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Empowering the Underserved: Assessing the role of Digital Banking in Enhancing Financial Inclusion in South Asia

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Abstract

The present study examines the impact of digital banking services on financial inclusion in three South Asian countries – India, Bangladesh and Nepal – during the years 2017 and 2021. In this thesis, savings, borrowing and receiving remittances are key indicators employed to evaluate financial inclusion, using data from The World Bank’s Global Findex Database. The research analyses two sets of cross-sectional data from 2017 and 2021, and explores the data applying logit regression models with marginal effects. The aim is to capture both pooled and country specific results and trends. The findings of this study eventually establish that digital banking services do significantly improve financial inclusion. Digital account ownership leads to an increased likelihood of saving and borrowing from a financial institution, as well as, receiving remittances on an individual level. The results also look at the role of digital banking explicitly in rural areas. These findings are also generally positive and significant, highlighting the capability of digital finance to bridge the financial inclusion gap in such developing countries, particularly for their large underserved populations. This research emphasizes the importance of financial literacy programs and infrastructure developments to increase general awareness and adoption of digital banking services. These forward-looking investments and policy changes can optimize the benefits of digital banking for financial inclusion, ultimately leading to economic growth and empowerment for these emerging South Asian economies.

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1. Introduction

Financial inclusion can be defined as access to widely available and affordable financial products and services, and is a crucial contributor to economic growth and poverty alleviation. By providing individuals the opportunity to save, invest, and manage risks, financial inclusion introduces tools that people can utilize to explore new potentials and economic opportunities. This can improve quality of life and wealth leading to economic growth and poverty alleviation. Over the previous decade, global financial inclusion has seen significant progress, reports from the Global Findex Database 2021 stating that 76% of adults now own an account at a financial institution, including online and mobile accounts. In comparison, only 69% of adults owned an account at a financial institution in 2017 (World Bank, 2017). Despite these developments, evident inconsistencies remain, especially within developing economies. According to the World Bank, around 1.4 billion adults remain unbanked. Furthermore, residents from just seven countries account for nearly half of that figure : Bangladesh, China, India, Indonesia, Mexico, Nigeria, and Pakistan. In Sub-Saharan Africa, only 55% of adults have an account at a financial institution or through a mobile money provider. Likewise, in South Asian countries the same statistic is only around 58% (Global Findex Database, 2021). These figures are well below the global average of 76%, showing the disparities among underserved populations. This thesis will focus on three developing countries particularly in South Asia : India, Bangladesh and Nepal. Evaluating the progress made by these countries is also essential. Hence, a comparison will be made using Global Findex data from 2017 and 2021.

To tackle financial inclusion issues across developing countries and take advantage of the global advancements in technology, investment into digital banking systems poses an ideal solution. Diener and Špaček (2021) explore digital transformation in banking through the adoption of digital banking services, which enable customers to perform banking transactions, manage accounts, and access financial products online or via mobile devices, enhancing customer experience and operational efficiency. These additional features have the potential to substantially improve financial inclusion by reducing transaction costs, increasing convenience and most importantly arranging easier accessibility of financial services in remote areas.

While mobile money usage has been adopted and embraced in developed countries, Africa has taken to the mobile money markets with a storm, particularly West Africa. This rapid rise can be credited mainly to Kenya's M-Pesa success story (Aker & Mbiti, 2010), leading Africa to take the crown for having one of the largest growing mobile money markets globally and transforming financial landscapes in recent times. M-Pesa was introduced to Kenya around 2007, and it used the platform to manage micro accounts, build customer deposits and broaden its customer network. The initiative was so successful that by 2016 over 75% of the adult population in Kenya had access to

formal financial services, up from 26.7% around a decade before (Ndung'u, 2017). Asia is also on the rise through countries like India and China, however, there are gaps to be filled in their markets to catch up.

To further build on this theme, it is crucial to define the idea of financial inclusion clearly. Chakravarty and Pal (2013) adeptly define financial inclusion as a process that serves to remove the barriers and overcome the inabilities of some societal groups and individuals, including the poor and disadvantaged, to access and use low-cost, fair and safe formal financial services, such as credit, deposits, insurance and payments, whenever needed. However, financial inclusion is also a lot more than that. It is a means to an end, enabling families to smooth out consumption and invest in the household's future. Ultimately financial inclusion bridges the divide between economic opportunity and economic achievement. This study will later expand on the inner frameworks of this theme.

Lack of financial systems and inclusion is particularly evident amongst specific economic subgroups, such as rural and under-educated regions. The World Bank defines rural populations as those typically residing in areas with restricted infrastructure, lower population density and fewer economic opportunities. Under-educated populations, defined in this paper and in multiple previous papers as those who have completed only primary school or less, face significant barriers to financial inclusion. According to UNESCO (2021), around 773 million adults around the world are illiterate, with the majority situated in rural regions of developing countries. Since these groups face disproportionate challenges against poverty and lack access to essential financial services, including these populations is critical for overall economic development and social equity (World Bank, 2021).

Exploration of previous literature leads to intriguing findings and possible gaps that can be further investigated. Demirgüç-Kunt et al. (2021) highlight that digital payments can increase financial inclusion by providing a low-cost, accessible way to transact, save, and borrow. They found that individuals who use digital payments are more likely to save and borrow from financial institutions, thereby integrating more deeply into the formal financial system. For example, in Kenya, M-Pesa users were seen to save 22% more compared to non-users (Jack & Suri, 2014). A previous study by Aker & Mbiti (2010) shared similar findings. Their research demonstrated that mobile banking reduced transaction costs, increased the speed and simplicity of financial transactions, and served as a safer way to handle money, which is especially important for underserved populations. More recently, the IMF (2021) assessed the impact of digital financial inclusion in emerging and developing economies through an index they constructed which depended on payment data from 52 developing countries. The study found that digital financial inclusion notably developed in most countries between 2014 and 2017, with superior improvements particularly in access and usage dimensions. The IMF reported that digital finance could boost GDP

by 2% and 3% in markets like Indonesia, and the Philippines respectively and in Cambodia, by up to 6%. For populations earning less than \$2 a day, this translates to a 10% increase in income in Indonesia and the Philippines, and around a 30% increase in Cambodia. McKinsey Global Institute (2016) further develops this idea, stating widespread adoption and use of digital finance could increase the GDPs of all emerging economies by 6%, or a total of \$3.7 trillion by 2025. This additional GDP can potentially create up to 95 million new jobs across all sectors of the economy. Hence, digital financial inclusion is highly beneficial on an individuals level but also provides widespread macroeconomic benefits.

Existing studies have focused on more general research and possibilities on this topic. Furthermore, the region of South Asia has yet to be as thoroughly explored as other regions such as Africa. Carrying out a comparative study between Asian countries with similar socio-economic and cultural backgrounds may result in more relevant and specific schemes for more effective digital banking schemes. Simultaneously, focusing on finer details such as disadvantaged populations can be more efficient than a general study. Hence, the research question for this thesis is as follows:

To what extent do digital banking services impact financial inclusion in developing countries, specifically India, Bangladesh and Nepal?

The research question leads to 3 main hypotheses for the selected countries. The first hypothesis (H1) is that *digital bank account ownership does not affect an individual's likelihood of saving using an account through a financial institution*. The second hypothesis (H2) is that *digital bank account ownership does not affect an individual's likelihood to borrow from a financial institution*. Finally, the third hypothesis (H3) is that *digital bank account ownership does not affect an individual's likelihood of receiving domestic remittances*.

2. Theoretical Framework and Literature Review

a) Digital Banking Services

The previously defined research question relies on the clear conceptualization of several terms. According to the World Bank, digital banking comprises various financial services delivered through digital channels. These services cover multiple activities such as online banking, mobile banking, digital payments, and money transfers. For this thesis, digital banking will be represented by mobile banking. The expected goal of embracing technological change and adopting digital banking is to enhance financial outreach. This is carried out by offering more accessible means of access to financial services for individuals who would traditionally lack these opportunities due to socio-economic factors. Digital banking services aim to improve financial outreach by reducing the barriers associated with traditional banking, namely geographical limitations, high transaction

costs, and lack of financial infrastructure. These platforms leverage technology and present remote banking means, allowing users to make transactions, save, borrow and control their finances through mobile devices and online platforms (Puschmann, 2017).

