actual behavior	0.207	0.005	-0.326	0.322	0.209
Attitude towards behavior	0.257	0.002	-0.359	0.360	0.153
Behavioral intention	-0.029	0.003	-0.287	0.295	0.848
Controllability	-0.045	0.003	-0.358	0.373	0.805
Perceived ease of use	-0.200	0.001	-0.256	0.256	0.119
Perceived enjoyment	-0.115	0.000	-0.341	0.356	0.527
Perceived usefulness	-0.086	0.003	-0.343	0.359	0.638
Self-efficacy	-0.018	0.004	-0.362	0.362	0.925
Subjective norm	0.021	0.002	-0.227	0.234	0.858
Trust	-0.114	0.002	-0.329	0.353	0.508

** violation of criteria's*

Appendix 11 - measurement invariance test - Gender

Gender	Mean - Original Difference (Gender – woman- man)	Mean - Permutation Mean Difference (Gender – woman- man)	2.5%	97.5%	Permutation p-Values
Actual behavior	-0.069	-0.003	-0.215	0.216	0.561
Attitude towards behavior	-0.214	-0.002	-0.224	0.212	0.054
Behavioral intention	-0.256*	-0.001	-0.225	0.217	0.022*
Controllability	-0.084	-0.000	-0.217	0.216	0.457
Perceived ease of use	-0.055	-0.002	-0.220	0.218	0.617
Perceived enjoyment	-0.004	0.000	-0.220	0.224	0.975
Perceived usefulness	-0.097	-0.002	-0.220	0.221	0.385
Self-efficacy	-0.497*	-0.001	-0.219	0.219	0.000*
Subjective norm	-0.146	0.001	-0.217	0.224	0.191
Trust	-0.037	-0.001	-0.225	0.215	0.738

Gender	Variance - Original Difference (Gender – woman- man)	Variance - Permutation Mean Difference (Gender – woman- man)	2.5%	97.5%	Permutation p-Values
Actual behavior	-0.115	0.000	-0.323	0.322	0.504
Attitude towards behavior	0.023	0.004	-0.343	0.370	0.897
Behavioral intention	-0.208	0.003	-0.286	0.303	0.168
Controllability	-0.278	0.003	-0.347	0.342	0.116
Perceived ease of use	-0.165	0.003	-0.255	0.260	0.210
Perceived enjoyment	-0.337	-0.002	-0.343	0.359	0.056
Perceived usefulness	-0.160	0.005	-0.355	0.370	0.389
Self-efficacy	0.130	0.006	-0.366	0.379	0.493
Subjective norm	0.153	0.006	-0.227	0.247	0.203
Trust	-0.205	0.004	-0.331	0.346	0.244

** violation of criteria's*

Appendix 12 - measurement invariance test - Payment provider

Payment provider	Mean - Original Difference (Trust Norway vs trust other)	Mean - Permutation Mean Difference (Trust Norway vs trust other)	2.5%	97.5%	Permutation p-Values
Actual behavior	-0.028	-0.002	-0.236	0.228	0.837
Attitude towards behavior	0.029	0.000	-0.231	0.227	0.816
Behavioral intention	0.023	-0.000	-0.234	0.233	0.851
Controllability	-0.025	-0.001	-0.243	0.228	0.832
Perceived ease of use	-0.034	-0.000	-0.237	0.230	0.787
Perceived enjoyment	0.005	0.001	-0.233	0.239	0.964
Perceived usefulness	0.038	0.000	-0.227	0.239	0.760
Self-efficacy	-0.204	0.000	-0.244	0.233	0.092
Subjective norm	0.018	-0.001	-0.239	0.230	0.893
Trust	-0.052	-0.002	-0.246	0.233	0.655

Payment provider	Variance - Original Difference (Trust Norway vs trust other)	Variance - Permutation Mean Difference (Trust Norway vs trust other)	2.5%	97.5%	Permutation p-Values
Actual behavior	-0.048	-0.009	-0.316	0.288	0.745
Attitude towards behavior	-0.262	-0.010	-0.369	0.349	0.159
Behavioral intention	-0.196	-0.004	-0.355	0.330	0.265
Controllability	0.043	-0.007	-0.339	0.314	0.797
Perceived ease of use	-0.084	-0.004	-0.278	0.265	0.553
Perceived enjoyment	-0.134	-0.008	-0.415	0.394	0.521
Perceived usefulness	-0.271	-0.005	-0.365	0.371	0.152
Self-efficacy	0.221	-0.007	-0.464	0.430	0.314
Subjective norm	-0.082	-0.007	-0.283	0.264	0.571
Trust	-0.271	-0.005	-0.394	0.393	0.184

** violation of criteria's*

Towards an understanding of factors affecting mobile wallet adoption: Evidence from Norway

NTNU
Norwegian University of
Science and Technology