# Dissertation Topic:

# Digital Payments Adoption and Financial Inclusion

# Case of G20 and Covid-19

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# 1. Abstract

This dissertation critically investigates the interplay between financial inclusion and the adoption of digital payments, examined through the lens of four pivotal research questions. Utilizing a quantitative approach, the study employs regression analyses on cross-sectional data from various countries, focusing on different dimensions including Internet access, education levels, age demographics, and financial stress due to COVID-19.These dimensions help the author explain the impact of Digital Payments Adoption on Financial Inclusion. The findings reveal nuanced relationships, for instance, while a strong positive correlation exists between digital payment adoption and financial inclusion, indicated by an R2 value of 0.902, the results also point to country-specific factors as significant influencers. Further, the role of education in digital payment adoption in low-income countries is partially substantiated, although the model explains only 47.1% of the variance. The age gap analysis yields a suspiciously high R2 value of 1.000, signalling potential overfitting or multicollinearity issues. Finally, the impact of COVID-19-related financial stress on digital payment usage in G20 countries is significantly highlighted, with an R2 value of 0.923. Despite its contributions, the research also uncovers limitations, such as potential model overfitting and unaccounted variables, necessitating further need for detailed analyses. This study serves as a comprehensive guide for policymakers and financial institutions, offering insights into the complex dynamics affecting financial inclusion and digital payment adoption.

## 2. List of Tables:



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# 4. Glossary

| Term | Unabbreviated Form/Definition |
|---|---|
| **AI** | Machines programmed to simulate human intelligence are called Artificial Intelligence. These machines can learn, reason, and self-correct. |
| **Blockchain** | Blockchain is a system of recording information in a way that makes it difficult or impossible to change, hack, or cheat the system. It is a digital ledger of transactions that is duplicated and distributed across the entire network of computer systems. |
| **COVID-19** | A novel coronavirus identified as the cause of a disease outbreak that began in Wuhan, China in late 2019 and has since spread globally. It primarily causes respiratory illness in humans. |
| **Digital Currencies** | A type of currency available in digital form, representing a balance in a database, and not in physical form like paper money or coins. It exhibits properties similar to physical currencies but allows for instantaneous transactions and borderless transfer of ownership. |
| **Digital Payments** | Refers to the use of electronic platforms to transfer money between two parties, eliminating the need for physical money. |
| **GDPR** | General Data Protection Regulation is a regulation introduced by the European Union to regulate data protection and privacy for all individuals within the EU and the European Economic Area. |
| **Mobile Banking** | The use of mobile devices to conduct banking activities, such as checking balances, transferring funds, and making payments. |
| **Online Lending** | A method of borrowing money through digital platforms without the direct intervention of a traditional financial institution. |
| **Python** | A high-level, interpreted programming language known for its simplicity and versatility. |

# 5. Introduction:

## 5.1 Description:

The finance industry has undergone a significant transformation with the widespread adoption of digital payment solutions, which have now become an integral part of modern financial services. The G20 nations , comprising of the 20 most influential global economies, has extended its support towards the development of a more secure and efficient financial system that benefits both individuals and businesses alike. Analysing global trends and the impacts of digital payment adoption is crucial for the G20.[1] The Covid-19 pandemic which brought the world to a standstill has further accelerated this trend, making digital payments a necessary and convenient option for many individuals worldwide. This research aims to provide an in-depth understanding of the evolution of this trend, its impact on financial inclusion in the context of G20 during the pandemic. The study seeks to offer insightful and comprehensive information on how the digital payment transformation has changed the financial landscape and has helped identify the key factors that have contributed to its growth. Ultimately, this research project aims to advance the readers knowledge in digital payments, provide insights into some nuanced Questions contributing to the ongoing Innovation in the field of finance.

## 5.2 Rationale:

In today's world, it is crucial to study the impact of digital payment adoption on financial inclusion. By examining the factors that influence the adoption of digital payment methods in G20 countries and understanding shifts in payment behaviour, we can gain insights into the future of financial services and economic development.[2].The Covid-19 pandemic has presented unforeseen challenges to traditional payment systems, highlighting the importance of digital financial solutions. Therefore, it is essential to investigate changes in digital payment behaviour during and after the pandemic to evaluate financial systems' adaptability and resilience during disruption.

## 5.3 Research Aims and Objectives:

The research aims to comprehensively analyse the evolution of digital payment adoption in G20 countries and its role in promoting financial inclusion, with a focus on the impact of the Covid-19 pandemic. To achieve this goal, we have established specific research objectives:

1. **Analysing the relationship between Prevalence of Digital payments and Internet access and its Impact on Financial Inclusion:**
   The Objective is to gather comprehensive data on Financial Inclusion, digital payment utilization and Internet access across countries, and using statistical techniques like Regression to examine the relation between variables.[3]
2. **Analysing the Influence of Education on usage of Digital Payments:**
   The Objective is to gather comprehensive data on Educational levels and the usage of Digital Payments for online shopping, to show the relation between Varying levels of Education and its consequent impact on Digital Payments Adoption.[4]

3. **Analysing Age disparity relation with adoption of Digital Payments.**
   The Objective is to gather comprehensive data on Age related trends to show whether the rate of Digital Payment Adoption is different for different age groups.[5]
4. **Analysing the Impact of Stressful situations such as COVID-19 on Digital payments Adoption.**
   The Objective is to Gather comprehensive data on Digital Payment usage during the Pandemic and to correlate it with the overall impact of financial stress.[6]

## 5.4 Research Questions:

**Research Question 1:**

“Is financial inclusion significantly higher in Countries where digital payments and Internet Access are more prevalent?”

**Research Question 2:**

“How does the level of education affect the use of digital payments for online purchases among those with Financial Accounts in low-income countries?”

**Research Question 3:**

Is Age gap a crucial factor in the adoption of digital payments among internet users?

**Research Question 4:**

Does financial stress due to COVID-19 influence the use of digital payments in G20 countries?

## 5.5 Summary of Findings:

Through conducting regression analyses on four distinct research questions, the authors findings provide substantive yet nuanced insights into this complex landscape of financial inclusion and digital payments. Although the high R2 values in the models for Research Questions 1 and 4 suggest a strong explanatory power, there may be concerns of overfitting or omitted variables. The research broadly confirms the positive influence of digital payments and Internet access on financial inclusion. Additionally, it underscores the role of financial stress due to COVID-19 in the adoption of digital payments in G20 countries. However, the models also reveal inconsistencies and limitations. For instance, the lower R2 value for Research Question 2 implies that there are other unaccounted factors affecting digital payment usage among different educational levels in low-income countries. Furthermore, the unusually high R2 value for Research Question 3 requires scrutiny for potential model overfitting or multicollinearity. Overall, the research offers valuable data-driven insights into its focal areas. However, it also highlights the need for more comprehensive models that account for additional variables and country-specific factors to deepen the understanding of these multifaceted issues.[7]

# 6. Literature Review

## 6.1 Overview of Traditional Banking Systems:

Traditional Banks are financial Institutions that offer a wide range of services. These include Accepting Deposits, disbursing loans and offering various investment products. These banks act as intermediaries in the Financial System, forming a Coherent circle of Individuals and Businesses who need capital for investment and those who deposit money for the long term. These processes carried out by Traditional Banks facilitate the growth of a country's economy by promoting Cash flow. The concept of traditional banking is defined by four distinct characteristics, as outlined by [8]. Firstly, traditional banks prioritise relationship lending, building long-term connections with clients and offering loans based on personal knowledge and trust. Secondly, they rely on core deposit funding, with stable deposits from household and business customers serving as their primary source of funding. Thirdly, traditional banks generate revenue through interest income and fees earned from providing noninterest financial services to their banking customers. Finally, traditional banks rely on physical bank branches to facilitate in-person interactions with customers. The author concludes that banks can be classified as traditional if they exceed the median for at least three of the four characteristics outlined above. This system has to date proven effective and the numbers speak for themselves. With approximately 25000 Traditional banks worldwide as of 2022 and over 60% of adults globally having a bank account[9], these figures indicate a well-established industry. The sector's AUM was approximately $124 Trillion in 2020[9]. Customer Trust is seen to be relatively high with 70% of people trusting traditional banks[10].

Though Traditional banking systems have worked efficiently, some inefficiencies are clearly visible. The operational Inefficiency including the cost-to-income ratio is about 60% of Traditional Banks[9]. This high ratio gives ample space and motive for Innovation to happen and roll out better efficient services. The use of Intelligent Technologies to enhance the speed and quality of services has not seen an active effort with only 51% of traditional banks considering the full adoption of Intelligent technologies. However, this development does not Guarantee sustained and Innovative growth, also With limitations on Financial Inclusion with Traditional banking practices, a large amount of the population remains unbanked which gives an opportunity to develop a new system that revolutionizes the process through Digitization. The slow Innovation in services along with Intense Regulatory Compliances have made it difficult for Traditional Banks to survive through outdated ways, especially in the G20 nations.

## 6.2 Role of G20 Nations in the Banking Landscape

The global banking industry generated around $345 billion in revenues in 2022 [9], and the majority of the banks are situated in the G20 nations.[12]. The Basel III regulations, which aim to improve the resilience of the banking system, have been put into place with the help of the G20. The G20 nations are a group of 19 countries and the European Union that constitute the largest economies in the world[17]. Together, they account for 85% of the global GDP and around 75% of global trade, and they have greatly influenced the banking industry.[11] Basel III was introduced after the 2008 financial crisis[13]. As discussed in [14][15] Basel is an international Regulatory framework that strived to improve the regulation, supervision, and risk management of the banking sector. Basel III works on key principles such as Liquidity coverage ratio, net stable funding ratio, and leverage ratio as seen in [15]. These ratios are important as they are designed to ensure that banks have enough liquidity to survive a significant stress scenario lasting 30 days to 1 year. This Reduces Systemic risk and market dependence by providing transparency and standardization to achieve resilience. The implementation of this has had several effects including increased capital requirements, improved risk management, enhanced liquidity requirements, reduced leverage and increased compliance for banks.[16]

## 6.3 Definition and Overview of Financial Inclusion

As economies become increasingly interconnected and digitised, ensuring that individuals have equal access to financial services across all verticals is paramount to the sustainable development of financial services and the growth of economies worldwide. Thus, Financial Inclusion becomes a vital component of this process. The Author in [18] defines financial inclusion as "having access to, and the use of financial services". According to the Author, financial inclusion enables individuals and households to save, invest in education and start businesses. This presents a way to create opportunities for both to grow their wealth using the different financial services provided by the banks, which can serve as a reserve during troubled times. The Author [19]. Discusses the significance of Financial Inclusion in multiple dimensions, in which the main is that financial inclusion is crucial for economic development and reducing income inequality. It is a critical factor for policymakers to consider while promoting sustainable economic development. With increasing financial inclusion, the growth of Technological Infrastructure has also increased due to the necessity of better systems to handle the customers.

### 6.3.1 Digital Financial Literacy and its Considerations:

Financial Inclusion also brings with it Financial Literacy. It's not just having the knowledge to use services but also knowing how to use them. This involves learning the Strengths of the services and also which actions might make the person Financially Vulnerable. This is essential in wading off Cyber-attacks. Though technology is constantly being improved, cyber-attacks are still a huge problem. As seen in [20], the average value per cyber-attack was the average cost of a single ransomware attack which is $1.85 million and the average cost of a data breach was about $4.35 million in 2022. The annual Global cost of Cybercrime is a staggering $6 trillion dollars per year, which is 1% of the Global GDP [21]. But, implementing Financial Inclusion has always been hard. [22] explains that people need to have Digital Literacy to properly understand and use Financial Services. They explain Digital Literacy as the ability to use digital technology effectively. They emphasise that it is a critical factor to promote financial inclusion due to its ability to impact people's lives immensely in a much better way. Digital literacy plays an important role in enabling access to financial services for individuals.

[23] takes it further when he explains the combination of Digital and Financial Literacy as the higher version of Financial Literacy. To quote the author, it's like "an old wine in a new bottle". The Author considers Digital Financial Literacy as a crucial factor, which acts as a bridge between Traditional Financial Systems and digital financial products. This adoption will promote Technological advancements and act as a "Policy Tool" to help Vulnerable Populations who lack Digital Financial Literacy to access the new era of services. This puts the world's Leading economies in a position where Global Policy on Digital Financial Literacy becomes a crucial factor in affecting the world economies. The Author's study on India showed that it ranked 49$^{th}$ in terms of overall Internet accessibility in 2021, and only 24% were Financially Literate by 2016. This can severely affect the Growth of the economy.[24]

### 6.3.2 Policy Frameworks Surrounding Financial Inclusion

To promote financial Inclusion various policy frameworks have been implemented by Governments and Financial Institutions which include rolling out of Digital Financial Services like P2P lending, Mobile Payments systems, and Cashless Transactions[26]. Microfinance Institutions are giving small loans and other services to low-income individuals.[25][27]. Some Notable Policy Frameworks include Indonesia's NFIS: Launched in 2012, it aimed to achieve a financial system which is accessible to all people alike and is made to promote economic growth, poverty reduction and income inequality in Indonesia. The following results were observed after the implementation, Formal Bank Accounts increased from 20% in 2011 to 36% in 2014. With this, the use of Digital financial services increased

from 1% in 2011 to 36% in 2014 [28]. Similarly, The NFIS in Afghanistan aimed to reduce Financial Exclusion by 15%, along with improved financial access for women.[29]. The “ACCESS Initiative” is an initiative in the US that seeks to foster financial Inclusion and is made to address the disparities experienced by minority, underserved and unbanked populations. According to the FDIC, the percentage of unbanked households in the US decreased from 7.7% in 2013 to 5.4% in 2019. The Initiative also led to Increased Financial Literacy and Increased Employment Opportunities[30]. In [31], the brief explains how the Unbanked population would pay anywhere between 1 to 5% to Cash a cheque, so an average person with an annual salary of $22000 would end up spending about $1000 annually in fees and extra costs. This can become a huge burden for those who don’t know how to use Digital Financial Services. So, the author expresses that the implementation of such frameworks can be an effective way to increase the accessibility of services.

Another important Policy framework is the use of Regulatory Sandboxes.[32] Explains Regulatory sandboxes as a mechanism adopted by countries to address obstacles in rolling out Digital Financial Services. It allows fintech companies and Governments to test innovative products, services or business models in a controlled environment where Regulatory flexibility and support are provided. The aim is to reach a balanced state where Customer Protections and Technological Innovations go hand in hand by means of temporary regulatory exemptions or relaxations. These tests are also tested over a smaller portion of the population and are also called the “Pilot Phase”[33]. The purpose of Regulatory Sandboxes is explained by [34] as follows, The authors believe that the increased implementation of Regulatory Sandboxes can Facilitate Real Innovation, without companies facing regulatory concerns, This gives them the freedom to experiment with new things without actually affecting the economic growth of the nations. But this would only be helpful if Countries worldwide actively invest and make an effort to promote this framework, An excellent example would be the implementation of the first regulatory sandbox in the United Kingdom, due to its popularity, more than 50 jurisdictions introduced this concept in their countries, showing positive response claim the authors. The induction of the Global Financial Innovation Network, an FCA-inspired coalition makes sure that there is consistent treatment provided in regulatory sandboxes, this gives extra trust to companies willing to invest and grow. Some key figures indicate that about 80% of Firms who have successfully tested their products in Sandboxes are still operational, this includes well-established firms like HSBC and Barclays.[35] .