The Technology Acceptance Model (TAM) hypothesizes that the acceptance and functions of technology are persuaded by perceived ease of use and anticipated usefulness (Davis, 1989). In digital banking, users are more inclined to embrace digital financial services if they perceive them to be more user-friendly and beneficial for managing their financial needs than traditional banks or informal financial institutions. This model answers some questions regarding lower adoption rates of digital banking services within different populations, specifically for rural and under-educated areas where digital literacy is likely to be lower. In such underserved regions individuals are not educated on such practical subjects, and those who are not taught about the utility of digital banking will not be inclined to embrace the change. Technology is often seen as an alien concept to multiple groups of individuals, for example the underserved populations or the ageing population who have not been significantly exposed to it. The inconsistencies answered by the TAM in this context is that the lack of financial literacy means that individuals aren't aware of the benefits and usefulness of digital banking. This leads to a significant proportion of the population overlooking how valuable and efficient digital banking is. It is critical for these subgroups to understand how technology can streamline the financial system and provide effortless use of financial services if people are educated on it. Without this, individuals will stick to what is comfortable. In many developing countries this is much more risky and less secure, and this is what we often see amongst these underserved populations.

Building on the TAM, Rogers' Diffusions of Innovations theory (2003) provides crucial insights into the determinants of digital banking service adoption among developing populations. The concept proposes that this acceptance is motivated by five important factors: relative advantage, compatibility, complexity, trialability and observability. Relative advantage is associated with the anticipated benefits of digital banking compared to traditional banking. Elements such as lower costs, greater convenience and faster and safer transactions can highlight digital finance platforms as a superior innovation and can gradually increase adoption. Compatibility is how digital banking aligns with the users' values, needs and experiences. This is crucial as traditional banking has already proven relatively incompatible with large sections of the selected regions, whether it is due to lack of infrastructure or trust. Hence, once again, being taught about digital finance may significantly increase compatibility compared to before, resulting in better adoption. Amongst developing populations, general awareness regarding technology and digitalisation may be lower. The complexity of the innovation which is digital banking in this case, plays a substantial role; user-friendly and intuitive platforms with logical processing can decrease presumed complexity and promote adoption. Trialability allows possible clients to explore digital banking on a trial-and-error

basis, diminishing initial investment liability. Digital banking is flexible and adaptive, allowing some freedom to explore the platform without fully committing. This will enable individuals to have a clear idea of the service. Lastly, observability relates to the clear visibility of the benefits of the innovation within the community, acting as a driving factor for increased adoption as individuals notice and are encouraged by the positive impacts.

Economic concepts related to asymmetric information also help to explain the adoption of digital banking services. Information asymmetry is when one party in a financial transaction has more or better information than the other, leading to inefficiencies and suboptimal decisions (Akerlof, 1970). This is apparent with conventional banks or informal financial mechanisms, which often include complex procedures, limited access to real-time data and vague fee structures. These factors can disadvantage consumers, particularly those less fortunate with lower financial literacy or lacking infrastructure, as they need to fully understand the intricacies of the financial services and the long-term implications of their financial choices. Contrastingly, digital banking offers real-time access to account balances, transaction histories, and financial statements, giving users financial clarity and, making informed decisions (Gomber et al., 2018). For instance, informal options such as loan sharks and a rotating savings and credit association (ROSCA) involve many more risks and uncertainties. This is mainly due to the lack of formal structure, regulation, and enforcement, which leads to higher interest rates, instability and high collateral on loans and may even provoke criminal behaviour. Most of these informal mechanisms operate beyond formal frameworks and institutions, making them more inclined to exploitation and fraud. They are not obligated by any regulations and can function by their own rules, leading to sly decisions and asymmetric information. This is apparent in most developing nations, especially in Asia and Africa. However, this is also where the positive impact of digital banking is visible, as demonstrated by Kenya's M-Pesa through transparency and consolidated structure, which helps mitigate the risk and uncertainty. Shaikh and Karjaluoto (2015) identified some critical queries regarding mobile banking adoption including perceived usefulness, perceived ease of use and security concerns. The paper emphasizes the value of user-friendly interfaces and the significant role consumer trust plays in the successful adoption of mobile banking. Furthermore, the accessibility and convenience of digital banking from anywhere at any time with an Internet connection clears geographical barriers, allowing more people to benefit from financial services and information (Donovan, 2012). Once again, the M-Pesa initiative can be seen as a role model for these benefits. M-Pesa provides a straightforward, accessible service requiring basic technological knowledge, catering to the more underserved populations. Additionally, it also arranges a secure and stable manner to store and transfer money, addressing key financial requirements within these communities.

The financial reach of digital banking has been depicted in previous literature in a number of ways. Aker & Mbiti (2010) investigated the impact of mobile banking on financial inclusion in

Kenya by evaluating the increase in mobile money accounts and the frequency of transactions. The study found that the use of mobile banking increased among populations who had not previously had access to such banking services because it considerably reduced transaction costs and expedited the financial transaction process. On the other hand, Asif et al. (2023) analysed the effect of fintech and digital financial services on financial inclusion in India, looking specifically into the middle class. Their study demonstrated that fintech businesses can play a critical role in aiding financial inclusion, with the number of Indians having bank accounts rising to nearly 80%. The study, which made use of secondary data from the Reserve Bank of India (RBI), discovered that fintech services were successful, especially in increasing middle-class consumers' access to and convenience with financial services. This thesis will quantify financial outreach by examining the adoption and usage rates of digital banking services for the populations of India, Bangladesh and Nepal. It will also explicitly focus on the rural populations as that is very relevant to these economies. In particular, the number of individuals using mobile banking services is measured, along with the extent to which these services are utilised for savings, borrowing and receiving remittances. This approach will lead to a thorough review of how digital banking services can penetrate underserved markets and enhance financial inclusion.

b) Financial Inclusion

The idea of financial inclusion is dynamic and multidimensional. For the objective of this study, financial inclusion refers to the availability and equal dispersion of opportunities to utilise financial services. This includes savings, making and receiving payments on account, remittance facilities and borrowing from formal financial institutions to name a few indicators. Financial inclusion, according to The World Bank (2021), attempts to guarantee that all kinds of individuals and enterprises have access to advantageous and accessible financial services that can help with their basic needs – provided sustainably. Sarma (2016) identifies financial inclusion in academic contexts as a procedure that ensures the ease of access, availability, and usage of the formal financial system for all members of the economy. This increases the participation of individuals who were previously eliminated from actively participating in the formal financial sector due to geographical constraints, lack of financial literacy and socio-economic factors. Similarly, the Consultative Group to Assist the Poor (CGAP, 2010) describes financial inclusion as, “a state in which all people who can use them have access to a full suite of quality financial services, provided at affordable prices, in a convenient manner, and with dignity for clients.” Theoretical economics labels financial inclusion as a crucial driver to boost economic growth and alleviate poverty. It provides widespread access to different financial services. For example, access to credit is one of the services that allow individuals and businesses to invest in new technologies and innovation, expand their business, and improve productivity and economic output. Small and medium-sized enterprises (SMEs) are very common in emerging economies, and these financial inclusion benefits are crucial to their owners.

Access to financial platforms also increases the chance to empower individuals; it benefits lower-income households especially by expanding their opportunities for earning income and possibly raising their standard of living. This empowerment is critical for poverty reduction as it equips the poor with tools to escape the poverty trap (Burgess & Pande, 2005). By using these strategies, financial inclusion can try to bridge the gap between the rich and the poor and eventually lessen the steadily rising income and wealth inequality that exists in these selected nations. Research by Beck, Demirgüç-Kunt, and Levine (2007) supports these claims. They argue that when an individual's financial needs are well catered to, their ability to invest in education, health and enterprise is also strengthened, ultimately fostering economic development. Moreover, financial inclusion assists in decreasing the manipulation of vulnerable groups by informal lenders such as loan sharks who charge unreasonable interest rates (Dupas & Robinson, 2013).

Economic theories create a solid framework for understanding the dynamics of financial inclusion. The financial intermediation theory explains that financial mediators, such as banks, reduce information asymmetries and transaction costs, improving resource allocation (Levine, 2005). It is known that financial intermediaries aid in transferring funds from those who are saving to those who are borrowing, hence increasing the efficiency of capital allocation. Furthermore, they also play a critical role in reducing information asymmetry between borrowers and lenders. Formal institutions such as banks deal with issues like this by conducting detailed credit assessments and observing the borrowers' actions. As a result, overall financial safety increases while money smoothly flows through the economy which promotes growth on an individual and aggregate level. The financial deepening theory is also relevant as it suggests that positive economic growth can be achieved through reduced transaction costs and increased availability of financial platforms due to financial development. King and Levine (1993) state that more advanced financial systems are usually more efficient at capital allocations, fostering entrepreneurship and innovation, which would be critical for economic growth within developing economies. Financial deepening is specifically relevant for developing countries, as these regions often have underdeveloped financial markets and restricted access to financial platforms. Fewer constraints in utilizing financial services lead to better allocation of resources, and improvements in allocation encourage entrepreneurship and innovation even within the more informal and disadvantaged sectors, acting as a stepping stone to escape the recurring cycle of poverty.

More profound research into previous studies regarding financial inclusion leads to an exciting avenue relating to ethics. A combination of 'banking' and 'The Social Contract Theory' introduced by Baradaran (2014) stresses the societal responsibilities of banks and their role in aiding social equity, debating that banks should ensure consumer protection, serve public welfare and provide fair access to credit. This theory explains that if formal financial institutions embrace this social responsibility, there is a new beginning of a more connected and equitable society, fostering better

economic opportunities for everyone regardless of their socioeconomic position. This is where the concepts overlap with financial inclusion, as societal responsibilities are being fulfilled by ensuring the inclusivity of the neglected groups in financial markets. This improvement would include providing affordable credit, options to open accounts with marginal fees, and financial literacy programs to develop financial knowledge (Claessens, 2006). Hence, the theory becomes relevant for this paper, as a significant proportion of individuals from South Asian countries such as India, Bangladesh and Nepal are excluded from formal financial systems as a result of socio-economic and cultural barriers. By engaging with the foundations of the Social Contract Theory, banks in these areas have the potential to bridge the financial inclusion gap.

c) Socio-economic and Cultural factors

As previously seen, there is a lot of existing literature and research regarding the effect of digital banking, financial institutions as well as the theories of financial inclusion and how these concepts interact. A less explored channel is looking particularly into behavioral economics and seeing how socio-economic and cultural factors specific to South Asia can influence the notion of digital banking and financial inclusion. The most widespread and general barrier is poverty, which restrains one's ability to invest, save and utilise financial services. The World Bank states that anyone earning less than \$2.15 a day is below the poverty line. High poverty levels bring about high levels of income inequality, where the richer urban societies have significantly better financial opportunities than the poorer, rural regions, ultimately leading to the rich getting richer and the poor are left behind. With more than 40% of the South Asian population under the poverty line, The World Inequality Database (2023) highlights exactly this point by stating that in Nepal and Bangladesh the richest 10% earn about 35% of the national income, while in India the richest 10% earns more than half of the national income. A lack of developmental and education programs additionally contributes to this issue. For instance, The Asian Development Bank (2022) states that in recent times less than a third of the Indian population is financially literate. This corresponds to many individuals being excluded from reaching formal financial institutions whether digital or not. As a result, they're forced to turn to loan sharks, exposing them to cycles of debt and increased poverty.

Deeply ingrained gender biases also act as a very influential barrier. In most South Asian countries, society and decision-making are dominated men, including financial decision-making processes. Particularly in rural regions, women are expected to handle household duties and not involve themselves in external and financial decisions. Sanyal (2009) explains that female behaviour in these regions is heavily altered by predetermined gender roles and societal beliefs. This patriarchal system existing in many South Asian societies not only impacts their access to financial services but also reiterates the financial dependency on male family members forced upon them. Digital banking can provide a lot more opportunities for freedom for women to escape this

system. This gives those, particularly in rural regions, the belief that they too can be financially stable as seen more in urban cities. Moving deeper, the regions' cultural norms and social structures play a crucial role in financial inclusion. Many rural populations globally are set in their own ways, not wanting to experiment with what is new to their society. Traditional beliefs and practices often outweigh rationality in these scenarios. For instance, in many rural areas, handling money through formal institutions and using their services is seen as taboo. These situations are well captured by Zins and Weill (2016) in their study of Sub-Saharan Africa, where they list 'religious and cultural reasons' as significant determinants of exclusion of certain subgroups. With South Asia having similar behaviours and beliefs in rural areas these trends are also likely to follow. Once again, some education on digital finance can help shatter these ancient and outdated beliefs and create more economic opportunities for these individuals. The improvements in their lifestyles could have a multiplier effect on the community, leading to overall economic empowerment.

The next crucial factor is the need for more trust in and around formal financial institutions. Historically, as evaluated in this paper, all three countries and many other developing countries have faced multiple instances of corruption and inefficiency with government and formal systems. This naturally led to a general scepticism of the situation. For instance, Loran (2023) experimented with barriers to financial inclusion within Bangladesh and she found that in her sample around 611 respondents had trust issues in terms of having a formal account, and 11% of them did not use formal channels of financial services due to lack of trust. This type of thinking and uncertainty nudges these individuals towards informal methods which are risky and expensive. Ranabhat (2023) explores the magnitude of this issue in Nepal and finds that many farmers and other rural inhabitants are forced to turn to unlicensed money lenders who extort money by charging interest which increases as fast as the numbers on water meter – locally known as 'meterbyaj'. If they can't repay, the loan sharks end up seizing all land or property the borrower owns, being forceful and abusing their power in a lot of cases. Digital banking can build this trust as it is mainly automated and controlled through personal devices instead of multiple intermediaries. Building trust can be gradual since any involved individuals already know the risks and problems of informal finances, so any positive outcomes from formal and structured systems should already nudge them to this option.

Geographical isolation and incompetent financial structure are also very relevant influences. Developing nations, particularly in Sub-Saharan Africa and South Asia have vast rural regions somewhat disconnected from the more affluent, urban areas. Looking specifically into the chosen economies, The World Bank (2022) provides data that shows that in 2022, 65% of the Indian population, 60% of the Bangladeshi population and 79% of the Nepalese population were considered to be rural. Singh et al. (2023) explore rural transformation and highlight the underlying issues of poor infrastructure, lack of basic amenities, poverty, hunger and lack of non-agricultural jobs in rural areas. With India, Bangladesh, and Nepal having such significant rural populations,

many of these economies are left alone in terms of development. Nepal, in particular, feels the consequences of these issues given their mountainous and extreme landscape. Around 77% of the country's surface is covered with hills and mountains (CBS, 2016). Remote regions, such as mountains at high altitudes have poor infrastructure and face definitive barriers in accessing banking services. This seems logical, as building on and investing in these rural mountainous areas is challenging as they are more costly have few foreseeable returns for the investment. This notion is supported by Sapkota (2018), who surveyed rural inhabitants from Nepal in their research. They found that the average time to reach local shops, primary schools and drinking water sources was around a 30 minute walk, and roads could only be reached with a 3 hour walk. Furthermore, secondary schools, health facilities and bus stops were reached only after 3 to 4 hours of walking. This kind of geographical isolation significantly limits the reach of traditional banking systems. However, digital banking platforms would benefit these scenarios if the economies invest long-term in building good networks and internet connectivity. This will include those excluded from financial systems through digital banking. Additionally, physically building and maintaining infrastructure would not be a requirement.

3. Data and Descriptive Statistics

All the data used and analyzed in this thesis was collected from the Global Findex Database of 2017 and 2021, made available by the World Bank. The Global Findex Database is the world's most comprehensive financial inclusion data set on how adults save, borrow, make payments and manage risks. The data is conducted through surveys and interviews using randomly selected, nationally representative samples. In most developing countries, data is traditionally collected through face-to-face interviews. Even within the randomly selected households, respondents are randomly selected. The Global Findex Database is the world's most comprehensive financial inclusion data set with almost 300 indicators on account ownership, payments, saving, credit and financial resilience. The data provided is also summarised by gender, income (adults living in the richest 60% and poorest 40% of households), labour force participation (adults in and out of the workforce), age (young and older adults), and rural and urban residence. Due to the extensive nature of the dataset and to measure long-term progress the available indicators are reported every 3-4 years. For this reason, this paper will use the more recent databases of 2017 and 2021. The 2021 edition, based on nationally representative surveys of about 144,000 adults in around 139 economies during the Covid-19 pandemic. In contrast, the 2017 edition is based on nationally representative surveys of about 155000 adults in around 136 economies. As most of the data and variables are very specific and on an individual level, most are binary variables with a few categorical variables.