However, from [36] we understand that Simple quantitative metrics often used by sandboxes, such as the number of firms admitted into the sandbox that are actually successful isn’t really an efficient way of qualifying it as a successful framework. Normally, Regulatory sandboxes have a limited duration to test their products, this is especially a disadvantage for fintech companies, which might potentially lead to a less-than-optimal testing process.[37]. Solutions tested in a sandbox may not actually perform well on a large scale, and dealing with the complexities of the continuously evolving market makes scalability an important issue for firms.[38]. [39,40] suggest that While Sandboxes offer a more flexible regulatory environment, there may still be uncertainty regarding the regulatory requirements that businesses need to meet once they exit the sandbox and enter the market. So, while Sandboxes provide an attractive environment to test products and grow business, it comes with its fair share of challenges. But the uncertainty goes both ways as policymakers need to be aware of how the company does tests. Relaxing Regulations even within the Sandbox, may lead to decreased consumer protection such as Misleading Sales practices, and unsuitable products that might put the focus group under financial risk often the cause of lack of supervision.[41] The exploitation of the Sandbox environment to engage in regulatory arbitrage is a growing concern in developed nations, this puts the consumer at risk.[42]. Lastly, Sandboxes are Resource Intensive, establishing and operating them requires significant resources including expenses on staff, and infrastructure. This can pose a challenge to

regulatory bodies with limited resources. The following key figures help make the background of Regulatory Sandboxes and its implementation Clearer. According to [43], as of 2020, there were 73 FinTech-centric startups across 57 Jurisdictions Worldwide.

A study by [45] found that Firms entering UK sandboxes saw an increase of 15% capital raised post entry and their probability of raising Capital post sandboxes increased by 50%.The report in [44], shows an interesting example where One firm tried to transfer funds from sterling(GBP) to South African rand(ZAR) using an intermediary digital currency. The rates of transfer were almost 5% to 50% cheaper than the best available alternative at that time. While the ethical considerations surrounding financial Inclusion are generally considered beneficial, as it aims to provide equal access to the most basic services for the poorest individuals, reducing income inequality and closing the disparity between the rich and poor [45], some major concerns in potential unethical behaviours such as fraudulent financial reporting, which have the capacity to cause serious consequences by misleading shareholders and undermining the integrity of the financial system[46]. Respecting the autonomy and privacy of individuals is also an important ethical consideration. The use of digital technologies to promote financial inclusion and roll out different financial services raises concerns about data privacy [47]. So it is extremely important that the frameworks that are made are robust enough o to protect personal information and ensure that autonomy isn't compromised.

### 6.3.3 Debates Surrounding Financial Inclusion:

[40] explains that a major debate surrounding this literature is the trade-off between financial Inclusion, Risk Management and Financial Stability, The major reason is that when promoting Financial Inclusion, the target audience is normally someone with not much financial literacy, this poses a huge risk for Institutions who might face Loan defaults.[48] Also, the Global economic condition needs to be taken into account while implementing plans for the framework, as implementing Financial Inclusion is an expensive process, and any disruptions in the Global economy will indirectly affect the process of Financial Inclusion. Another debate that [49] emphasises is that financial inclusion can either worsen inequalities or create further forms of exclusion. This is supported by [50] where they found that higher levels of financial inclusion initially led to greater income inequality. Further, they also found that Financial Inclusion has an age-dependent factor, which suggests that Financial Inclusion might not reach all segments and a certain group of the Population might be left behind. A significant point to be considered as pointed out by [51] is that the Impact of Financial Inclusion over time and across regions seems to be context-dependent.

There are many challenges faced by Global Economies to roll out Financial Services due to the Impact of COVID-19.[52] found out that The Nations with better financial access and Use pre-covid had a lower mortality risk from COVID-19. [53] explains that due to the pandemic, Almost every Traditional banking service was shut down, including Access to Physical Banking Facilities, branch closures, and reduced working hours. These disruptions have affected the individuals and Businesses relying on Traditional Banking Facilities. Due to the economic stagnancy and Financial Instability, the overall financial Sector has been Affected. This has led to certain challenges such as Loan defaults, Credit defaults, and Reduced Investment activities[54]. The Impact on Remittances has been significant, where there was a decline in Global remittances in 2020, so people relying on Remittances, were deeply affected as their source of Income and Financial Support was cut off[53].The Pandemic also provided an opportunity to develop Digital Financial Services after Traditional Services couldn't be used. This accelerated the demand for Digital services such as Digital, Cashless Payments and access to Financial Services on Handheld devices, including services like Investments, Insurance and Bills which provide an effective way to promote financial Inclusion during COVID-19 [55].

### 6.3.4 Successful Policy Implementations by G20 nations:

Some Notable Policy Implementations include the U.S. CARES Act.[56] Explains that one of the key components of the CARES Act was the provision of direct stimulus payments known as the (EIP) or the Economic Impact Payments to Citizens. These included people with Job Instability, less financial resources and people with more dependable. The result of this was that the people were able to improve their financial situation through investing and debt reduction. The CARES Act offered people safety and choices about how to manage spending needs and wants. The disbursing of the funds was achieved using Digital Platforms. This allowed for efficient delivery of funds. Another study done by [50], showed that the CARES Act's $296 Billion in Stimulus Payments increased consumer spending by $130 Billion only within 2 weeks of the Stimulus Payments. Singapore is another country that introduced its SGQR(Standardized QR code system for Payments) which provided financial Incentives to small business owners to adopt Digital Payment Methods[57].

Fintech Partnerships provide a way to develop new technologies for the transfer of funds, One such example is Nigeria's NIRSAL Microfinance Bank, it collaborated with Fintech companies to disburse Credit to households and SMEs in a Streamlined manner. By leveraging Digital Platforms, the disbursement process was made simpler and Transparent, reducing the potential for corruption and ensuring that all Records are right. Another example is the "European FinTech Task Force". It is a collaborative effort that was taken to deliver financial Assistance to households and SMEs [58]. Also, to further improve the process and make it more efficient [59][60] highlights Important regulations such as the Revised Payment Services Directive(PSD2) and the General Data Protection Regulation (GDPR) in boosting Fintech Development. An Important concept in Financial Inclusion is Digital Identity Authentication, [61] explains the concept of Self-sovereign Identity(SSI), which includes the consolidated information of the individual's consolidated digital identity. Australia's MyGovId provided a digital Identity solution that encourages the use of Digital identity Solutions that encourages the use of Digital identification to access government services and receive Financial Aid, without having the need for Physical Verification. This system aimed to streamline the process and make access to services both Government and Financial simple to use[62].

### 6.3.5 Technology's Role in Promoting Financial Inclusion

The Challenges provided by COVID-19 gave the Global economies an opportunity to develop technologies that can handle Extreme global events such as COVID-19. These include Technologies like Digital Payments, Blockchain Technology, Artificial Intelligence, Biometric Identification, Cybersecurity Algorithms and Open Banking. The focus of this report is on the Evolution and Use of Digital Payments. [63] Explains Digital Banking as "Electronic Transfer of Funds between Parties, typically facilitated through digital platforms or devices". It involves using Technological devices such as Mobiles, Computers and the use of the Internet to Initiate Authorize and complete financial Transactions, various methods include mobile wallets, online banking, QR code payments, contactless payments and P2P transfers.[64].

## 6.4 Digital Payments:

Digital Payments have been proven very important due to a multitude of factors which include Convenience of Transaction, allowing Businesses and Individuals to make and receive payments anytime and anywhere. The Speed of the transaction is near instantaneous for the transfer of funds resulting in a more efficient transaction compared to Traditional Transaction methods. This speed helps faster Cash flow through the economy resulting in the growth of the economy[65]. [66] explains that Digital payment systems incorporate an infrastructure that employs high-end security measures to protect sensitive data such as Personal/Financial Information, the system uses technologies like Encryption, Tokenization and Biometric authentication to Implement this security procedure. Robust

Cybersecurity algorithms are developed to safeguard the Technological Infrastructure and systems from Cyber-attacks. They also explain that Mobile payment solutions can enable People from remote areas to access Advanced and updated Financial Services. Digital Payments have been growing at a rapid rate in the G20 countries.[67] The total value of Digital Payments was over $3 trillion; it experienced significant growth and was projected to reach $4.93 trillion in 2020 which is a 23.7% increase from the previous year. To promote Financial Inclusion for the underbanked population several systems are being designed. [67] discusses the use of Digital footprints to develop innovative financial solutions, This will help to provide access to credit history and the companies can use their Digital data to assess their creditworthiness, thus reducing inequality.

[68] highlights that CBDC have the potential to accelerate Financial Inclusion, where CBDCs can provide individuals with access to central bank currency through Digital wallets issued by Government and companies. This can help bridge the gap between the underbanked population and formal financial services. However, he also emphasizes that the rapid adoption of Digital Payments solutions might put the Traditional system at High risk and affect the current monetary policy. So, Regulators need to be careful about the speed of implementation of the technologies to ensure balanced growth. For any technology to have a balanced approach to growth, Trust, Well-thought and regulated Government Policies, awareness and security are essential. A study done in Indonesia by [69] found that Trust and Government policies were of significant importance in terms of determining whether or not people adopted Digital Payments. Trust proved to be most influential in implementing and promoting Digital Payments Adoption.

Another study done by [70] explores how the rate of adoption of Digital Payments was the lowest in the United States of America, which identified factors such as a Lack of Awareness and Understanding of how Digital Payments work along with concerns about Privacy and Security. Also, the study found out that people in the United States, generally found that traditional methods such as Cash were still Relevant. The role of the Government is extremely crucial in promoting Digital Payments adoption.[71] talks about the Implementation of Europe's PSD2 or the Revised Payments Service Directive, it was introduced in 2015 and effective in 2018. It Obliges Traditional banks to share customer data with TPPs to Initiate payments and access account information for better financial services.[72] The SCA(Strong Customer Authentication) which mandates multi-factor authentication for online transactions has the capacity to curb fraud. This enhanced security promoted and helped Digital Payments Adoption. Furthermore, by enhanced security to protect customer data a legal framework was established which provided transparency and increased trust within the people.[73], explains that UPI is a "Real-time inter-banking payments system introduced by the National Payments Corporation of India in 2016". It enables users to link multiple bank accounts to a single mobile device which offers seamless and easy access to Various Financial services across different platforms. Individuals can send and receive funds, purchase insurance, and Invest in the various opportunities provided by Fintech Providers.[74] explains that to promote the adoption, the interface was made to be easily usable for anyone. Further, Cashbacks and discounts were offered across services such as Railway bookings, and government and private services. The reduction of Transaction fees was the main reason for adoption, additionally, businesses who use Digital Payments might also receive a tax benefit till a certain limit.

### 6.4.1 Evolution of Digital Payments:

The COVID-19 Pandemic has had a significant impact on consumer behaviour leading to a shift towards Digital Payments. A study by [74], showed that Effort expectancy and Performance Expectancy significantly influenced whether Adoption would take place. A study done by[75] shows that the Rate of Adoption of Digital Payments in Lower and lower-middle income countries depended upon the level of government involvement.[76] found that Baby Boomers and Generation X were the New users of Digital Payments during the COVID-19 pandemic, This could be leveraged to increase digital payments users across a broader age range. To facilitate a balanced adoption, Partnerships between Government and Private companies are essential as this aim to leverage the strength of the resources of both sectors to bring about new innovative products. An example is the Digital Country Partnership(DCP's) by Mastercard, Mastercard has established Digital Partnerships with the Governments and Public Sector bodies of France, Czechia, Slovakia and Jersey. The company aims to provide services to the People by leveraging Mastercard's Technology, Partnerships, and data insights. By doing this, they are able to Bring forth services dedicated to the population of the country[77].

[78]The BIS came up with Project Nexus, it is a project aimed at creating a common hub where countries can make fast payments and initiate cross-border payments efficiently. It is a collaboration between Central banks, governments and private sector companies to develop and Implement new innovative solutions. The Project focused on countries in the APAC region including countries such as Singapore, Thailand, and Malaysia which have already established fast and efficient cross-border payments. During the Pandemic, the world saw a huge change in Payment trends across the globe. According to [79], Cash Usage declined during the pandemic, it lowered from 23% in 2019 to 19% in 2021. [80] showed that The pandemic led to an increase in Digital Payments by 40% in low and middle-income countries. Online Payments and in-app mobile wallet payments have seen a dramatic increase in popularity with 66% of consumers using online card payments and 70% using online or in-app mobile wallet payments in 2022[81]. The consumer adoption of Digital Payments has surged in the COVID-19. A McKinsey survey found that 67% of consumers increased their online purchases, these people were mostly between 18 to 34. Another report from Mastercard showed that contactless payments grew 2-3x faster than traditional methods in Q1 2020, with 51% of Americans using them. Adobe revealed a 77% surge in the U.S. online shopping in 2020, reaching $813 billion. Visa's 2020 showed that 43% of small businesses adapted by expanding operations worldwide. ACI Worldwide highlighted a 23% rise in international digital transactions in May 2020.[82,83,84]. Merchants worldwide have also benefitted from the adoption of digital payments.

### 6.4.2 Access to Digital Payment Services:

Due to the diverse range of services available such as Point of sales machines the availability of QR code scanners and NFC-based devices. These quick and effective solutions help facilitate settlements, promote reduced handling of Cash, provide integrated tools for Finance Management and also offer the customers multiple forms of payments. Point of Sales Systems market size was valued at $62.34 Billion in 2018 and was expected to grow at a CAGR of 7.8% from 2019 to 2025.[85]. Digital Payments data is becoming an increasingly important component in credit scoring models, offering a micro view of an individual's financial behaviour and creditworthiness without the traditional drawbacks.[86] explains that Traditional Scoring Models often relied on Personal Payment History on loans and credit cards, debit levels, length of Credit History and types of Credit in use. The drawback of this model is that the system overlooks People who seem Financially stable but have little to no traditional credit history. Recently the concept of Alternative Data has been gaining importance, Alternative data refers to "Non-traditional sources of Information that can be used to assess creditworthiness". This includes Digital payment Data, utility payments, rent payments, and even social media activity. The use of

alternative data in credit scoring has the potential to benefit individuals in low-income economies who do not have a credit or bank account due to insufficient credit history. [87] found that call detail records with traditional data significantly increase the performance of credit scoring models. This also helps promote financial Inclusion by providing credit opportunities to those who are traditionally not selected due to the old Credit scoring system. However, Concerns regarding the use of Alternative data by TPP is still a problem, regarding concerns with Data safety. Government Initiatives are also taking ground with the introduction of CBDCs.

Central Bank Digital Currencies are dramatically changing the landscape of global finance and monetary policy. CBDC's aim is to combine the benefits of Digital Payments, Tokenization and the trust and stability of Government-Backed Fiat Money[88]. Countries are actively pursuing the adoption of CBDCs to gain the best of both worlds. This shift though challenges traditional concepts of money and Regulations and thus brings the need to bring in new regulatory frameworks and risk assessments[89]. Some successful implementations of the CBDC are the Bahamas Sand Dollar, the USA's Digital Dollar, China's Digital Yuan, and Sweden's e-krona[90]. QR codes and contactless payments have revolutionized the way we conduct financial transactions by making them quicker, easier, faster and more efficient. By simply scanning a QR code with a smartphone, even small vendors can accept digital payments without needing a complex point-of-sale system. These contactless payments using NFC technology have made transactions seamless and faster, reducing the time consumers spend at checkout times. A study by [100] examines the use of QR codes to receive digital payments.

The study extends the Unified Theory of Acceptance and Use of Technology(UTAUT) model to understand the factors influencing consumers' intention to use QR code-based payment methods. It highlighted the fact that ease of use, trust and social influence played a huge role in influencing customer's decision to trust and use QR codes. While the process becomes easier, the study also emphasizes that convenience, security and social norms shape consumer's attitudes and behaviours towards contactless payments using QR codes. From [101], we see that there was a 433% increase in dynamic QR code scans from global users in 2022 compared to 2021 figures. 36% of people have used QR codes as a payment method, with 53% saying they would use QR codes as a payment method in the future. QR code payment transactions are projected to reach a market size of more than 2.7 million US dollars by 2025.