Out of all the countries, data was explicitly selected for India, Bangladesh and Nepal as this thesis aims to focus on and compare developing economies in South Asia. The dataset for the three countries in 2021 and 2017 consisted of 5000 observations, with India having 3000 observations and Bangladesh and Nepal with 1000 observations each. However, the datasets needed to be cleaned to some extent to streamline the data and exclude inconsistent and unnecessary data points. To make the data processing more simple, each country was given a numeric value. In both datasets, there were three account variables: a general account, a financial institution account and a mobile money account variable. For this analysis, it is required that the number of financial institution accounts and mobile money accounts totalled to the number of general accounts. However, this was not the case; a ‘new account’ variable was generated to smoothly match these numbers. This variable corrected some inconsistencies and accurately reflected individuals with a financial institution account or a mobile money account, matching the overall number of accounts in the dataset. In this research, a mobile money account represents a digital account. Finally, a variable for digital account is generated. It differentiates individuals with a mobile money account from everyone else, whether they have any other type of financial account or are entirely unbanked. This is done because this thesis aims to evaluate the impact of digital banking services on financial inclusion, including individuals whether they use traditional banking or are completely excluded from financial systems.

Independent Variable :

The independent variable will be the ‘digital account’ variable explained previously; it is also a binary variable. This variable was selected as the main objective of this thesis, which is to evaluate the impact of digital banking on financial inclusion as a whole. Mobile banking was explicitly chosen to represent digital banking as it can be recognised as one of the essential components of digital financial services. Multiple reliable sources, including The World Bank, have identified mobile money accounts as a reliable representation of what digital banking entails and consists of, particularly given the global technological advancements.

Dependent Variables :

The dependent variables investigated in this study are chosen because they are three key indicators for financial inclusion. The dependent variables for the three hypotheses are savings, borrowing and receiving remittances. These are all recognised globally by well-accredited organizations such as the Global Partnership for Financial Inclusion (GPII), The Consultative Group to Assist the Poor (CGAP), and The World Bank. These three chosen variables are also part of the identified G20 Financial Inclusion Key Indicators.

Savings (Savings_{fin}) here is a binary variable which indicates whether or not an individual has saved using an account at a financial institution. In the survey, the individuals were asked, “Have you saved using an account at a financial institution?” This selection was made because saving

through a formal platform such as a financial institution is one of the fundamental steps to improving financial inclusion. Especially within developing economies, saving at a financial institution is associated with improved financial planning and security which can then transfer into increased productive investment and income. With these steps comes opportunities to escape the poverty cycle for large parts of these populations, something that would not have presented itself without improved financial stability through saving safely.

Borrowing (Borrow_{fin}) here is a binary variable which indicates whether or not an individual has borrowed from a financial institution. In the survey, the individuals were asked, “Have you borrowed from a financial institution?” Borrowing is another fundamental element of financial inclusion, as access to credit and loans allow people in need to invest in education, health, family, and possible business or work opportunities that can improve their standards of living and household welfare. Analysing this variable sheds light on the role digital banking plays in enhancing opportunities for underserved populations, involving them more in the economy, and thereby fostering economic development.

Receiving Domestic Remittances (Remittances) here is a binary variable which indicates whether or not an individual has received domestic remittances. In the survey, the individuals were asked, “Have you received domestic remittances?” This is very relevant to developing countries, particularly the ones chosen in this study. Remittances are a crucial source of income for many of these South Asian households. They are used to meet daily needs and improve nutritional outcomes, they have also been linked with higher enrolment rates for children and alleviating poverty. Less fortunate households may have fewer family members with better economic and life opportunities. They send money back home to support the family in the form of remittances. World Bank Blogs state in an article that remittances are a vital lifeline for these poor households, helping them build resilience and avoid financial crises.

Control Variables :

This study will control for the variables – age, gender, education level and employment status, each picked because they could influence digital banking adoption, financial behaviour and inclusion. This will be essential in attempting to minimize confounding effects, establishing valid results and improving the relevance and precision of the findings. Age can influence financial decision-making and digital literacy. The older population may be at a point where saving is more attractive while the youth may look to borrow more (Demirgüç-Kunt et al., 2018). The older generation may also be less accepting and familiar with digital banking than the youth, particularly in developing countries. As mentioned before, gender discrimination and biases can always be present, mainly due to cultural, social and economic barriers in South Asian countries. In the analysis, Female represents whether the individual is female. Varying education levels are expected

to affect financial knowledge and utilization of formal financial systems; individuals with higher education are likely to have better financial literacy and more likely to embrace formal platforms (Klapper, Lusardi & Panos, 2013). Finally, employment status is a necessity to control for as employed individuals are more likely to save, borrow and engage with financial institutions compared to those who are unemployed (Beck, Demirgüç-Kunt, & Levine, 2007). Hence, accounting for these factors gives a better chance to evaluate the isolated effect of digital banking on financial inclusion. Naturally, there are other variables which will go unaccounted for in this study as not all relevant factors can be controlled for, which can be seen as one of the limitations of this study.

Interaction Term :

Alongside the previously mentioned variables, for the pooled and country-specific analysis done for 2021, this study also includes the variable 'Rural' as an interaction term. This is done to investigate the impact of digital banking on financial inclusion in rural areas separately, which can be assumed to be the regions that would benefit the most from financial inclusion. These regions represent a vast majority of the populations of the chosen South Asian countries. As mentioned earlier, rural areas often face severe financial obstacles, like lack of financial infrastructure, financial literacy and challenging socio-economic norms.

Descriptive Statistics :

Table 1 and 2 contain the descriptive statistics for 2021 and 2017 respectively. The sample consists of 5000 observations for most variables, with slight variations. Out of the total observations recorded, Table 1 states that in 2021 14.2% of individuals had a digital account while Table 2 shows that in 2017 only 5.28% had a digital account. From this, we can already gather that the adoption of digital finance has significantly improved from 2017 to 2021. Around 13.11% of the surveyed individuals saved in financial institutions in 2021 while for 2017 the value was 18.2%. 11.76% of the surveyed individuals borrowed from financial institutions in 2021 while for 2017 this was 8.76%. Additionally, 17.97% out of the surveyed individuals received domestic remittances in 2021 whereas in 2017 it was 18.68%. These statistics give an idea about the possible lack of financial inclusion in the South Asian regions, for the chosen countries in particular. Both for 2017 and 2021 the implementation of these indicators for financial inclusion is very poor. The average age of the sample in 2021 is 36.71 years while for 2017 it was 37.49. In 2021 the gender split amongst the observations was pretty much even with 50.32% being female, in 2017 it was similar with 53.6% being female. The variable education represents the level of education and has a mean value of 1.54 in 2021 and 1.43 in 2017. It is a categorical variable with the levels completing primary education (1) followed by secondary education (2) and finally completing tertiary education (3). Later for the analysis education = 1 is taken as the reference category. The sample includes individuals with

varying levels of education. Still, the variation is mainly between completing primary and secondary education, with only a relative few having completed tertiary education, with 2017 having even fewer individuals who completed secondary and tertiary education compared to 2021. The employment variable represents if the individual in question is employed. In 2021 around 56.58% of the total individuals in the dataset are employed and for 2017 58.32% were in the workforce. Additionally in 2021, 55% of the sample population are settled in rural areas, showing the variation in the sample and a good base to investigate these rural populations. The 2017 dataset did not have any data on the rural variable. This stat could be interpreted as the South Asian economies becoming more open and growing from 2017 to 2021 as more information is openly available and analysed.

Tables 6, 7 and 8 in the Appendix show the descriptive statistics of the given variables in 2021 split by country. There is some variation between the predictor and outcome variables amongst the three South Asian countries.