Contactless payments refer to a type of digital payment method that allows individuals to make transactions without physically touching a payment terminal or exchanging cash. Instead, they use technologies like RFID or NFC to facilitate the transaction, this is achieved by waving or tapping a device, such as a smartphone or contactless card, near a payment terminal[102]. One of the main benefits as pointed out by [103] is the accelerated adoption of contactless payment systems, due to the reduced need for Physical contact which is handy during times like COVID-19. The global contactless payments market size was valued at USD 34.55 billion in 2021 and is expected to grow by a CAGR of 19.1% from 2022 to 2030[104]. It is also projected that the total contactless payment market is projected to reach $166.46 Billion by 2030. Another report[105], showed that contactless payments increased by 50% in more than 1000 markets globally from Q1 of 2020 to Q1 of 2021 which showed one billion more transactions. Global contactless card purchases are set to reach $10 Trillion by 2027[104].

### 6.4.3 Security Measures for Digital Payments:

Though Digital Payments and Similar technologies involve robust algorithms to keep their data and money safe, Frauds and scams still happen. [91] discusses an intelligent payment card fraud system which uses a hypothesis test to determine the effectiveness of using multiple features and variables in combination to predict fraud. [92] discusses the use of Machine Learning Algorithms for fraud detection in Digital payments systems, the study highlights the increasing Financial Losses from the Traditional Methods of Safety and emphasizes that these Machine Learning Algorithms can provide a high level of safety. Data Privacy and safety have been an issue of concern, especially in the past few years. [93] emphasizes that the role of multinational tech giants in shaping privacy settings is crucial. The Data of the users must be handled with care and TPP should be thoroughly vetted before handing over data. The study highlighted the need to critically analyse and understand Privacy control implemented by Digital Payments Platform. Another study by [94] discussed the emergence of Digital marketplaces for data monetization and highlighted concerns such as privacy and security that hinder the adoption of such platforms.

[95] Blockchain is a distributed ledger technology that enables the secure and transparent recording of transactions across multiple participants, This system functions in a way where each participant maintains a copy of the ledger or record and the transaction is verified and added to the ledger through a consensus mechanism, where the participants vote to decide whether or not a transaction is going through. According to [96], blockchain technology has the potential to transform how payments are made, making it more secure. It offers benefits such as increased transparency, traceability and efficiency across payments. In digital payments, encryption and two-factor authentication (2FA) are critical for ensuring data privacy and security. Encryption techniques like SSL/TLS create secure links between servers and clients, while end-to-end encryption safeguards data from sender to recipient. Tokenization replaces sensitive information like credit card numbers with unique identifiers, making intercepted data useless. 2FA adds an extra layer of security by requiring a secondary verification step, often via SMS or an authentication app, before a transaction can be completed.[98] These technologies work together to protect both consumers and merchants from fraud and data breaches.

Mobile payment technologies have experienced a surge in adoption, particularly during the COVID-19 pandemic, which has accelerated the shift towards cashless transactions. Features like one-click payments, biometric authentication and seamless integration have made mobile payments increasingly easy. However, the user experience and adoption depend on a number of factors. [99] examines the relationship between trust, user satisfaction, and continuance intention towards mobile payment. The study focused on a trust-building process that emphasizes that user trust is essential for massive adoption and growth. This can only happen when Transparency is kept at the Centre of Attention. The study highlighted that the maximum no of users were generally young and Digital Literacy played a big role in recognizing the pitfalls of slow adoption.

The Literature provides a detailed yet broad picture of the Financial Inclusion Landscape, the Traditional banking model, the challenges associated with it and the need for the Adoption of Digital Payments in a world with unpredictable ongoing events. We identify certain gaps which bring forth a few questions, Does adoption of Digital Payments really help Financial Inclusion? How does Digital or Financial Literacy affect the changing nature of Financial Inclusion? With Changing Banking Models, are people really inclined for the transition and does Age matter? This Research deeply delves into these questions and tries to establish a relation between these variables, providing a framework for future Inquiries on the matter.

# 7. Research Methodology:

## 7.1 Research Philosophy and Approach:

The Evolution of Financial Payment Services has seen a noteworthy ascent in Financial Inclusion which was achieved by Innovating and Adopting new forms of Digital Payments. By offering scalable and on-demand services to the most financially underserved communities Digital Payments have the potential to revolutionize the way Financial Services are accessed, used and Innovated. This is particularly crucial inn terms of the Underserved Populus due to reasons of demographics, socioeconomics and Literacy. This Research seeks to understand the relation between Digital Payments and Financial Inclusion by including various facilitator factors such as age, education and trust.[106][107]

Any approach to research requires a Methodology to proceed with. The methodology provides a clear pathway to Identify gaps and Hypothize certain possible scenarios and possibly aim to achieve the Objectives of the research. In this context, a well-structured Methodology is essential to extract relevant insights from the Datasets using Quantitative methods and to achieve the aim of Research Analysis. This chosen Methodology will decide the Relevance and Accuracy of the Research. The Author of this report chooses the Positivism Paradigm to utilize for this Research. The Positivism Paradigm guides scientific enquiry by emphasizing the use of Quantitative and Empirical evidence, clubbing it together and to understand the Phenomenon to be researched.[108][109].

The Positivism paradigm is characterized by some key assumptions: First, it assumes that there is an Objective reality that can be studied through a series of systematic observations and Data Collection. Second, A positivist believes that knowledge can be obtained through the use of scientific methods and that the scientific enquiry must be based on Empirical Evidence. This approach involves the collection of Quantitative data to perform Data analysis and consequently generate relevant insights. Positivism Seeks to identify patterns and regularities in the data to make valid predictions.[110]

This Research is built around the Financial payments Data from World Bank[111] and attempts to find Relationships and Patterns between Digital Payments and its consequent Impact on Financial Inclusion, thus supporting the Authors decision to select Positivism Paradigm. The author uses the approach of Reviewing Past Literature to identify gaps and then come up with theory and Hypothesis tests which can be tested using the Quantitative and Empirical evidence. This approach seems suitable because it allows the Author to test the Hypothesis against specifically created datasets from the Original Dataset, answering the Relevant Research Questions, ensuring that the proper process of the Methodology is followed.

Regression Analysis is a statistical method that is used to examine the relation between two variables, dependent and Independent ,It aims to examine the relation between both by making predictions based on Data analysis and results. The significance of performing Regression lies in its ability to provide relevant insights and quantify the impact of the Independent variable on the dependent variable. Researchers can determine the strength of the relation between the variables by analysing the Regression Coefficients. This process helps the Researcher identify important factors that influence the outcome.

The Regression Analysis for this research involved examining the contents of the Original dataset from world bank to decide which relevant columns to include which would be then used to test our Hypothesis of our consequent Research Questions. The Research Questions and their Consequent Hypothesis were derived from studying the Literature and finding relevant data columns within the Original Dataset. The Original Dataset was processed using Python to select relevant columns and create a new Dataset specifically designed to answer our Hypothesis. Regression was performed on

each of the created Datasets to generate Results and derive relevant insights from them which provided concrete evidence to support or Reject the Hypothesis.[112]

The survey dataset was conducted between 2011 to 2021 by Gallup Inc. It is a comprehensive survey which involved recording responses from 150,000 adults in over 148 countries. Approximately 1000 people were surveyed in each country to collect the data. The data covered various aspects related to Financial Inclusion, usage of financial services, use of digital financial services and barriers to financial Inclusion. The final data was weighted to account for the Population distribution within each country, so that it accurately reflects the characteristics and gives a true idea of the impact on each country. The Final data also included data from other sources such as the International Monetary fund's Financial Access Survey database to complement and enhance the analysis.[113]

The Author of this research chooses the Onion research Model to qualify the Methodology adopted. From our Observation it is clear that the model corresponds to the foundational layers of the Onion Research Model. This is relevant to the research as our strategy to evaluate is based on Measurable Data. Quantitative Research is an integral part of the research the effects over time can vary depending on the Intensity of the event affecting the Variables. Keeping these things in Mind, The author qualifies that, the onion research model can accurately reflect the nuances of the research and provide in-depth insights which validates the Authors choice for the chosen Methodology.[114][115]

## 7.2 Data Collection Methods and Tools:

The Primary data source for the Research was obtained from World Bank, it consists of data gathered from a survey conducted by Gallup Inc. Further certain variables were selected form The International Monetary fund's Financial Access Survey dataset. The Final Dataset, consisted of records from 148 countries with over 150000 people responding to the survey questions.[116]On an average from each country 1000 people answered the survey, suggesting a good sample set for a Dataset on a Global Level. The Survey was conducted from 2011 to 2021, with world bank releasing a new report every 3 years. The Dataset values are spread across 2011,2014,2017 & 2021 suggesting that the data captured a wide range of responses.[117]

The survey used a weighted average method, which ensured that the population distribution accurately reflected the characteristics to be observed and would give the true reality of Adoption of Digital Payments and its relation to Financial Inclusion of the Global Economies. The world bank dataset, also referred to as the Global Findex, was used to create 4 new datasets using Python. Consequently, Python was used to Clean and Process the data to generate relevant insights from it. Data Processing steps included, deleting Unwanted columns, Dealing with empty values or Values defined as N/A . Further the data had to be Transformed into a single format(Float representing Decimal Numeric Format). The Percentage signs were dropped and converted to consequent Decimal Numeric for further analysis. Finally, Tableau was used to generate relevant Graphs using data Visualization.

## 7.3 Data Analysis Technique:

This study performs Regression Analysis using Python. Python is known for its fast data processing speed and its ability to be versatile in the Regression Analysis. Due to its Extensive Libraries and resources which are specifically designed for data analysis and statistical modelling[]. Python was the preferred choice to conduct regression analysis due to the availability of various packages and modules which can be imported to perform the analysis.[]. The Author of this report uses two important libraries, first the panda's library to Process the data by converting it into Data frame. The statsmodel library focuses on statistical modelling and econometrics. It provides range of statistical

modelling techniques including Linear Regression, Time series analysis and other generalized linear models. It offers statistical tests, model diagnostics and visualization tools to support the Regression analysis. The primary analysis technique used is the OLS regression model or Ordinary Least Squares using the 'statsmodel' library.

The Dataset 1 aims to understand the complex relation of "Made a Digital Payment" and its relation to the "Financial Institution account". It tests the possibility of whether Adoption of Digital Payments really promotes Financial Inclusion. The dataset was cleaned and Transformed to remove discrepancies and any odd features such as Unnamed columns and missing values. After this the OLS regression model was used for estimating the unknown parameters in a linear regression model. It minimizes the sum of the squared residuals, making it an efficient technique for this kind of analysis.

## 7.4 Ethical Considerations and Limitations:

The Primary dataset retrieved from the world bank website was treated with utmost confidentiality. Though the dataset is available publicly, every step was taken to ensure proper ethical actions. The Research Conducted by the Author of this report strictly followed the data Protection regulations. The data was stored safely and was utilised solely for this study. Additionally, The Literature that was reviewed to understand the intricate complicacies was understood and used with utmost honesty to find relevant information. Every article refereed to has been properly referenced in accordance with the International standards. Similarly, Relevant Graphs, Charts and other Data Visualizations obtained from Company reports were properly referenced and no intention was set to use them as the Authors own. The content was properly cited to avoid Plagiarism and the research ensured that the results and Interpretations of the Qualitative data wasn't taken out of context. Further the Results and Interpretations obtained from the Regression results was cited as a product of the Author to prevent Plagiarism. The entire content is written with utmost thought and maintains the authors original Intention and meaning.

The approach while robust has its own set of Limitations. While the dataset is comprehensive and provides insight into a multitude of factors, there are a number columns with alternate missing values. Many columns consist of Inconsistent data making it harder to perform Regression Analysis. This can highly impact the accuracy of the consequent result. While the dataset covers a huge geographical region, it is observed that there are a number of variables and questions which do not contain a response. Further, this dataset was last updated in 2021. With the data absent for the recent 2 years, drawing relevant conclusions for the Present year was deemed not possible. This could hamper the decision making of Policy-makers and decision-makers alike.

The Regression Analysis was thoroughly executed but was processed based on Selected variables with Quality data and very low or no missing values. Considering this, It is highly possible that the influence of other untested variables might impact the overall results or might suggest different conclusions. This can easily create confusion and provide a half-hearted idea of the Impact of Digital Payments Adoption on Financial Inclusion. The Literature though providing depth and understanding of related concepts and frameworks might contain one sided opinion and Though biases regarding the specific topic as Perspective regarding digital payments can change according to the demographics, socioeconomics and Relevant situations when the Research was conducted.

# 8. Data Analysis and Research results:

## 8.1 Overview of analysis and Research approach:

This research aims to investigate the Impacts of Digital Payments Adoption on Financial Inclusion in the Context of G20 countries with COVID-19 as the main influencing event. The Research branches from the single most important question. How does the digital Payment Adoption affect Financial Inclusion in the various global economies of the world. The study determines Hypothesis to test this Research approach, where Null hypothesis suggests no significant Impact and Alternate Hypothesis suggesting that at least one of the factors has an impact on Financial Inclusion.

This Research employs a survey dataset from the world bank which comprises the data of 165 countries over the span of 4 years from 2011 to 2021. Through Regression Analysis, the Author of this report identifies patterns and relationships between the carefully selected dependent variable such as (Number of Financial Accounts describing Financial Inclusion) and various other Independent variables impacting them, serving as pillars for this analysis.

## 8.2 Regression Analysis:

The following section details the Regression Process and its consequent results for each of the 4 datasets created from the Original Dataset. These datasets contain the necessary variables to test the authors hypothesis in response to the proposed research question. Along with this a comparative analysis of these results and their integration with the Qualitative Literature is provided for In-depth insights.

### 8.2.1 Research Question 1: "Is financial inclusion significantly higher in Countries where digital payments and Internet Access are more prevalent?"

**Justification of Dataset Used:**

The dataset used explores the relationship between Financial Inclusion and Digital Payments in the G20 countries from 2011 to 2021. This time frame is especially crucial as it gives an idea of the Rate of Adoption and Financial Inclusion Pre-covid, during COVID and Post-covid. The dataset proves to be of high importance in identifying how different countries are performing related to Financial Inclusion and can hence provide valuable insights to Private and Government Institutions in terms of expanding their reach and promoting Financial Inclusion through Digital Payments Adoption.

**Hypothesis Testing:**

**Null Hypothesis ($H_{0}$): "There is no significant relationship between the prevalence of digital payments, internet access and financial inclusion."**

$$H_0 : \beta (1) = \beta (2) = 0$$

This equation represents the null hypothesis, it signifies that there is no significant relationship between the prevalence of Digital Payments and Financial Inclusion. Here β (1) is the coefficient for "Made a digital payment (% age 15+)" and β (2) is the coefficient for "Has access to the internet (% age 15+)". The Null Hypothesis suggests that neither of these have any effect on financial Inclusion.

**Alternative Hypothesis ($H_1$): "There is a significant relationship between the prevalence of digital payments, internet access and financial inclusion."**

$$H_1: \beta(1) \neq 0 \text{ or } \beta(2) \neq 0$$

This equation represents the alternate hypothesis, which suggests that there is at least one of the coefficients that have a significant relation to Financial Inclusion, Implying that either "Made a digital payment (% age 15+)" or "Has access to the internet (% age 15+)" or both have a significant impact on financial Inclusion.

**Justification for selection of Dependent and Independent Variables:**

**Dependent Variable:**

**"Financial institution account (% age 15+)"**

The variable serves as an excellent indicator to measure financial Inclusion. Having a Financial Account is a foundational element to being Financially Included. Further, the digital payments column can be utilised to establish if there is a relationship between Financial Accounts and Digital Payments.

**Independent Variables:**

**"Country Name":**

This variable is essential for us to get a more in-depth understanding of how the levels of Financial Inclusion vary across global economies and what are its corresponding reasons.

**"Made a digital payment (% age 15+)":**

This variable serves as a direct measure of the prevalence of digital payments within each country. It is crucial to test the core hypothesis that higher usage of digital payments is associated with greater financial inclusion.

**"Has access to the internet (% age 15+)":**

This variable acts as a facilitator for both digital payments and financial inclusion. Many digital payment methods require Internet access. It is useful in gaining insights about the relation between the population having Internet Access and is making digital payments.

**Regression Model:**

$$\text{Financial institution account (\% age 15+)} = \alpha + \beta(1)*(\text{Made a digital payment (\% age 15+)} + \beta(2)*(\text{Has access to the internet (\% age 15+)}$$

Here, α is the constant term and β (1) and β(2) are coefficients representing the weight or influence of each respective independent variable on the dependent variable, "Financial institution account (% age 15+).". Apart from Direct Relation variables(Financial Accounts and Digital Payments), various facilitator variables such as Country Names and Income levels have helped in providing a Comprehensive and more nuanced insights of the Proposed question. The facilitator variables provide contextual information on often overlooked but crucial factors such as demographics and Socioeconomics and are identified as crucial areas to identify impacts. By isolating these variables, the model can then provide actionable insights for policymakers and decision-makers alike.

**Interpretation of Regression Results:**

From the Regression results[Table 1.1,1.2,1.3] The regression model exhibits an R-squared value of 0.902, suggesting that 90.2% of the variability in financial inclusion is explained by the independent variables selected. This high value highlights the model's relevance in studying the dynamics of financial inclusion in G20 countries amid the COVID-19 pandemic. The adjusted R-squared of 0.866 also confirms that the model isn't overfitted and suggests that the model did a good job in capturing the the underlying patterns from within the data. The standard error rate of 0.019 measures the deviation of the observed values suggesting that the Model is well fitting and the results do not stary too far away from the baseline.

The coefficient for "Made a digital payment (% age 15+)" is 0.1070 meaning that for every 1 unit increase in the variable, the dependent variable in our case “Financial Institution Account” changes by 0.1070, the p-value Is 0.001 and the t-statistic is 3.391. The p-value is less than 0.05, this indicates that the variable can significantly impact the Financial Inclusion of a country. The high t-statistic value indicates that it very unlikely that the coefficient for the Independent variable is 0, suggesting that the dependent variable is significantly impacted by the Independent variable.

The coefficient for "Has access to the internet (% age 15+)" is 0.0700 meaning that for every 1 unit increase in the variable, the dependent variable in our case changes by 0.0700. The model generates a p-value of 0.018 and a t-statistic of 2.428. The low p-value indicates that this variable has a strong relation to the Dependent variable and the Level of Internet access can Impact the Promotion of Financial Inclusion. The t-stat value indicates that its very unlikely that the coefficient for the Independent variable is 0, suggesting that the Independent variable significantly impacts the dependent variable.[Graph 1.1, 1.2,1.3]

Given these results, we reject the null hypothesis (H0) in favour of the alternative hypothesis (H1), confirming a significant relationship between digital payment and Internet access prevalence and their relation to financial inclusion.

This finding is pivotal for policymakers and stakeholders aiming to improve financial inclusion.The positive and statistically significant coefficient and values suggest that Digital payments and internet access can be leveraged as effective tools to broaden financial inclusion, particularly in the context of the COVID-19 pandemic's acceleration of digital transformation.

### 8.2.2 Research Question 2: “How does the level of education affect the use of digital payments for online purchases among those with Financial Accounts in low income countries?”

**Justification of Dataset Used:**

The chosen dataset explores how education levels impact the use of digital payments among people over 15 with financial accounts in low-income countries. The dataset contains specific variables that allow for a detailed analysis, including factors like year, country, and financial account status. By focusing in on low-income countries, the dataset fills a gap in existing research, addressing a group that's often neglected in studies on financial inclusion. The dataset proves to be of high importance in identifying how big a role does education play in impacting Financial Inclusion .

**Hypothesis Testing:**

**Null Hypothesis (*H*0): Higher educational level correlates with increased use of digital payments for online purchases among those with financial accounts in low-income countries.**

$$H0: \beta 1=\beta 2=0$$

Here, β 1 and β 2 represent the coefficients for the independent variables "Used a mobile phone or the internet to buy something online, primary education or less (% ages 15+)" and "Used a mobile phone or the internet to buy something online, secondary education or more (% ages 15+)," respectively. The null hypothesis proposes that the educational level, whether primary or secondary and above, has no impact on the use of digital payments for online purchases among those with financial accounts in low-income countries. In other words, it suggests that the coefficients for these educational variables ($\beta 1$ and $\beta 2$) in the regression equation are zero, meaning they don't influence the dependent variable.

**Alternative Hypothesis (*H*1):**

$$H1: \beta 1 \neq 0 \text{ or } \beta 2 \neq 0$$

The alternative hypothesis, on the other hand, argues that at least one of these educational levels does have an impact. This is indicated by either $\beta 1$ or $\beta 2$ (or both) being different from zero. These hypotheses are designed to test the core of the research question: “How the level of education affects digital payment usage in low-income countries”.

**Dependent variables:**

**"Made a digital online payment for an online purchase (% of internet purchasers, age 15+)":**

This dependent variable is used for measuring the use of digital payments in online transactions. It aligns directly with the core inquiry of the Research Question, which is to explore the impact of education on digital payments adoption within the framework of financial inclusion. By focusing on people aged 15 and above, it broadens the scope to include a wider group of the populus.

**Independent variables:**

**"Used a mobile phone or the internet to buy something online, primary education or less (% ages 15+)":**

This variable is crucial for understanding the digital payment behaviours of those with primary education or less. It allows us to test whether lower educational attainment impacts the intention of people to engage in digital transactions. Given that financial inclusion efforts often target marginalized groups, understanding how education level influences digital payment adoption among this demographic is vital.

**"Used a mobile phone or the internet to buy something online, secondary education or more (% ages 15+)":**

Similar to the first variable, but focused on those with secondary education or higher, this variable enables us to examine if higher education levels correlate with increased digital payment usage. It provides a contrast to the first variable, allowing for a more nuanced understanding of the role education plays in digital payment adoption for people with Higher qualification, it aims to analyse if the adoption rate is higher in people with higher education status..

**"Financial institution account (% age 15+)":**

This variable serves as a proxy for financial inclusion, indicating how many people have access to formal financial services. It helps us control the influence of broader financial infrastructure on digital payment usage.

**"Income group":**

Income level can be a significant factor affecting financial behaviours. By including this variable, the analysis can capture the nuances related to income disparities, offering a more comprehensive view of digital payment adoption.

**Regression Model:**

The model formulated to delve into the research question is as follows:

$$Y = \alpha + \beta 1(\text{Primary Education or Less}) + \beta 2(\text{Secondary Education or More})$$

$$+ \beta 3(\text{Lower Middle-Income Group}) + \beta 4(\text{Upper Middle Income Group}) + \epsilon$$

Here, *Y* is the dependent variable "Made a digital online payment for an online purchase (% of internet purchasers, age 15+)", which measures the percentage of people aged 15 and above who have made a digital online payment for an online purchase.

**Explanation of Coefficients:**

The $\alpha$ intercept gives us the baseline—essentially, the starting point—for digital payment usage when all other variables are zero. Then we have $\beta 1$ and $\beta 2$, which represent the impact of primary and secondary or higher education levels, respectively, on digital payment usage. A significant $\beta 1$ would imply that those with primary education or less have a different likelihood of using digital payments compared to the baseline. Similarly, $\beta 2$ tells us how those with secondary or higher education differ from the baseline in their digital payment habits. $\beta 3$ *and* $\beta 4$ and serves as a control variable indicating the scale of general financial inclusion by focusing on the percentage of people with Lower middle and Upper Middle-Income Group, shedding light on how broader access to financial services correlates with digital payment usage.

**Interpretation of Regression Results:**

From the regression results[Table 2.1,2.2,2.3] The R-squared value of 0.471 suggests that approximately 47.1% of the variance in the dependent variable is explained by the independent variables in the model. However, the adjusted R-squared, which penalizes for model complexity, drops to 0.279. This discrepancy suggests that some variables might not be as informative as we'd like, possibly introducing noise into the model.

The F-statistic is 2.457 with a probability of 0.00368. This indicates that the model is statistically significant at conventional levels (e.g., $p<0.05$), suggesting that at least one of the independent variables is a significant predictor of the dependent variable.

The coefficient for "Primary Education or less" is -0.3430 this indicates that for each 1 unit change in the Independent variable, the dependent variable changes by -0.3430. The p-value of 0.353 is greater than 0.05, this shows that the variable is not statistically significant and does not have significant or

relevant impact on the dependent variable. The negative coefficient suggests that lower education correlates with reduced digital payment usage, and the high p-value (>0.05) indicates that this is not statistically significant.

The coefficient for “Secondary Education or more” is 0.5070 this indicates that for each 1 unit change in the Independent variable, the dependent variable changes by 0.5070 . The p-value of 0.017 is less than 0.05 showing its statistical significance in its impact on the Dependent variable. This shows that the Dependent variable is highly affected by this Independent variable. This is statistically significant and indicates that higher education levels are positively associated with increased digital payment usage.

The coefficients for 'Lower middle income' and 'Upper middle income' are 0.0449 and 0.3397 with p-values of 0.438 and 0.004, respectively. Only 'Upper middle income' shows statistical significance, indicating that income levels do play a role in digital payment adoption.

The data supports the alternative hypothesis (*H*1) that educational level does influence the use of digital payments, particularly among those with secondary education or more. The study indicates that education level, particularly secondary or higher, is an essential factor in digital payment adoption, which in turn, plays a significant role in financial inclusion.

Based on the regression results, the alternative hypothesis (H1) proves to be true. Educational level, specifically secondary education or more, significantly influences the use of digital payments for online purchases among those with financial accounts in low-income countries.

**Interpretive Analysis and Critical Insights**

[Graph 2]The first visualization—centered on low-income countries—reveals a stark disparity in digital payment adoption between individuals with primary and secondary education. This finding is not merely a statistical observation; it is a critical social commentary that necessitates urgent policy intervention. Educational programs tailored to these demographics could serve as an effective bridge across this digital divide.

Similarly, the second visualization concerning upper-middle-income countries problematizes the overly simplistic narrative that economic affluence alone can foster digital financial inclusion. The data suggest that even in higher-income settings, education remains a pivotal determinant, cautioning policymakers against neglecting educational programs that enhance digital financial literacy.

The third visualization accentuates that educational attainment is not just a social variable but a critical underpinning for economic development. The statistically significant correlation between individuals with 'Secondary Education or More' and digital payment adoption strongly advocates for educational reforms that imbue digital financial literacy as a core curriculum component.

Lastly, the fourth visualization unveils the role of income, particularly in the upper middle-income bracket, as another significant determinant. While this may intuitively make sense, it warrants a nuanced policy response to ensure that digital payment systems do not exacerbate existing economic disparities.

### 8.2.3 Research Question 3: Is Age gap a crucial factor in the adoption of digital payments among internet users?

**Justification of Dataset Used:**

The dataset is purposefully designed to examine the influence of age on the adoption of digital payments, particularly divided into two age group, younger (15-24) and older (25+) categories. This specificity allows us to directly test our hypothesis, making it invaluable for our research question. Beyond age, the dataset incorporates variables like 'Year' and 'Country,' providing a temporal and geographical context The dataset not only enables us to explore age-specific trends in digital payment adoption but also to gauge the broader impact of these trends on financial inclusion, especially in the era of COVID-19.

**Hypothesis Testing:**

**Null Hypothesis (H0)**

$$\mathbf{H0: \beta 1 = \beta 2 = 0}$$

β1 and β2 represent the coefficients for the independent variables "Made or received a digital payment, young (% ages 15-24)" and "Made or received a digital payment, older (% age 25+)," respectively.

The null hypothesis posits that age does not significantly influence the adoption of digital payments among internet users. Mathematically, it asserts that the coefficients representing younger and older age groups in digital payment adoption *β*1 and *β2* are equal. In the context of the research question "Is the Age gap a crucial factor in the adoption of digital payments among internet users?", the null hypothesis essentially suggests that age is not a critical factor. This would mean that policies or initiatives aimed at increasing digital payment adoption need not focus on age-specific strategies

**Alternative Hypothesis ($H_1$):**

$$\boldsymbol{H1: \beta 1 \neq \beta 2 \neq 0}$$

Contrary to *H*0, the alternative hypothesis argues that age is a significant factor affecting digital payment adoption. Mathematically, this is represented by *β*young not being equal to *β*older. Within the scope of our research question, the alternative hypothesis indicates that the age gap could indeed be a crucial factor. If this hypothesis is confirmed, it would suggest that age-specific interventions could be more effective in promoting digital payment systems, thereby contributing to financial inclusion, particularly relevant in the context of G20 countries and the impact of COVID-19.

**Justification for Selected Variables:**

**Dependent Variable:**

**"Made or received a digital payment (% age 15+)"**

The dependent variable serves as a comprehensive measure of digital payment adoption among the general population aged 15 and above. This variable is not only quantitatively specific but also demographically broad, making it ideal for examining the influence of various factors like age, internet access, and geographical location. Its relevance is highlighted as it directly aligns with the core inquiry into digital payment adoption and its role in financial inclusion.

**Independent Variables**

**"Made or received a digital payment, young (% ages 15-24)":**

This variable allows the reader to delve deeper into the younger demographic, providing a nuanced understanding of how age influences digital payment adoption. Its specificity is crucial for testing the hypothesis that younger people are more inclined towards digital payments.

**"Made or received a digital payment, older (% age 25+)":**

As a counterpart to the first variable, this focuses on an older age group. The comparison between the younger and older groups will furnish insightful data on whether age plays a significant role, thereby directly answering our research question.

**"Has access to the internet (% age 15+)"**

Internet access serves as a foundational element for digital payments. Its inclusion controls for the basic infrastructure required for digital payment adoption, making the model more robust.

**Regression Model:**

$Y = \alpha + \beta1 * (\text{Young \% ages 15-24}) + \beta2 * (\text{Older \% age 25+}) + \beta3 * (\text{Internet Access}) + \varepsilon$

Here, *Y* represents the dependent variable, which is "Made or received a digital payment (% age 15+)."

In the regression model, *Y* represents the dependent variable, capturing the percentage of individuals aged 15+ who have made or received a digital payment. The coefficients $\beta1$ and $\beta2$ examine the impact of younger (ages 15-24) and older (age 25+) individuals on digital payment adoption, directly addressing the research question about age gap. $\beta3$ serves as a control for internet access, an essential infrastructure for digital payments. An error term $\epsilon$ is included to account for unexplained variability.

**Interpretation of Regression Results:**

From the regression result[Table 3.1,3.2,3.3]. The R-squared value of 1.000 is strikingly high, suggesting that the model explains 100% of the variance in the dependent variable. This could be an indicator of overfitting, as it's unusual for a model to capture all the variance in real-world data.

The F-statistic is 1.533e+04, with a very low probability of 1.70e-99. This indicates that the model is statistically significant, and at least one independent variable significantly predicts the dependent variable.

**Young (% ages 15-24)**: The coefficient for "Young (% ages 15-24)" is 0.1736 which suggests that if the Independent variable changes by 1 point the dependent variable will change by 0.1736 with a p-value of 0.000, indicating a statistically significant positive relationship between the younger age group and digital payment adoption.