Table 1. Descriptive statistics 2021

<i>Variables</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
Dig_account	5000	0.142	0.349085	0	1
Savings_fin	4980	0.1311245	0.3375704	0	1
Borrow_fin	4985	0.1175527	0.32211	0	1
Remittances	4975	0.1796985	0.3839747	0	1
age	5000	36.7142	15.11816	15	90
Female	5000	0.5032	0.5000398	0	1
education	4988	1.539495	0.6309349	1	3
emp	5000	0.5658	0.495701	0	1
Rural	5000	0.55	0.4975435	0	1

Note : This table presents descriptive statistics for all variables used in the analysis. "Obs" refers to the total number of observations. "Std. Dev" refers to standard deviation. "Min" and "Max" refer to the minimum and maximum values recorded for each variable, respectively.

Table 2. Descriptive statistics 2017

<i>Variables</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
Dig_account	5000	0.0528	0.2236564	0	1
Savings_fin	4940	0.1825911	0.38637	0	1
Borrow_fin	4953	0.0876237	0.2827754	0	1
Remittances	4886	0.1868604	0.3898393	0	1
age	5000	37.4856	15.4402	15	90
Female	5000	0.536	0.4987522	0	1
education	4990	1.431864	0.5946804	1	3

emp	5000	0.5832	0.4930785	0	1
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Note : This table presents descriptive statistics for all variables used in the analysis. "Obs" refers to the total number of observations. "St. Dev" refers to standard deviation. "Min" and "Max" refer to the minimum and maximum values recorded for each variable, respectively.

4. Methodology

This study has the goal to examine the impact of digital banking services on financial inclusion through 3 main hypotheses. Given the datasets being used, most of the variables being used for this analysis are binary variables. As a result, this thesis will apply logit regression models with marginal effects during the investigation, which is ideally suited for binary variables. The Logit model approximates the odds of an outcome taking place based on one or more predictor variables, but interpreting these given odds directly is fairly difficult and inefficient. For this reason, this paper also incorporates the use of marginal effects, improving the interpretability of results. Marginal effects transform the odds from the logit model results into probabilities, and can also be interpreted in terms of percentage points, making the results a lot more intuitive and more straightforward to incorporate to real-life situations.

Step 1 : Analysing the 2021 dataset

To start, the 2021 dataset is analyzed using a pooled approach for the 3 countries chosen in this study, followed by a separate country-wise analysis approach. This plan allows to capture general trends around the South Asian regions as well as spot particular country-specific distinctions regarding the impact of digital banking services on financial inclusion.

Hypothesis 1 : Digital bank account ownership does not affect an individual's likelihood of saving using an account through a financial institution.

$$\Pr(\text{Savings_fin}_i=1)=\beta_0+\beta_1\cdot\text{Dig_account}_i+\beta_2\cdot\text{Rural}_i+\beta_3\cdot(\text{Dig_account}\times\text{Rural})_i+\beta_4\cdot\text{age}_i+\beta_5\cdot\text{Female}_i+\beta_6\cdot\text{education}_{2i}+\beta_7\cdot\text{education}_{3i}+\beta_8\cdot\text{emp}_i+\epsilon_i$$

Hypothesis 2 : Digital bank account ownership does not affect an individual's likelihood to borrow from a financial institution.

$$\Pr(\text{Borrow_fin}_i=1)=\beta_0+\beta_1\cdot\text{Dig_account}_i+\beta_2\cdot\text{Rural}_i+\beta_3\cdot(\text{Dig_account}\times\text{Rural})_i+\beta_4\cdot\text{age}_i+\beta_5\cdot\text{Female}_i+\beta_6\cdot\text{education}_{2i}+\beta_7\cdot\text{education}_{3i}+\beta_8\cdot\text{emp}_i+\epsilon_i$$

Hypothesis 3 : Digital bank account ownership does not affect an individual's likelihood of receiving domestic remittances.

$$\Pr(\text{Remittances}_i=1)=\beta_0+\beta_1\cdot\text{Dig_account}_i+\beta_2\cdot\text{Rural}_i+\beta_3\cdot(\text{Dig_account}\times\text{Rural})_i+\beta_4\cdot\text{age}_i+\beta_5\cdot\text{Female}_i+\beta_6\cdot\text{education}_2i+\beta_7\cdot\text{education}_3i+\beta_8\cdot\text{emp}_i+\epsilon_i$$

For the marginal effect of all 3 hypotheses, the general formula looks like this: $\partial\Pr(Y_i)/\partial\text{Dig_account}_i$. While doing marginal effects, the model won't consider the constant at all and won't consider the interaction effect unless specified by a command. While computing marginal effects, the interest is in the change in the probability of the outcome variable as a result of changes in the predictor variable. The constant in a logit model represents the base log-odds of the dependent variable when the predictor variable is zero, hence, it does not affect the marginal effect of the predictor variable on the probability of the outcome variables. As a result, the constant isn't present for marginal effects, since the focus is purely on the effect of the predictor variable on the probability of the outcome. The marginal effect of the interaction term is not automatically provided through the regression. A separate computation needs to be done for the marginal effect of the interaction variable. The computation required looked like this – $\partial\Pr(Y_i)/\partial\text{Dig_account}_i$ for $\text{Rural} = 0,1$.

Step 2 : Comparing 2021 results with 2017 results

The comparative analysis between 2021 and 2017 aims to test if there was an overall change effect of digital banking in between those four years. Due to global technological advancements and increasing digital economies, a difference can be expected. As this extensive financial inclusion survey is only carried out every 3-4 years the full comparison could only be done between these two years rather than as a trend of all the years in between. However, in the 2017 dataset, no variable stated if the individual was from a 'Rural' region so the interaction term was excluded. This also shows the improvement at 2021 where the data is more specific and leads to better analysis.

Hypothesis 1 : Digital bank account ownership does not affect an individual's likelihood of saving using an account through a financial institution.

$$\Pr(\text{Savings_fin}_i=1)=\beta_0+\beta_1\cdot\text{Dig_account}_i+\beta_2\cdot\text{age}_i+\beta_3\cdot\text{Female}_i+\beta_4\cdot\text{education}_2i+\beta_5\cdot\text{education}_3i+\beta_6\cdot\text{emp}_i+\epsilon_i$$

Hypothesis 2 : Digital bank account ownership does not affect an individual's likelihood to borrow from a financial institution.

$$\Pr(\text{Borrow_fin}_i=1)=\beta_0+\beta_1\cdot\text{Dig_account}_i+\beta_2\cdot\text{age}_i+\beta_3\cdot\text{Female}_i+\beta_4\cdot\text{education}_2i+\beta_5\cdot\text{education}_3i+\beta_6\cdot\text{emp}_i+\epsilon_i$$

Hypothesis 3 : Digital bank account ownership does not affect an individual's likelihood of receiving domestic remittances.

$$\Pr(\text{Remittances}_i=1)=\beta_0+\beta_1\cdot\text{Dig_account}_i+\beta_2\cdot\text{age}_i+\beta_3\cdot\text{Female}_i+\beta_4\cdot\text{education}_{2i}+\beta_5\cdot\text{education}_{3i}+\beta_6\cdot\text{emp}_i+\epsilon_i$$

These logit models were carried out for 2021 and 2017 and then compared. Marginal effects were used again to interpret the results better and make them more applicable. However, the comparison was done using the pooled approach, and not a country specific comparison.

5. Results and Analysis

This chapter presents the empirical results for the relationship between digital banking services and financial inclusion. The investigation is done in multiple ways with pooled results, country specific results, looking at specific interaction terms and different results across 2017 and 2021. As a result, the result section will be split into three parts: the baseline pooled results, results by country heterogeneity and results by time heterogeneity. This was done to present the analysis in a structured manner and show more depth in the research.

To better understand the adoption of digital finance in India, Bangladesh and Nepal and its adoption over time, we can analyze figures 1 and 2. The bar graphs presented here display the proportion of financial accounts and digital accounts out of the total observations for each country. From both figures, it is clear that between 2017 and 2021 the proportion of individuals with any type of financial account has remained relatively consistent. India comfortably had the largest proportion of individuals having financial accounts, with nearly 80% of the individuals in the dataset having some kind of financial account in 2017 and 2021. The only slight jump seen is from Nepal which experienced an increase in the proportion of financial accounts by 6% from 2017 to 2021. However, moving on to the key indicator – the proportion of the observations with digital accounts, we see some substantial changes. It is worth mentioning that in general the proportions aren't extremely high but the changes from 2017 to 2021 show improvements in digital finance adoption. For Bangladesh the percentage of individuals in the dataset with digital accounts increased from 19.9% to 27.9%. For India, this jump was nearly by 10% rising from around 2.17% to 12.13%. Nepal is a special case as in 2017 there was no data available about individuals with digital accounts. This already shows a lack of embracing digital finance, but by 2021, there was a jump to 6.7% of the individuals having a digital account.