**Older (% age 25+)**: The coefficient for "Older (% age 25+)" is 0.1736 which suggests that if the Independent variable changes by 1 point the dependent variable will change by 0.1736 with a p-value of 0.000, indicating a statistically significant positive relationship between the younger age group and digital payment adoption.

Based on these results, the null hypothesis($\mathbf{H_0}$)that younger internet users are more likely to adopt digital payments than older ones—doesn't hold. Both age groups significantly influence digital

payment adoption, but the impact is stronger for the older age group. Therefore, the alternative hypothesis($\mathbf{H_1}$) proves to be true.[Graph 3]

The Literature reveals that age is a significant factor in the adoption of digital payments, mainly due to lack of Financial Knowledge and access to and having the ability to use services, but contrary to popular belief, older individuals contribute even more and in fact is the significant contributor.

**Age Groups vs. Digital Payment Adoption:**

This bar chart illustrates the impact of different age groups on digital payment adoption. The chart should show two bars representing "Young (% ages 15-24)" and "Older (% age 25+)" with their respective coefficients from the regression results. This visualization highlights the significance of age in digital payment adoption.

**Trends Over Time:**

Create a line chart that demonstrates how digital payment adoption has evolved over the years (the "Year" variable). Include two lines or series, one for each age group, and show how adoption rates have changed annually. This visualization helps in understanding the temporal aspect of digital payment adoption.

**Comparing Age Groups by Coefficients:**

Create a grouped bar chart or a forest plot that directly compares the coefficients of the two age groups ("Young (% ages 15-24)" and "Older (% age 25+)"). This visualization provides a clear visual representation of how much each age group contributes to digital payment adoption, making it easier to understand the impact of age.

### 8.2.4 Research Question 4: Does financial stress due to COVID-19 influence the use of digital payments in G20 countries?

**Justification of Dataset Used:**

The dataset is gathered to explore the relation between financial stress induced by COVID-19 and the adoption of digital payments in G20 countries. It directly addresses the critical research question: "Does financial stress due to COVID-19 influence the use of digital payments?" by providing essential metrics such as the percentage of people adopting digital payments for the first time during the pandemic and those facing severe financial hardships. This dual focus allows for robust hypothesis testing, specifically challenging the thought whether financial stress has a significant impact on digital payment adoption. It serves as a comprehensive tool for understanding the complex relationship between economic stress factors and digital financial behaviours. The dataset is indispensable for this research, offering a nuanced view that could shape future financial inclusion policies, particularly in the digital realm.

**Hypothesis Testing:**

**Null Hypothesis ($\mathbf{H_0}$):**

Financial stress due to COVID-19 has a significant effect on the adoption of digital payments.

$$\mathbf{H_0 : \beta 1 \neq 0}$$

The null hypothesis posits that financial stress due to COVID-19 has a significant impact on the adoption of digital in-store payments among individuals aged 15 and above in G20 countries. It suggests that the coefficient for this financial stress variable (β1) in the regression equation is not zero, indicating that it significantly influences the dependent variable. The dependent variable in this case is the percentage of people who have "Made a digital in-store merchant payment for the first time after COVID-19 started."

**Alternative Hypothesis ($H_1$):**

Financial stress due to COVID-19 does not significantly affect the adoption of digital payments.

$$H1: \beta 1 = 0$$

The alternative hypothesis contends that financial stress due to COVID-19 has no meaningful impact on the rate of digital in-store payment adoption among individuals aged 15 and above in G20 countries. In essence, it suggests that β1 in the regression equation is equal to zero, meaning that the financial stress variable does not significantly affect the dependent variable.

**Justification for Selected Variables:**

**Dependent Variable:**

**"Made a digital in-store merchant payment for the first time after COVID-19 started (% who made a digital in-store payment (% age 15+)"**

The chosen dependent variable serves as a precise gauge for measuring the adoption of digital payments in the context of the COVID-19 pandemic. It captures the shift in consumer behaviour specifically triggered by the pandemic. This variable helps us understand how external factors like a global crisis can influence payment behaviours, thereby providing depth to the broader discussion on digital payments and financial inclusion.

**Independent Variable:**

**"Experience or continue to experience severe financial hardship as a result of the disruption caused by COVID-19: very worried (% age 15+)"**

This variable is critical for answering the research question because it directly measures the level of financial stress experienced due to COVID-19. The variable's focus on those who are "very worried" sharpens its relevance, providing a more nuanced understanding of the extent to which financial stress influences digital payment adoption. If a significant correlation is found between this independent variable and the dependent variable, it would substantiate the claim that financial stress is a significant driver for the adoption of digital payments.

**Regression Model:**

$$Y = \alpha + \beta 1 * X + \epsilon$$

Here, Y is the dependent variable, which measures the percentage of people aged 15 and above who have made a digital in-store merchant payment for the first time after COVID-19 started, and X represents the Independent variable explaining the Financial Hardship.

The α intercept provides the baseline level of digital in-store payment adoption when the independent variable is zero. The coefficient β1 represents the impact of experiencing severe financial hardship due

to COVID-19 on the likelihood of adopting digital in-store payments for the first time. A significant β1 would imply that those who are very worried about their financial situation due to the pandemic are more or less likely to adopt digital payments compared to the baseline. ϵ is the error term, accounting for other unobserved factors that might influence the dependent variable.

**Interpretation of Regression Results:**

From the regression result[Table 4.1,4.2,4.3] The R-square value of 0.923 suggests that approximately 92.3% of the variance in the dependent variable—percentage of people aged 15 and above who adopted digital in-store payments for the first time after COVID-19 started—is explained by the independent variables in the model. The adjusted R-square of 0.897, which accounts for model complexity, is also high. This indicates that the model is robust and fits the data well, capturing most of the variability in digital payment adoption.

The F-statistic is 35.38 with a probability close to zero ($p<0.0001$). This means that the model is statistically significant at conventional levels ($p<0.05$), suggesting that at least one of the independent variables is a significant predictor of the dependent variable.

**Experience or continue to experience severe financial hardship as a result of the disruption caused by COVID-19: very worried (% age 15+):**

The coefficient for this variable is $\beta1=0.7154$ with a p-value of 0.000. This indicates that for a 1 point increase in the Independent variable, the dependent variable increases by 0.7154. The low p-value indicates that this variable significantly Impacts the Rate of Digital Payment Adoption. The high t-statistic value indicates that it very unlikely that the coefficient for the Independent variable is 0, suggesting that the dependent variable is significantly impacted by the Independent variable. This is statistically significant and indicates that experiencing financial stress due to COVID-19 has a substantial positive impact on the rate of digital payment adoption.

**Hypothesis Testing:**

Based on the regression results, the null hypothesis $H_0$ that stated "financial stress due to COVID-19 has a significant impact on the adoption of digital payments" proves to be true. The coefficient for the financial stress variable is significant, and its magnitude suggests that for each unit increase in the percentage of people who are "very worried" due to financial hardship from COVID-19, there is an associated increase of approximately 0.7154 units in the percentage of people who adopt digital payments for the first time.

**Data Insights:**

**Methodological Considerations**

The visualization[Graph 4] was generated using a scatter plot to represent the relationship between the dependent variable—"Percentage of individuals aged 15 and above who made a digital in-store payment for the first time after COVID-19 started"—and the independent variable—"Percentage of individuals aged 15 and above who are very worried due to severe financial hardship caused by COVID-19." Each point on the scatter plot represents a specific country, and the plot was created using data specifically from the year 2021 to focus on the impact of the COVID-19 pandemic.[Graph 4]

The visualization reveals a positive relationship between financial stress due to COVID-19 and the adoption of digital payments. This is not just a statistical correlation but a powerful insight into human behaviour under financial stress. People are more likely to adopt digital payments when they are

financially stressed, possibly due to the convenience, safety, and potential savings associated with digital transactions.

It suggests that financial inclusion policies should not merely focus on long-term objectives but also consider immediate responses to crises that could catalyse behavioural change. For example, a government could incentivize digital payments during an economic crisis by offering tax breaks or cash-back offers for digital transactions. Such a strategy could accelerate the adoption of digital payments and make the financial system more resilient to shocks.

# 9. Discussion of Findings

## 9.1 Interpretation of Regression Results:

**Research Question 1:**

The regression model for this question shows an impressive R2 value of 0.902, suggesting that approximately 90.2% of the variance in financial inclusion can be accounted for by the model. The predictors "Made a digital payment (% age 15+)" and "Has access to the internet (% age 15+)" were statistically significant, supporting the hypothesis that financial inclusion is higher in countries where digital payments and Internet access are more prevalent. However, the model also indicates that country-specific factors and income levels are crucial. For example, 'Australia,' 'Brazil,' and 'China' show significant coefficients, indicating that these countries have specific characteristics influencing financial inclusion beyond digital payments and internet access.

**Research Question 2:**

For this question, the R2 value is 0.471, which is comparatively lower than the first model. This suggests that the model explains about 47.1% of the variance in the use of digital payments for online purchases among those with financial accounts in low-income countries. Interestingly, "Used a mobile phone or the internet to buy something online, secondary education or more (% ages 15+)" was found to be statistically significant, indicating that education level does have a role in the adoption of digital payments. However, the model's lower R2 and the non-significance of primary education suggest that other factors might be at play, warranting further investigation.

**Research Question 3:**

This model boasts an R2 value of 1.000, which is unusually high and may indicate overfitting or multicollinearity, as nearly all the real-world phenomena have some level of unexplained variance. The predictors related to age ("Made or received a digital payment, young (% ages 15-24)" and "Made or received a digital payment, older (% age 25+)") are highly significant, supporting the idea that age plays a crucial role in the adoption of digital payments. However, the unrealistically high R2 value should be scrutinized further for potential issues in the model.

**Research Question 4:**

The R2 value for this question is 0.923, indicating that the model explains 92.3% of the variance in the use of digital payments due to COVID-19 in G20 countries. The predictor "Experience or continue to experience severe financial hardship as a result of the disruption caused by COVID-19: very worried (% age 15+)" was highly significant, suggesting that financial stress due to COVID-19 has a notable influence on the adoption of digital payments. However, the coefficients for most countries were not significant, implying that the impact of financial stress is relatively uniform across these countries, or that country-specific factors were not adequately captured.

# 10. Conclusion:

## 10.1 Summary of Aims, Methodology and Findings

The purpose of this research was to thoroughly examine the development of digital payment usage in G20 countries and its effect on financial inclusion, with a particular focus on the transformative impact of the COVID-19 pandemic. This study utilizes a positivism paradigm and leverages quantitative methods, utilizing a vast dataset from the World Bank and the International Monetary Fund that includes surveys from 2011 to 2021 across 148 countries. Employing a methodology rooted in Regression Analysis and executed via Python, the study aims to achieve four key objectives: exploring the correlation between digital payment prevalence and internet access on financial inclusion, analyzing the influence of educational levels on digital payment adoption, investigating age-related trends in digital payment usage, and understanding the pandemic's impact on financial behaviors. The findings, based on Ordinary Least Squares (OLS) regression models, reveal significant relationships across these dimensions, providing a nuanced understanding of how digital payment systems contribute to financial inclusion in diverse contexts.

## 10.2 Implications of Findings

The research findings have far-reaching implications for both policy-makers and industry stakeholders, highlighting the critical role of internet access, education, and age in the adoption of digital payments. The strong positive correlation between internet access and digital payment adoption suggests an urgent need for policy interventions to bolster digital infrastructure, especially in financially underserved communities. Similarly, the influence of education levels on digital payment usage calls for educational initiatives aimed at increasing financial literacy, which can help in broader financial inclusion. The age disparity in the adoption of digital payments points to the necessity of tailoring digital financial services to the specific needs and limitations of different age groups. Finally, the surge in digital payments during stressful times like the COVID-19 pandemic underscores the system's resilience and adaptability, advocating for its robustness in crisis management plans. Taken together, these findings provide a comprehensive roadmap for targeted efforts to promote financial inclusion through digital payment systems.

## 10.3 Ethical Issues Surrounding the Research

The Research’s Ethical Considerations were kept at the forefront while generating Insights. During this process, extra care was taken to avoid any ambiguity related to Transparency and thus all qualitative and quantitative data was properly referenced. Effort was made to genuinely explain the interpretation of the various authors keeping in mind the Original Context of the different authors. Handling of data was done with utmost care and emphasis was targeted towards ensuring Integrity of the Data remains Intact.

## 10.4 Limitations of Research Findings

The Insights provided some real perspective on how Digital Payments and Financial Inclusion are related and despite this effort the research comes with Limitations of its own. The process of selecting only a handful of variables to determine the outcome can’t be justified completely, as There can be some variable which Is not considered but can prove to have a significant impact. The Original Dataset was vast and hence, relevant columns needed to be extracted and processed, this is because the raw data was unclean in the first place. Using such a data set might result in Incorrect analysis. While we selected 20 countries to be part of our analysis, originally there are 148. This shows that analysis was done on a single subset of countries. This limits the scope as there are countries who have implemented Digital Payments and are not included in the G20.

## 10.5 Recommendations for Future area of study:

The Research has provided some valuable insights into the various factors affecting Digital Payment adoption and its consequent effect on Financial Inclusion. Through the Research the Author has Identified Future Research Scopes for an even more in-depth Analysis.

1) Future Research can delve deeper into analysing the Rural/urban divide and its Impact of Digital Payments on Financial Inclusion.
2) Future Research can study the Government regulations and how it can Impact Digital Payment Adoption.
3) As digital Payments become increasingly popular, the need for Cybersecurity algorithms has become Increasingly Important.
4) Most studies focus on Global Economies, however smaller nations have proven to be quite adaptable and hence research on this topic is of paramount importance
5) Further Marginalized groups can be designed and modified to be more inclusive towards Marginalised population.

# 11. Appendix

## 11.1 Tables:

### 9.1.1 Dataset 1:

**Table 1:** Regression description for Dataset 1

| |
|---|
| Dependent Variable: Financial institution account (% age 15+) |
| Method: Least Squares |
| Date: 08/16/23 Time: 23:11 |
| Sample: 80 |
| Included observations: 58 |

**Table 2:** OLS Regression results for Dataset 1

| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **P-value** |
|---|---|---|---|---|
| A | 0.7256 | 0.019 | 38.206 | 0.000 |
| Made a digital payment (% age 15+) | 0.1070 | 0.032 | 3.391 | 0.001 |
| Has access to the internet (% age 15+) | 0.0700 | 0.029 | 2.428 | 0.018 |

**Table 3:** OLS Regression descriptive statistics for Dataset 1

| | |
|---|---|
| **R-squared** | 0.902 |
| **Adjusted R-squared** | 0.866 |
| **F-statistic** | 25.36 |
| **Prob(F-statistic)** | 7.47e-22 |
| **Mean dependent var** | 0.780 |
| **S.D. dependent var** | 0.222 |
| **Sum of Squared Residuals** | 3.890 |
| **Durbin-Watson stat** | 1.829 |

9.1.2 Dataset 2:

**Table 1:** Regression description for Dataset 2

| |
|---|
| Dependent Variable: Made a digital online payment for an online purchase (% of internet purchasers, age 15+) |
| Method: Least Squares |
| Date: 08/17/23 Time: 12:41 |
| Sample: 80 |
| Included observations: 58 |

**Table 2:** OLS Regression results for Dataset 2

| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **P-value** |
|---|---|---|---|---|
| A | -0.0637 | 0.040 | -1.590 | 0.117 |
| Used a mobile phone or the internet to buy something online, primary education or less (% ages 15+) | -0.3430 | 0.366 | -0.937 | 0.353 |
| Used a mobile phone or the internet to buy something online, secondary education or more (% ages 15+) | 0.5070 | 0.207 | 2.454 | 0.017 |
| Lower middle income | 0.0449 | 0.058 | 0.780 | 0.438 |
| Upper middle income | 0.3397 | 0.114 | 2.988 | 0.004 |

**Table 3:** OLS Regression descriptive statistics for Dataset 2

| | |
|---|---|
| **R-squared** | 0.471 |
| **Adjusted R-squared** | 0.279 |
| **F-statistic** | 2.457 |
| **Prob(F-statistic)** | 0.00368 |
| **Mean dependent var** | 0.117 |
| **S.D. dependent var** | 0.274 |
| **Sum squared resid** | 5.942 |
| **Durbin-Watson stat** | 1.631 |

9.1.3 Dataset 3

**Table 1:** Regression description for Dataset 3

| |
|---|
| Dependent Variable: Made or received a digital payment (% age 15+) |
| Method: Least Squares |
| Date: 08/17/23 Time: 19:28 |
| Sample: 80 |
| Included observations: 57 |

**Table 2:** OLS Regression results for Dataset 3

| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **P-value** |
|---|---|---|---|---|
| A | -0.0047 | 0.003 | -1.528 | 0.132 |
| Made or received a digital payment, young (% ages 15-24) | 0.1736 | 0.011 | 15.585 | 0.000 |
| Made or received a digital payment, older (% age 25+) | 0.8286 | 0.009 | 88.855 | 0.000 |
| Has access to the internet (% age 15+) | -0.0003 | 0.003 | -0.116 | 0.908 |

**Table 3:** OLS Regression descriptive statistics for Dataset 3

| | |
|---|---|
| **R-squared** | 1.000 |
| **Adjusted R-squared** | 1.000 |
| **F-statistic** | 1.533e+04 |
| **Prob(F-statistic)** | 1.70e-99 |
| **Mean dependent var** | 0.556 |
| **S.D. dependent var** | 0.385 |
| **Sum of squared residuals** | 11.725 |
| **Durbin-Watson stat** | 2.601 |

9.1.4 Dataset 4:

**Table 1:** Regression description for Dataset 4

| |
|---|
| Dependent Variable: Made a digital in-store merchant payment for the first time after COVID-19 started (% who made a digital in-store payment (% age 15+) |
| Method: Least Squares |
| Date: 08/18/23 Time: 13:25 |
| Sample: 80 |
| Included observations: 59 |

**Table 2:** OLS Regression results for Dataset 4

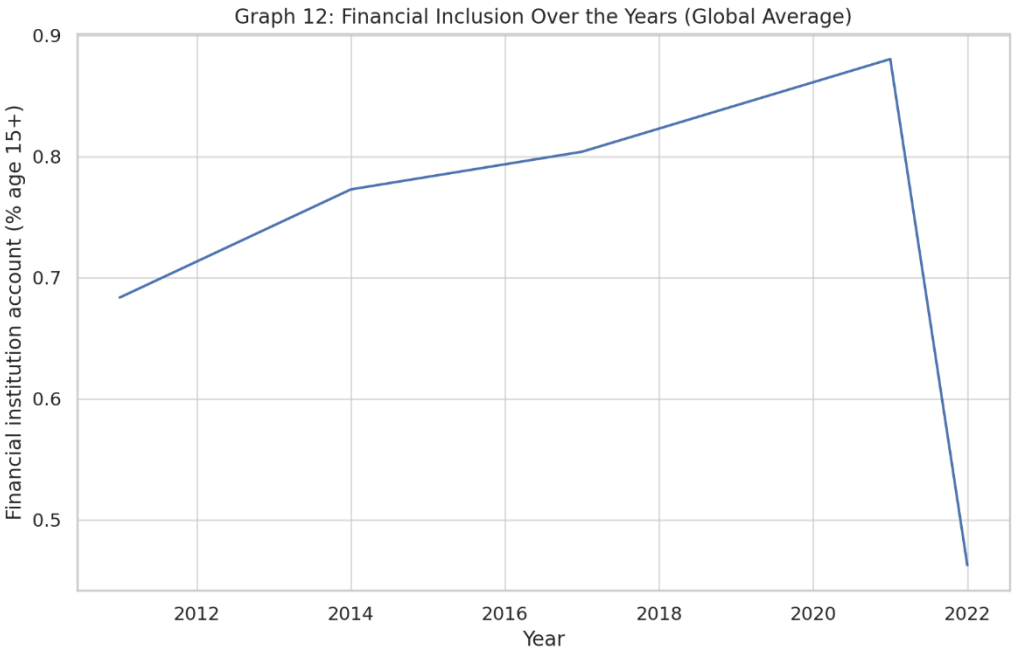
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **P-value** |
|---|---|---|---|---|
| A | 0.0044 | 0.021 | 0.211 | 0.833 |
| Experience or continue to experience severe financial hardship as a result of the disruption caused by COVID-19: very worried (% age 15+) | 0.7154 | 0.030 | 23.870 | 0.000 |

**Table 3:** OLS Regression descriptive statistics for Dataset 4

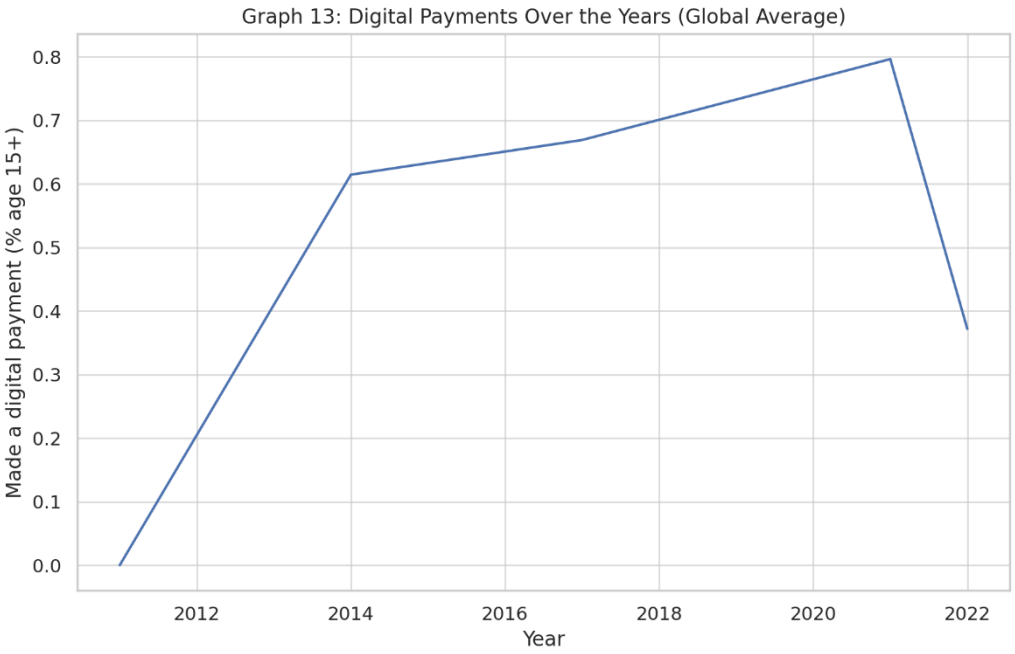
| | |
|---|---|
| **R-squared** | 0.923 |
| **Adjusted R-squared** | 0.897 |
| **F-statistic** | 35.38 |
| **Prob(F-statistic)** | 1.29e-25 |
| **Mean dependent var** | 0.039 |
| **S.D. dependent var** | 0.129 |
| **Sum of Squared Residuals** | 1.313 |
| **Durbin-Watson stat** | 2.236 |

## 11.3 Figures/Graphs:

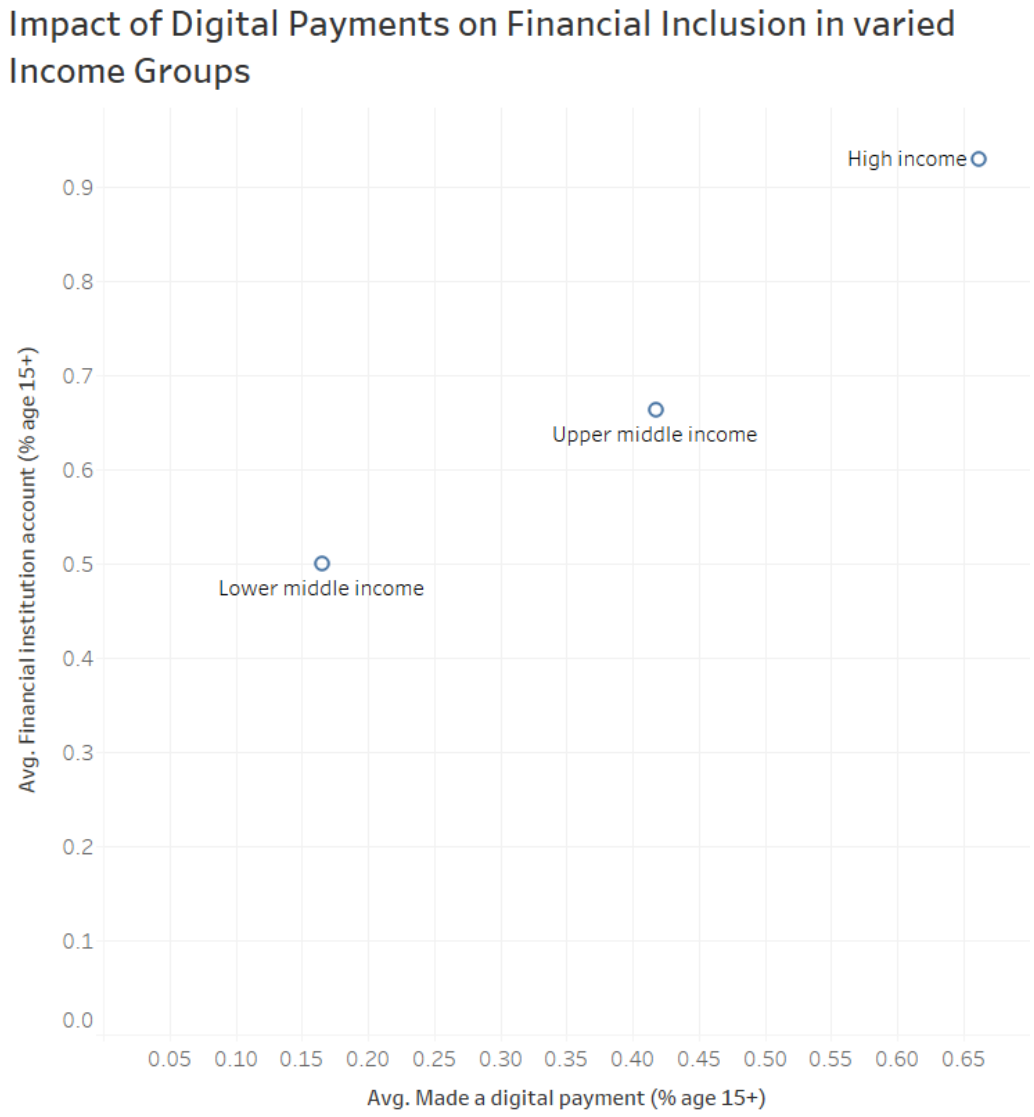
**Dataset 1:**




**Graph 1.1: Global Average of Financial Inclusion over the years**
**Author: Aditya Chavan. Data Visualization Created in Tableau**



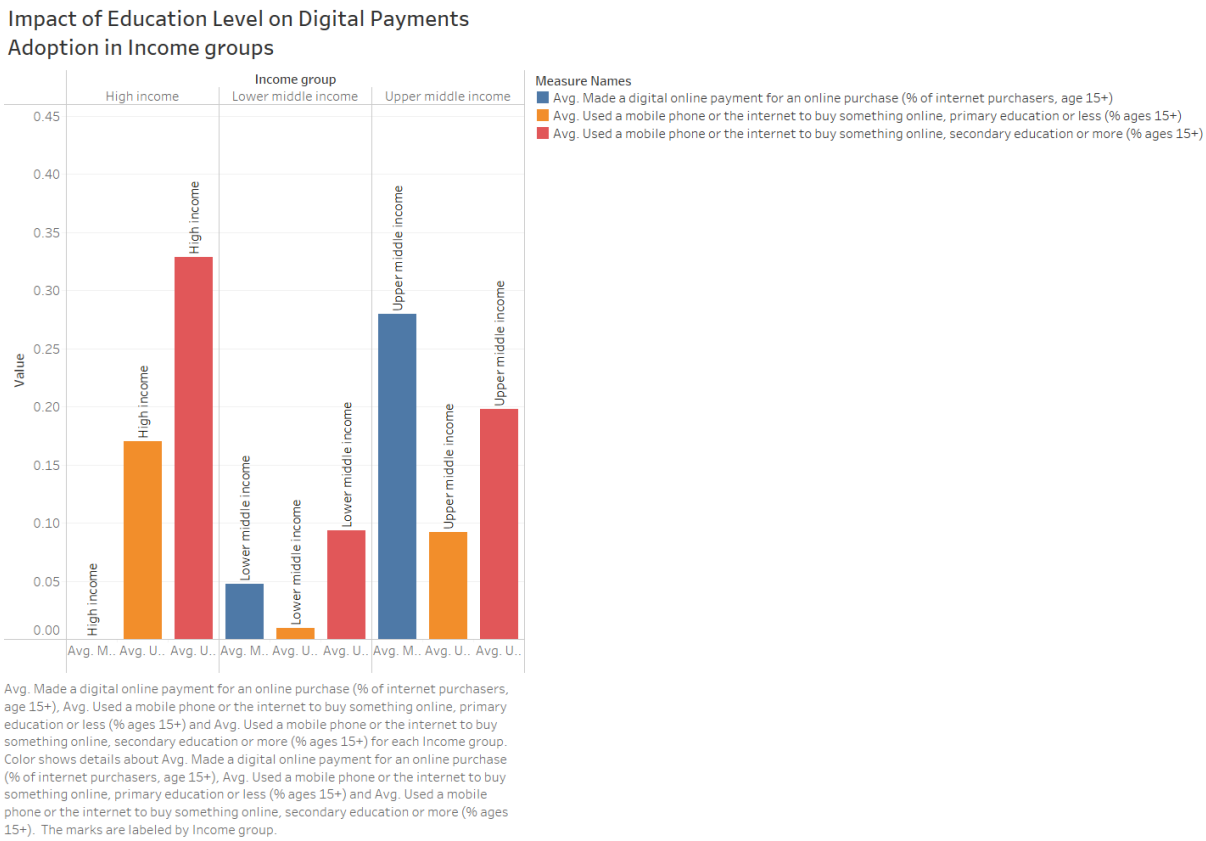

**Graph 1.2: Global Average of Digital Payments Made over the years**
**Author: Aditya Chavan. Data Visualization Created in Tableau**