The information presented previously explains a few things. Based on the randomized and varied sample, it can be assumed that these developing South Asian countries have consistently had a sufficient proportion of the population with normal financial accounts in traditional banking. Nevertheless, there is a clear gap when it comes to digital banking, even with the improvements from 2017 to 2021. This is very apparent in India particularly, as when compared to Bangladesh

they have a lot more financial accounts but substantially fewer digital accounts in proportion to their population. This could be due to multiple reasons, such as better financial and microfinance programs in Bangladesh, but it is a statistic worth keeping in mind.

Figure 2. Representation of 2017 data

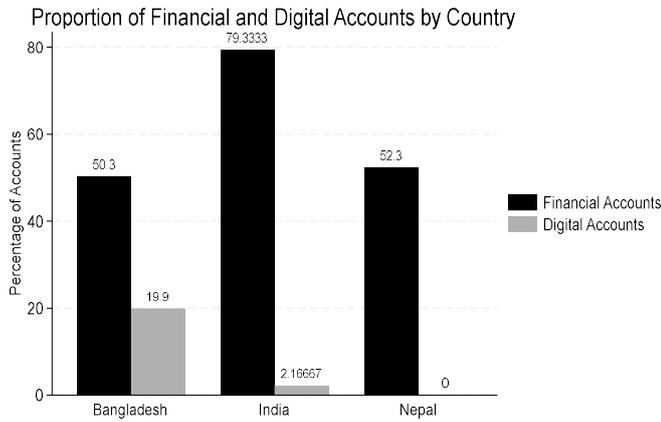
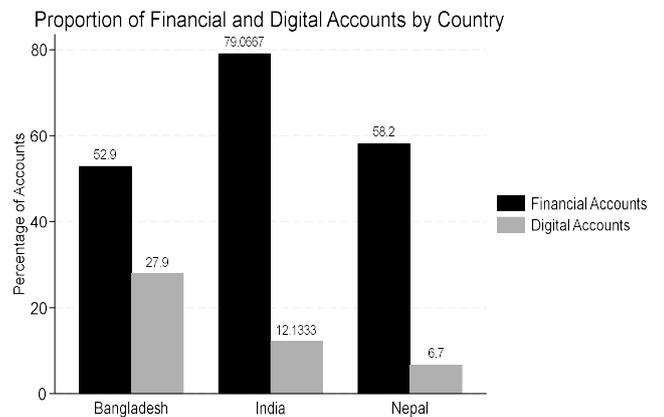


Figure 1. Representation of 2021 data



5.1 Baseline Pooled Results

Table 3 shows the baseline pooled results for all three hypotheses for the 2021 dataset, using logit regression with marginal effects. Model 1 and 2 represent the results for hypothesis 1, model 3 and 4 represent the results for hypothesis 2 and finally model 5 and 6 represent the results for hypothesis 3.

Models 1 and 2 explain the impact of having a digital bank account on an individual’s likelihood to save through an account at a financial institution. Without any controls, from model 1, we find that an individual that has a digital account is more likely to save at a financial institution by 11 percentage points compared to an individual without a digital account. This result is positive and significant at the 1% level. In model 2 the interaction term and controls are added to the equation. These findings show that an individual with a digital account is more likely to save at a financial institution by 9.2 percentage points compared to an individual without a digital account. This is still positive and significant at the 1% level, as are several other variables. The interaction term is positive and significant at the 1% level, explaining that an individual with a digital account is 10.2 percentage points more likely to save at a financial institution compared to someone without a digital account, specifically from a rural region. Age, education level and employment are the controls that are all positive and significant at the 1% level. Age is minimal, but education shows that if the individual has completed a higher level of education they are more likely to save at a financial institution. This is especially substantial for those who have completed tertiary education compared to the reference group of those who completed primary education, as they are 16.7

percentage points more likely to save. This is quite intuitive. Similarly, those who are employed are more likely to save at a financial institution by 5.1 percentage points compared to those unemployed. Having a steady flow of income could lead to saving more.

Models 3 and 4 explain the impact of having a digital bank account on an individual's likelihood to borrow from a financial institution. Without any controls, from model 3 we find that an individual who has a digital account is more likely to borrow from a financial institution by 6 percentage points compared to an individual without a digital account. This result is positive and significant at the 1% level. In model 4 the interaction term and controls are added to the equation again. These findings show that, an individual that has a digital account is more likely to borrow from a financial institution by 7 percentage points compared to an individual without a digital account. This is still positive and significant at the 1% level. Again interpreting the interaction effect, we see that within a rural region, an individual with a digital account is more likely to borrow from a financial institution by 5.3 percentage points compared to an individual without a digital account. This coefficient is positive and significant at the 5% level. From the controls, female and employment are positive and significant at the 1% level. Being a female increases the likelihood of borrowing from a financial institution by 2.5 percentage points. This result disagrees with the general consensus of previous literature and research but could be due to the dataset amongst other reasons. Once again, being employed increases the likelihood of borrowing from a financial institution by 5.5 percentage points. This is logical, as having a steady income and job security can lead to more confidence in borrowing and investing.

Models 5 and 6 explain the impact of having a digital bank account on an individual's likelihood of receiving domestic remittances. Without any controls, from model 3 we find that, an individual with a digital account is more likely to receive domestic remittances by 20.4 percentage points compared to an individual without a digital account. This result is very positive and significant at the 1% level. In model 4 the interaction term and controls are added to the equation. These findings show that an individual with a digital account is more likely to receive domestic remittances by 24.9 percentage points compared to an individual without a digital account. This is also very positive and significant at the 1% level. Furthermore, the interaction effect finds that within a rural region, an individual with a digital account is more likely to receive domestic remittances by 21.4 percentage points compared to an individual without a digital account. Once again the coefficient is positive and significant at the 1% level. From the controls, being from a rural area compared to an urban area decreases the likelihood of receiving domestic remittances by 1.9 percentage points. This is significant at the 10% level. Once again being a female has a positive and significant coefficient at the 5% level and more intuitive. Finally both completing secondary education compared to primary education and being employed have positive and significant coefficients at the 1% level.

Hence all the models found positive and very significant results regarding the effect of the predictor variable on the outcome variables. They significance and magnitude of the coefficients show the potential positive impact digital bank accounts can provide for financial inclusion if correctly implemented. These results align with the general idea of the hypotheses and economic theory. The Pseudo R2 of the models are all relatively low but the significance and fit of the predictors and the model are good.

Table 3. Baseline pooled Logit regression results 2021 – marginal effects

	Savings fin		Borrowing fin		Remittances	
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Dig_account	0.110*** (0.011)	0.092*** (0.016)	0.060*** (0.011)	0.070*** (0.017)	0.204*** (0.011)	0.249*** (0.021)
Dig_account#Rural		0.102*** (0.024)		0.053** (0.023)		0.214*** (0.030)
Rural		-0.009 (0.010)		-0.013 (0.009)		-0.019* (0.011)
age		0.001*** (0.000)		0.000 (0.000)		0.000 (0.000)
Female		0.015 (0.010)		0.025*** (0.010)		0.024** (0.011)
education						
2		0.059*** (0.011)		0.005 (0.011)		0.041*** (0.013)
3		0.167*** (0.024)		-0.029 (0.016)		0.024 (0.021)
emp		0.051*** (0.014)		0.055*** (0.009)		0.046*** (0.011)
Observations	4980	4969	4985	4973	4975	4964
Pseudo R2	0.023	0.050	0.072	0.018	0.056	0.063
Wald chi2	98.76	193.10	28.19	67.78	279.59	303.65
p-value	0.000	0.000	0.000	0.000	0.000	0.000

Standard errors in brackets
* p<0.10, ** p<0.05, *** p<0.01

5.2 Results by Country Heterogeneity

Table 4 shows the hypothesis results for each of the three chosen countries using the 2021 dataset. This was done to investigate the results from table 3 further, to see if the results are influenced by specific countries, and to see the effects of digital banking on these financial inclusion indicators within each country.

For the first hypothesis with the outcome variable of saving at a financial institution, the analysis by economy showed that having a digital account in Bangladesh does not significantly impact the likelihood of saving at a financial institution. In general, the whole model for Bangladesh is insignificant. However, for India and Nepal, we see quite different results from those of Bangladesh. In India, having a digital bank account increases an individual's likelihood of saving at a financial institution by 18.4 percentage points compared to individuals without a digital bank account. This coefficient is positive and significant at the 1% level. We also see positive and significant results for the interaction effect at the 1% level. In rural India, an individual with a digital bank account increases their likelihood of saving at a financial institution by 15.8 percentage points than someone without a digital account. Most of the controls also have significant results. Being from a rural area has a negative but significant effect on saving at the 1% level. Age and the increasing levels of education had a positive and significant impact on saving at the 1% level. For Nepal, having a digital bank account increases the individuals likelihood of saving at a financial institution by 17.1 percentage points compared to individuals without a digital bank account. This coefficient is positive and significant at the 1% level. We also see positive and significant results for the interaction effect at the 1% level. In rural Nepal, an individual with a digital bank account increases their likelihood of saving at a financial institution by a substantial 23.4 percentage points compared to someone without a digital account. Most of the controls also have some level of significant results. The most significant controls were the increasing levels of education compared to the reference level and being employed, having clear positive and significant coefficients at the 1% level.

For the second hypothesis with the outcome variable of borrowing from a financial institution, this analysis showed that the effect found in the pooled baseline results was dominated by India. This is because both Bangladesh and Nepal have insignificant results for the impact of having a digital bank account on borrowing from a financial institution. The India model has the main significance for this analysis. In India, having a digital bank account increases the individual's likelihood of borrowing from a financial institution by 8.1 percentage points compared to individuals without a digital bank account. This coefficient is positive and significant at the 1% level. We also see positive and significant results for the interaction effect at the 5% level. In rural India, an individual with a digital bank account increases their likelihood of borrowing from a financial institution by 5.9 percentage points than someone without a digital account. Out of the controls, age and female are low but positive at the 10% significance level. Being employed increases the likelihood of borrowing from a financial institution by 5.2 percentage points at the 1% significance level.

For the third hypothesis with the outcome variable of receiving domestic remittances, the analysis showed positive and significant results for each specific country. For Bangladesh, having

a digital bank account increases the individual's likelihood of receiving remittances by 27.3 percentage points compared to individuals without a digital bank account. This coefficient is positive and significant at the 1% level. We also see positive and significant results for the interaction effect at the 1% level. Within rural regions of Bangladesh, an individual with a digital bank account increases their likelihood of receiving remittances by 21.6 percentage points than someone without a digital account. Now onto India, we find that having a digital bank account increases the individual's likelihood of receiving remittances by 22.5 percentage points compared to individuals without a digital bank account. This coefficient is positive and significant at the 1% level. We also see positive and significant results for the interaction effect at the 1% level. Within rural regions of India, an individual with a digital bank account increases their likelihood of receiving remittances by 18.4 percentage points than someone without a digital account. Finally in Nepal, individuals with digital bank accounts are 19.5 percentage points more likely to receive remittances than those without these accounts. This coefficient is positive and significant at the 1% level. Again we see positive and significant results for the interaction effect at the 1% level. Within rural regions of Nepal, an individual with a digital bank account increases their likelihood of receiving remittances by 20.8 percentage points than someone without a digital account.

Table 4. Country heterogeneity Logit regression results - marginal effects

	Savings_fin			Borrowing_fin			Remittances		
	Bangladesh	India	Nepal	Bangladesh	India	Nepal	Bangladesh	India	Nepal
Dig_account	0.014 (0.016)	0.184*** (0.027)	0.171*** (0.064)	0.041 (0.028)	0.081*** (0.023)	0.052 (0.055)	0.273*** (0.034)	0.225*** (0.030)	0.195*** (0.066)
Dig_account#Rural	0.057* (0.031)	0.158*** (0.035)	0.234*** (0.080)	0.021 (0.048)	0.059** (0.030)	0.030 (0.064)	0.216*** (0.061)	0.184*** (0.039)	0.208*** (0.080)
Rural	-0.025* (0.014)	-0.037*** (0.013)	-0.050* (0.029)	-0.018 (0.026)	-0.001 (0.011)	0.000 (0.026)	-0.013 (0.031)	-0.007 (0.012)	-0.007 (0.030)
age	0.000 (0.001)	0.002*** (0.000)	0.001* (0.001)	-0.001 (0.001)	0.001* (0.000)	-0.000 (0.001)	0.000 (0.001)	0.001 (0.000)	-0.001 (0.001)
Female	0.001 (0.016)	0.023* (0.013)	-0.030 (0.024)	0.068*** (0.024)	0.021* (0.012)	-0.019 (0.022)	0.015 (0.031)	0.013 (0.013)	-0.008 (0.027)
education									
2	0.008 (0.017)	0.074*** (0.016)	0.109*** (0.031)	-0.043 (0.026)	0.017 (0.014)	-0.009 (0.027)	0.051* (0.030)	0.010 (0.015)	0.075** (0.032)
3	0.062 (0.076)	0.127*** (0.027)	0.198*** (0.067)	-0.056 (0.083)	-0.023 (0.017)	0.013 (0.054)	-0.073 (0.095)	0.018 (0.013)	0.194*** (0.073)
emp	0.041** (0.018)	0.010 (0.013)	0.097*** (0.024)	0.091*** (0.026)	0.052*** (0.011)	0.036 (0.024)	0.049 (0.031)	0.045*** (0.013)	0.026 (0.029)
Observations	998	2971	1000	999	2974	1000	997	2971	996
Pseudo R2	0.041	0.080	0.061	0.023	0.027	0.010	0.069	0.067	0.041
Wald chi2	21.30	190.31	52.45	21.65	54.58	7.14	77.66	167.31	42.43
p-value	0.006	0.000	0.000	0.006	0.000	0.521	0.000	0.000	0.000

Standard errors in brackets

* p<0.10, ** p<0.05, *** p<0.01

5.3 Results by Time Heterogeneity

Table 5 shows a different variation for analyzing the hypotheses. It compares the results for each of the hypothesis between the comprehensive datasets of 2017 and 2021, looking at possible changes in the effect of digital banking on the financial inclusion indicators over time. The 2017 dataset had slightly less information than 2021, such as not having the ‘Rural’ variable; hence, the analysis was done without the interaction effect.

For the first hypothesis, in 2017, an individual with a digital bank account increased their likelihood of saving at a financial institution by 7.2 percentage points. On the other hand, in 2021, an individual with a digital bank account increased their likelihood of saving at a financial institution by 7.6 percentage points. Both these coefficients are positive and significant at the 1% level. There is a slight increase in the effect of digital banking on saving in 2021 compared to 2017. Both the 2017 and 2021 models have positive and significant control variables. Age, increasing levels of education compared to the reference group and being employed all increase the likelihood of saving at the 1% significance level.

The second hypothesis shows a slightly more significant difference between 2017 and 2021. In 2017, having a digital bank account increased an individual’s likelihood of borrowing from a financial institution by 3.3 percentage points compared to those without a digital account, but in 2021, the likelihood increased to 6.5 percentage points. Once again some controls such as age, female and employment are positive and significant in the models, they follow a similar trend to the previous analyses.

Finally for the third hypothesis, the 2021 results are slightly more positive than 2017. In 2021 having a digital account increased the individual’s likelihood to receive domestic remittances by 19.5 percentage points compared to those without a digital account, while in 2017 the likelihood of doing so was 17.2 percentage points. The controls follow a similar trend to what we have seen for previous models and results.