**Graph 1.3: Impact of Digital Payments on Financial Inclusion in varied Income Groups**

**Author: Aditya Chavan. Data Visualization Created in Tableau**

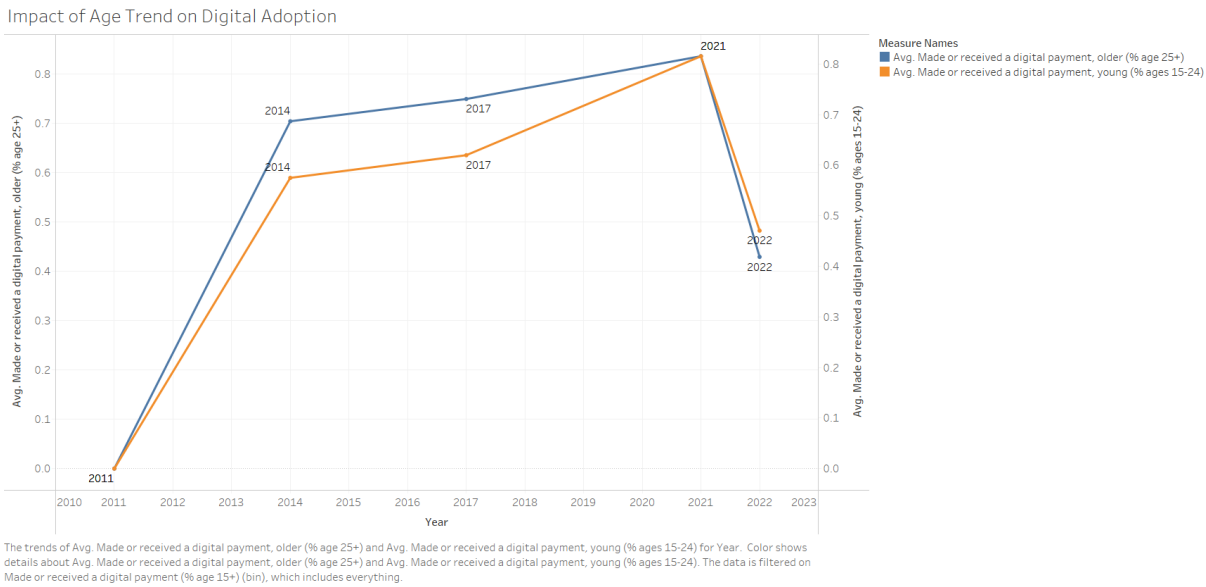
## Dataset 2:




**Graph 2: Impact of Education Level on Digital Payments Adoption in Income groups**

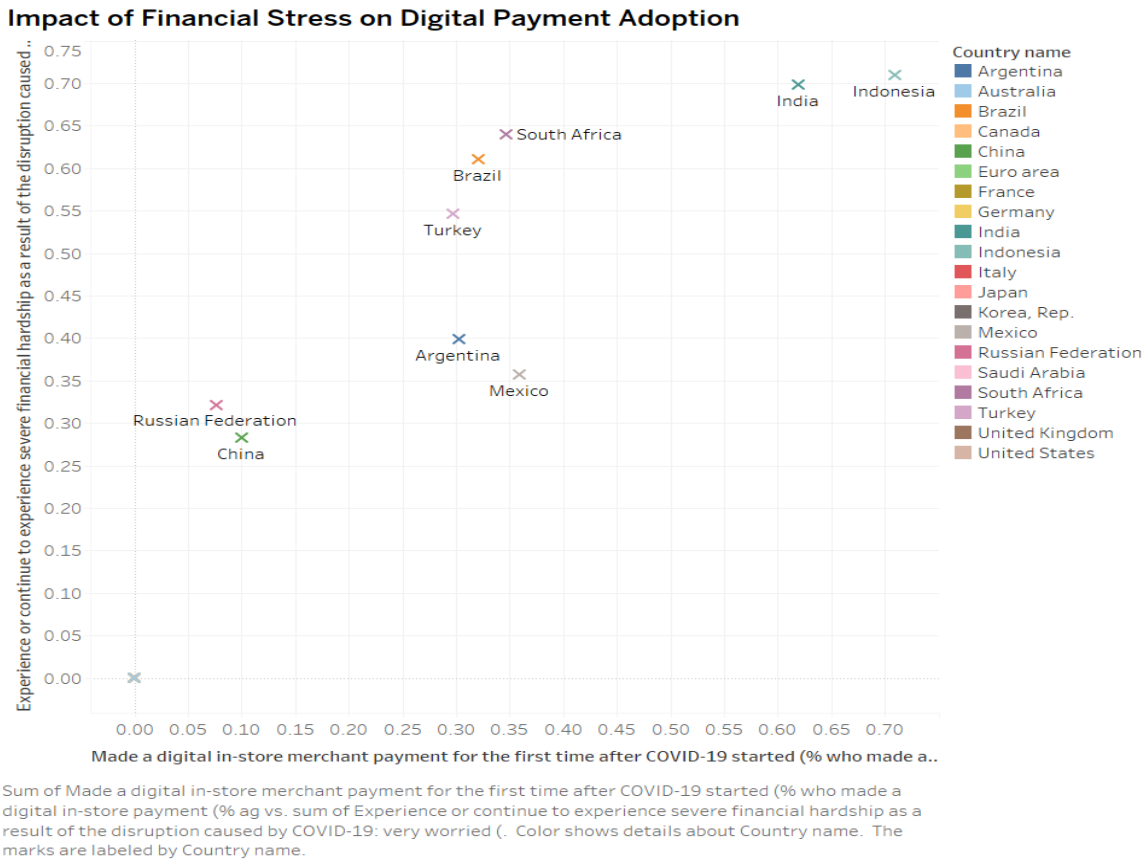
**Author: Aditya Chavan. Data Visualization Created in Tableau**

## Dataset 3:



**Graph 3: Age trend for Digital Payment Adoption**
**Author: Aditya Chavan. Data Visualization Created in Tableau**

**Dataset 4:**




**Graph 4: Impact of Financial Stress on Digital Payments Adoption**
**Author: Aditya Chavan. Data Visualization Created in Tableau**

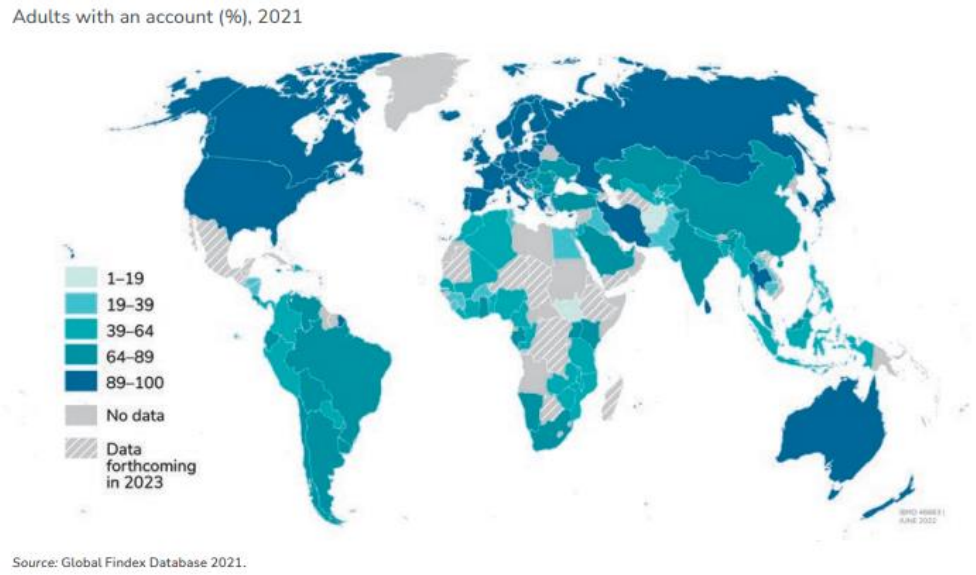



**Figure 1: Account ownership.**

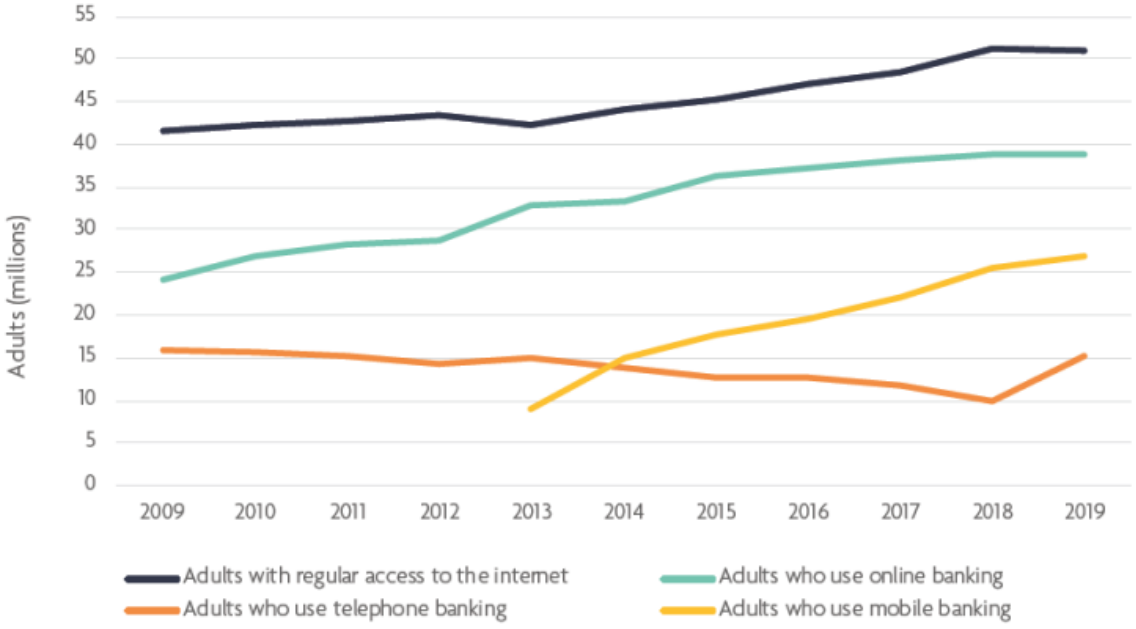



**Figure 2: Internet users and accessibility**

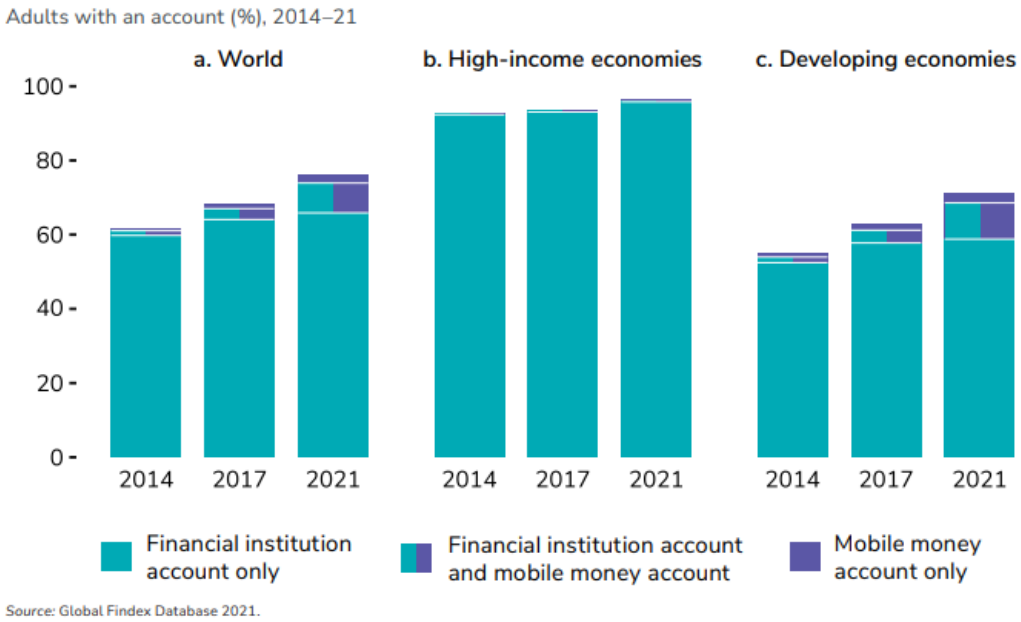
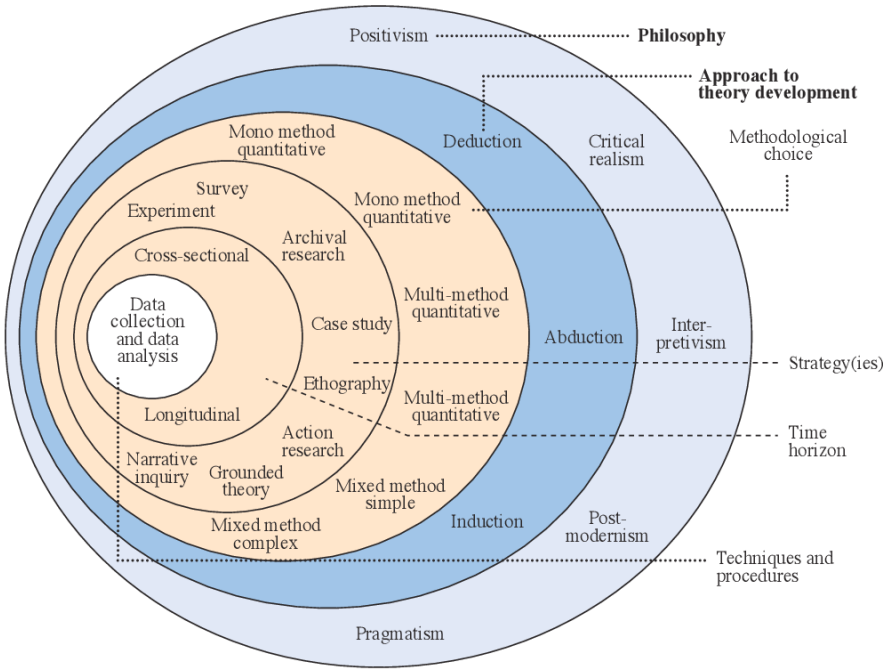



**Figure 3: Mobile Money Accounts**




*e 1*. Research onion[1]

**Figure 4: Onion research Model**

| | Dispute protections | Protection against fraud | Protection against technical errors | Protections against insolvency, including retailer insolvency or bank failure |
|---|---|---|---|---|
| CHAPS | Consumer Rights Act<br>Consumer Contracts Regulations (replaced Distance selling Regulations) | Confirmation of Payee name checks help prevent fraud (where implemented)<br>Autorise Push Payments Scams – Contingent Reimbursement Model Voluntary Code<br>Unauthorised payment protection (PSD2) | Customer error – Credit Payment Recovery (CPR).<br>Confirmation of Payee name checks help prevent errors (where implemented) | Financial Services Compensation Scheme (FSCS) (bank failure)<br>The UK Banking Act (bank failure) |
| Open Banking | Consumer Rights Act<br>Consumer Contracts Regulations (replaced Distance selling Regulations) | Unauthorised payment protection (PSD2)<br>Strong Customer Authentication (SCA)<br>Confirmation of Payee name checks help prevent fraud (where implemented) | OBIE payment reversal proposals<br>Confirmation of Payee name checks help prevent errors (where implemented) | Safeguarding under PSD2 provisions |
| SEPA | SEPA batch offered "R" processing that enables refund, reject, recall and return processes on the payment | Will depend on individual PSPs and their jurisdiction | SEPA Direct Debits refunds procedure similar to Direct Debit Guarantee but time limited | Will depend on individual PSPs and their jurisdiction |