Table 5. Time heterogeneity Logit regression results - marginal effects

	Savings fin		Borrowing fin		Remittances	
	2017	2021	2017	2021	2017	2021
Dig_account	0.072*** (0.020)	0.076*** (0.011)	0.033** (0.016)	0.065*** (0.012)	0.172*** (0.020)	0.195*** (0.012)
age	0.002*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Female	0.029** (0.011)	0.015 (0.010)	-0.002 (0.009)	0.025*** (0.010)	0.000 (0.012)	0.023** (0.011)
education						
2	0.091*** (0.014)	0.060*** (0.011)	0.006 (0.010)	0.006 (0.011)	0.025* (0.013)	0.041*** (0.013)
3	0.264*** (0.030)	0.167*** (0.024)	-0.008 (0.017)	-0.028* (0.016)	0.019 (0.025)	0.024 (0.021)
emp	0.094*** (0.011)	0.051*** (0.010)	0.048*** (0.011)	0.054*** (0.009)	0.053*** (0.011)	0.045*** (0.011)
Observations	4931	4969	4945	4973	4877	4964
Pseudo R2	0.046	0.050	0.017	0.017	0.023	0.061
Wald chi2	210.09	192.11	49.31	64.65	112.59	299.29
p-value	0.000	0.000	0.000	0.000	0.000	0.000

Standard errors in brackets
 * p<0.10, ** p<0.05, *** p<0.01

6. Discussion and Conclusion

The primary aim of this study was to examine the impact of digital banking services on financial inclusion in developing countries, with a particular focus on India, Bangladesh and Nepal. This was done because they have similar socio-economic environments so the study can be specific to a subgroup of developing countries. By fixing on the years 2017 and 2021, this paper investigates the influence of digital banking on a few key global financial inclusion indicators, namely, saving and borrowing at a financial institution and receiving domestic remittances.

The results of the analyses indicate significant support for all three hypotheses formulated in this thesis. There is a clear positive and significant relationship between ownership of a digital bank account and saving through an account at a financial institution. As a result, from the analysis done in this particular study there is sufficient evidence to reject hypothesis 1. Similarly, there is a clear positive and significant relationship between digital bank account ownership and borrowing from a financial institution. As a result, from the analysis done in this particular study there is sufficient evidence to reject hypothesis 2. Finally, there is also a clear positive and significant relationship

between ownership of a digital bank account and receiving domestic remittances. As a result, from the analysis done in this particular study there is sufficient evidence to reject hypothesis 3.

Results by country heterogeneity shows that in some situations the pooled results are influenced more by a singular country, such as India. This could be due to India having significantly more observations in the dataset or being more advanced in the digital finance markets, but it could also be attributed to multiple other reasons. The time heterogeneous models did show more positive results in the impact of digital banking on the chosen financial indicators in 2021 compared to 2017. This could be due to reasons such as increased proportion of digital accounts in 2021 as shown by Figure 1 and 2, better acceptance and understanding of technology in 2021 than in 2017, or could be due to the effect of Covid-19 where individuals from every part of society had to align their lifestyle and decision making processes to the new remote and online standard.

The reasons for these results were expressed in the theoretical framework which looked at reduced transaction costs, increased convenience and outreach, better security, increased transparency and better credit options. Furthermore, for the chosen countries in particular, the impact of digital banking is relevant. In such South Asian countries, many individuals leave their households in search of better economic opportunities. If this is achieved, it is very common to send money back through remittances to families and households to improve their standards of living. Simultaneously, informal moneylenders and loan sharks are very common in these developing countries due to poor financial infrastructure. Hence, the option of digital banking opens a new, safer opportunity for these populations which could have huge potential if appropriately implemented.

However, even if the results from this particular thesis find a positive and significant relationship between digital banking and the outcome variables, it is important to be aware of the limitations of this study. In no way do these results suggest a causal relationship between digital banking and financial inclusion through these indicators. In particular, there are endogeneity issues that could not be avoided. Issues such as reverse causality, where the relationship between digital banking and the inclusion indicators could work both ways. For example it is possible that those who already have a tendency to save may be more inclined to adopt digital banking rather than digital banking increasing the likelihood of saving. There is also the issue of omitted variable bias. It is not possible to take into account every variable that may influence both the dependent and independent variables. In this scenario, factors such as the economic climate and trust in financial institutions could be such omitted factors that can lead to biased estimates. Finally there may be the issue of selection bias. Even though the sample from the dataset was randomly selected and nationally representative, there may be possible self-selection within the analysis. Those who have embraced digital banking may intrinsically be different to those who do not. Especially in South

Asian countries, factors such as higher education, social and societal positions, and financial literacy could disturb the relationship between digital banking and financial inclusion. Lastly, as the study focuses on three South Asian countries, it has low external validity for countries outside of this region.

As a result, for further research, the ideal way to set up this research would be through conducting Randomized Controlled Trials (RCTs). Now, even after the random selection of a nationally representative sample from the different countries, each participant would randomly be assigned to adopt digital banking services. This would help to form a causal relationship by eliminating endogeneity issues and selection bias. Future research on this topic should also look at this theme from a different perspective. Considering these emerging economies, a critical part of the adoption and implementation of digital banking would rely on financial literacy, moreover, educating large parts of the population on how to utilise these services. Researchers and financial institutions can look to implement findings from the institutional theory and Amartya Sen's capability approach. In this context, they both suggest that the provision of digital finance is just the tip of the iceberg. The ultimate challenge and target is to equip the populations in need with the skills and belief to utilize these services for a better standard of living and develop their economic prospects. This includes creating trust-building initiatives and introducing financial literacy programs to overcome misconceptions and deep-rooted biases. For instance, Kuriakose & Iyer (2015) identify that the mere opening of bank branches or accounts and providing easier credit to promote consumption is not sufficient; the ability of the user to meaningfully utilize the facilities and services to enrich their life is a crucial component of the process of financial inclusion.

This thesis has concluded that digital banking services have the potential to significantly improve financial inclusion in developing countries. Through increased likelihood of saving, borrowing and receiving remittances, digital banking enhances economic empowerment, specifically for underserved rural populations. By building on this framework by taking into account the limitations of this study and incorporating different programs to aid its adoption, researchers and policy makers can more effectively evaluate the dynamics of digital finance and enhance financial inclusion.

7. References

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8. Appendix

Table 6. Descriptive statistics Bangladesh 2021

<i>Variables</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
Dig_account	1000	0.279	0.4487319	0	1
Savings_fin	999	0.0560561	0.2301452	0	1
Borrow_fin	1000	0.156	0.3630369	0	1
Remittances	998	0.2745491	0.4465105	0	1
age	1000	36.897	15.34216	15	90
Female	1000	0.588	0.4924414	0	1
educ_new	999	1.571572	0.5207446	1	3
emp	1000	0.421	0.4939666	0	1
Rural	1000	0.26	0.4388537	0	1

Note : This table presents descriptive statistics for all variables used in the analysis. "Obs" refers to the total number of observations. "St. Dev" refers to standard deviation. "Min" and "Max" refer to the minimum and maximum values recorded for each variable, respectively.

Table 7. Descriptive statistics India 2021

<i>Variables</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
Dig_account	3000	0.1213333	0.3265687	0	1
Savings_fin	2,981	0.1402214	0.3472748	0	1
Borrow_fin	2,985	0.0971524	0.2962148	0	1
Remittances	2,981	0.1365314	0.3434095	0	1
age	3000	36.078	14.43822	15	90
Female	3000	0.4606667	0.4985336	0	1
educ_new	2,989	1.561057	0.6721927	1	3
emp	3000	0.5563333	0.4968992	0	1
Rural	3000	0.5833333	0.4930888	0	1

Note : This table presents descriptive statistics for all variables used in the analysis. "Obs" refers to the total number of observations. "St. Dev" refers to standard deviation. "Min" and "Max" refer to the minimum and maximum values recorded for each variable, respectively.

Table 8. Descriptive statistics Nepal 2021

<i>Variables</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
Dig_account	1000	0.067	0.2501471	0	1
Savings_fin	1000	0.179	0.3835441	0	1
Borrow_fin	1000	0.14	0.3471607	0	1
Remittances	996	0.2138554	0.4102319	0	1
age	1000	38.44	16.68211	15	90
Female	1000	0.546	0.4981286	0	1
educ_new	1000	1.443	0.5942256	1	3
emp	1000	0.739	0.4393997	0	1
Rural	1000	0.74	0.4388537	0	1

Note : This table presents descriptive statistics for all variables used in the analysis. “Obs” refers to the total number of observations. “St. Dev” refers to standard deviation. “Min” and “Max” refer to the minimum and maximum values recorded for each variable, respectively.