**Figure 5: Fraud, Disputes and Technical errors**


**Figure 6: Overview of Payments and its use**

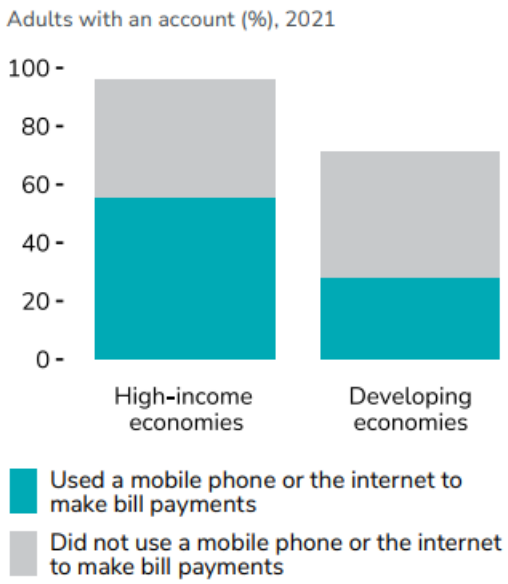



**Figure 7:Method used to make Bill Payments**

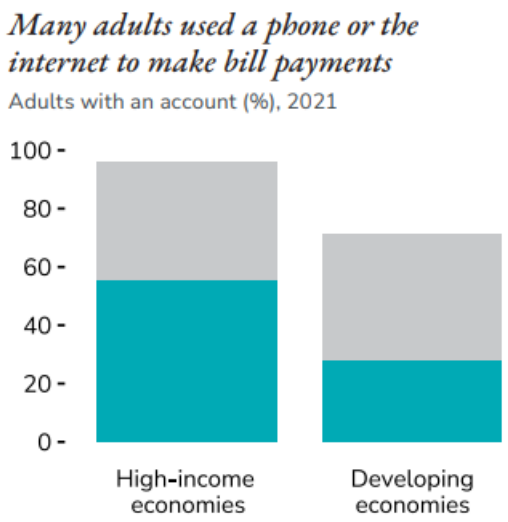



**Figure 8: Number of Adults using a Phone to make Bill payments. Source: Global Findex Report 2021**

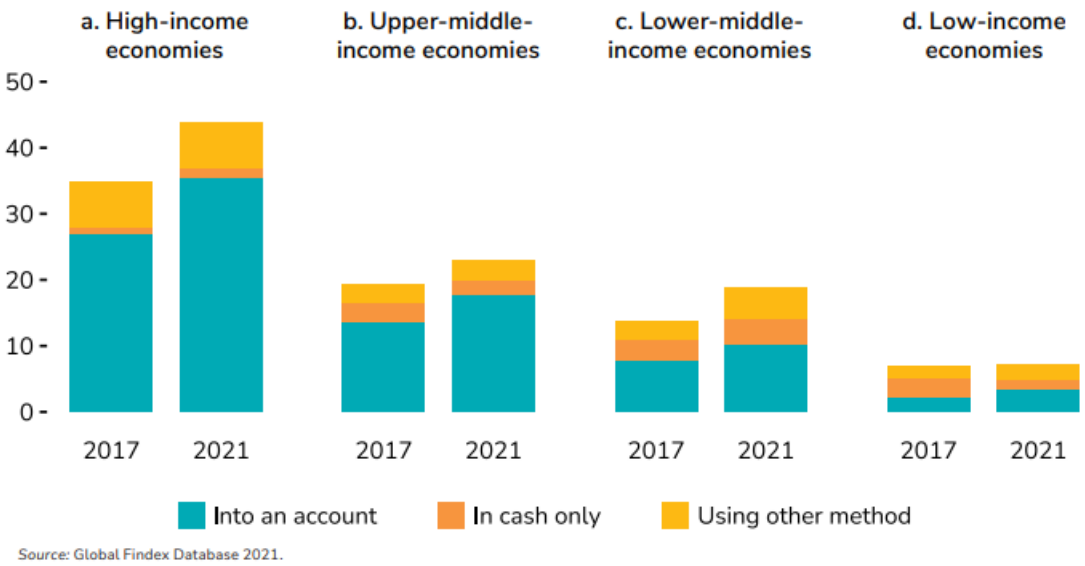



**Figure 9: Distribution of Payment Method in Various Economy Classes. Source: Global Findex Report 2021**

## 11.4 Python Codes:

All codes have been duly created by the Author of this report: Aditya Chavan.

The codes are made in Google Colaboratory.

Note: Original Global Findex file must be uploaded first to Test the code.

### 9.4.1 Python Code for Data Cleaning and Regression Analysis:

**Research Question 1:** "Is financial inclusion significantly higher in Countries where digital payments and Internet Access are more prevalent?"

```
"""Original file is located at
    https://colab.research.google.com/drive/1Y26k3C0KRmCXa-PL_5eGCAVzQrWJ-8EB
"""

import pandas as pd

# Load the Global Findex Excel file to read the data

global_findex_df = pd.read_excel('/content/Global Findex.xlsx', dtype=str)


# Filter the DataFrame based on specific columns and country names related to Research Question 1

filtered_df = global_findex_df[[

    'Country name',
```

```
    'Year',
    'Adult population',
    'Income group',
    'Financial institution account (% age 15+)',
    'Has access to the internet (% age 15+)',
    'Made a digital payment (% age 15+)'
]]

# Filter based on specific countries, In our Case G20 nations
countries_to_keep = ['United States', 'China', 'India', 'Germany', 'United Kingdom',
                     'France', 'Brazil', 'Italy', 'Canada', 'Australia',
                     'Russian Federation', 'Mexico', 'Korea, Rep.', 'Indonesia', 'Turkey',
                     'Saudi Arabia', 'Argentina', 'South Africa', 'Japan', 'Euro area']

#Python command to Filter columns
filtered_df = filtered_df[filtered_df['Country name'].isin(countries_to_keep)]

# Save the resulting DataFrame to a new Excel file
filtered_df.to_excel('RQ1_processed.xlsx', index=False)
# Read the newley generated processed data file
df = pd.read_excel('/content/RQ1_processed.xlsx', engine='openpyxl')

# Drop unnamed columns to avoid inconsitencies
df = df.loc[:, ~df.columns.str.contains('^Unnamed')]

# Replace NaN values with '0%' in columns ending with '%'
for col in df.columns:
    if col.endswith("% age 15+") or col.endswith("% of population age 15+)"):
        df[col].fillna('0%', inplace=True)

# Convert the string percentages to float in columns ending with '%'
for col in df.columns:
```

```
    if col.endswith("% age 15+") or col.endswith("% of population age 15+)"):
        df[col] = df[col].str.rstrip('%').astype('float')

# Replace NaN values with float 0 in the last 3 columns
last_three_cols = df.columns[-3:]
df[last_three_cols] = df[last_three_cols].fillna(0.0)

# Save the processed DataFrame as a new Excel file
df.to_excel('RQ11.xlsx', index=False, engine='openpyxl')

# Import statsmodel Library for Statistical Analysis
import statsmodels.api as sm
# Load the processed data from Excel
df = pd.read_excel('/content/RQ11.xlsx')
# Separate dependent and independent variables
Y = df['Financial institution account (% age 15+)']
X = df[['Made a digital payment (% age 15+)', 'Has access to the internet (% age 15+)']]

# Create dummy variables for country and income group
country_dummies = pd.get_dummies(df['Country name'], drop_first=True)
income_dummies = pd.get_dummies(df['Income group'], drop_first=True)

# Add dummy variables to independent variables
X = pd.concat([X, country_dummies, income_dummies], axis=1)

# Save DataFrame with dummy variables to a new Excel file
X.to_excel('RQ11Dummy.xlsx', index=False)

# Add constant term to independent variables (necessary for statsmodels)
X = sm.add_constant(X)

# Create OLS Regression model
```

```
model = sm.OLS(Y, X)


# Fit the model
result = model.fit()


# Get summary statistics
summary = result.summary()
print(summary)
```

### 9.4.2 Python Code for Data Cleaning and Regression Analysis:

**Research Question 2: “”**

```
"""
Original file is located at
https://colab.research.google.com/drive/1oXY7PjI0Ud8kShdgsWv6-jSl6neiD8vA
"""
import pandas as pd
# Load the Global Findex Excel file
global_findex_df = pd.read_excel('/content/Global Findex.xlsx', dtype=str)
# Filter the DataFrame based on specific columns and country names
filtered_df = global_findex_df[[
    'Country name',
    'Year',
    'Adult population',
    'Income group',
    'Financial institution account (% age 15+)',
    'Made a digital online payment for an online purchase (% of internet purchasers, age 15+)',
    'Used a mobile phone or the internet to buy something online, primary education or less (% ages 15+)',
    'Used a mobile phone or the internet to buy something online, secondary education or more (% ages 15+)'
]]


# Filtering the data to include specific countries
```

```
countries_to_keep = ['United States', 'China', 'India', 'Germany', 'United Kingdom',
                     'France', 'Brazil', 'Italy', 'Canada', 'Australia',
                     'Russian Federation', 'Mexico', 'Korea, Rep.', 'Indonesia', 'Turkey',
                     'Saudi Arabia', 'Argentina', 'South Africa', 'Japan', 'Euro area']

filtered_df = filtered_df[filtered_df['Country name'].isin(countries_to_keep)]

# Save the resulting DataFrame to a new Excel file
filtered_df.to_excel('RQ2_processed.xlsx', index=False)

# Read the original Excel file
df = pd.read_excel('/content/RQ2_processed.xlsx', engine='openpyxl')

# Drop unnamed columns
df = df.loc[:, ~df.columns.str.contains('^Unnamed')]

# Replace NaN values with '0%' in columns ending with '%'
for col in df.columns:
    if col.endswith("% age 15+") or col.endswith("% ages 15+"):
        df[col].fillna('0%', inplace=True)

# Convert the string percentages to float in columns ending with '%'
for col in df.columns:
    if col.endswith("% age 15+") or col.endswith("% ages 15+"):
        df[col] = df[col].str.rstrip('%').astype('float')

# Replace NaN values with float 0 in the last 3 columns
last_three_cols = df.columns[-3:]
df[last_three_cols] = df[last_three_cols].fillna(0.0)

# Save the processed DataFrame as a new Excel file
df.to_excel('RQ21.xlsx', index=False, engine='openpyxl')
```

```
# Import required libraries
import statsmodels.api as sm

# Load the processed data from Excel
df = pd.read_excel('/content/RQ21.xlsx')

# Separate dependent and independent variables
Y = df['Made a digital online payment for an online purchase (% of internet purchasers, age 15+)']
X = df[['Used a mobile phone or the internet to buy something online, primary education or less (% ages 15+)', 'Used a mobile phone or the internet to buy something online, secondary education or more (% ages 15+)']]

# Create dummy variables for country and income group
country_dummies = pd.get_dummies(df['Country name'], drop_first=True)
income_dummies = pd.get_dummies(df['Income group'], drop_first=True)

# Add dummy variables to independent variables
X = pd.concat([X, country_dummies, income_dummies], axis=1)
# Save DataFrame with dummy variables to a new Excel file
X.to_excel('RQ21Dummy.xlsx', index=False)

# Add constant term to independent variables (necessary for statsmodels)
X = sm.add_constant(X)

# Create OLS model
model = sm.OLS(Y, X)

# Fit the model
result = model.fit()
# Get summary statistics
summary = result.summary()
print(summary)
```

9.4.3 Python Code for Data Cleaning and Regression Analysis:

**Research Question: “”**

```
"""
Automatically generated by Colaboratory.
Original file is located at
https://colab.research.google.com/drive/1czCAcxsR8KiNU4BW2ez4Xchl1dDr-VLs
"""
#Importing the pandas library for Data Processing
import pandas as pd

# Load the Global Findex Excel file
global_findex_df = pd.read_excel('/content/Global Findex.xlsx', dtype=str)

# Filter the DataFrame based on specific columns and country names
filtered_df = global_findex_df[[
   'Country name',
   'Year',
   'Adult population',
   'Financial institution account (% age 15+)',
   'Has access to the internet (% age 15+)',
   'Made or received a digital payment (% age 15+)',
   'Made or received a digital payment, young (% ages 15-24)',
   'Made or received a digital payment, older (% age 25+)'
]]

# Filter based on specific countries
countries_to_keep = ['United States', 'China', 'India', 'Germany', 'United Kingdom',
                     'France', 'Brazil', 'Italy', 'Canada', 'Australia',
                     'Russian Federation', 'Mexico', 'Korea, Rep.', 'Indonesia', 'Turkey',
                     'Saudi Arabia', 'Argentina', 'South Africa', 'Japan', 'Euro area']

filtered_df = filtered_df[filtered_df['Country name'].isin(countries_to_keep)]
```

```
# Save the resulting DataFrame to a new Excel file
filtered_df.to_excel('RQ3_processed.xlsx', index=False)

# Read the original Excel file
df = pd.read_excel('/content/RQ3_processed.xlsx', engine='openpyxl')

# Drop unnamed columns
df = df.loc[:, ~df.columns.str.contains('^Unnamed')]

# Replace NaN values with '0%' in columns ending with '%'
for col in df.columns:
    if col.endswith("% age 15+") or col.endswith("% ages 15-24") or col.endswith("% age 25+"):
        df[col].fillna('0%', inplace=True)

# Convert the string percentages to float in columns ending with '%'
for col in df.columns:
    if col.endswith("% age 15+") or col.endswith("% ages 15-24") or col.endswith("% age 25+"):
        df[col] = df[col].str.rstrip('%').astype('float')

# Replace NaN values with float 0 in the last 3 columns
last_four_cols = df.columns[-4:]
df[last_four_cols] = df[last_four_cols].fillna(0.0)

# Save the processed DataFrame as a new Excel file
df.to_excel('RQ31.xlsx', index=False, engine='openpyxl')

# Import required libraries
import statsmodels.api as sm

# Load the processed data from Excel
df = pd.read_excel('/content/RQ31.xlsx')
```

```
# Separate dependent and independent variables
Y = df['Made or received a digital payment (% age 15+)']
X = df[['Has access to the internet (% age 15+)', 'Made or received a digital payment, young (% ages 15-24)',
    'Made or received a digital payment, older (% age 25+)']]

# Create dummy variables for country and income group
country_dummies = pd.get_dummies(df['Country name'], drop_first=True)

# Add dummy variables to independent variables
X = pd.concat([X, country_dummies], axis=1)

# Save DataFrame with dummy variables to a new Excel file
X.to_excel('RQ31Dummy.xlsx', index=False)

# Add constant term to independent variables (necessary for statsmodels)
X = sm.add_constant(X)

# Create OLS model
model = sm.OLS(Y, X)

# Fit the model
result = model.fit()

# Get summary statistics
summary = result.summary()
print(summary)
```

9.4.4 Python Code for Data Cleaning and Regression Analysis 4:

**Research Question 4: "**Does financial stress due to COVID-19 influence the use of digital payments in G20 countries?**"**

```
"""

Automatically generated by Colaboratory.

Original file is located at

https://colab.research.google.com/drive/1k5RNt1lfGgRRslilIWJZH_0ijCdgP0Cr

"""

#import the pandas module for Data Preparation

import pandas as pd


# Load the Global Findex Excel file

global_findex_df = pd.read_excel('/content/Global Findex.xlsx', dtype=str)


# Filter the DataFrame based on specific columns and country names

filtered_df = global_findex_df[[

   'Country name',

   'Year',

   'Adult population',

   'Financial institution account (% age 15+)',

   'Made a digital in-store merchant payment for the first time after COVID-19 started (% who made a digital in-store payment (% age 15+)',

   'Experience or continue to experience severe financial hardship as a result of the disruption caused by COVID-19: very worried (% age 15+)'

]]


# Filter based on specific countries

countries_to_keep = ['United States', 'China', 'India', 'Germany', 'United Kingdom',

                     'France', 'Brazil', 'Italy', 'Canada', 'Australia',

                     'Russian Federation', 'Mexico', 'Korea, Rep.', 'Indonesia', 'Turkey',

                     'Saudi Arabia', 'Argentina', 'South Africa', 'Japan', 'Euro area']


filtered_df = filtered_df[filtered_df['Country name'].isin(countries_to_keep)]
```

```
# Save the resulting DataFrame to a new Excel file
filtered_df.to_excel('RQ4_processed.xlsx', index=False)

# Read the original Excel file
df = pd.read_excel('/content/RQ4_processed.xlsx', engine='openpyxl')

# Drop unnamed columns
df = df.loc[:, ~df.columns.str.contains('^Unnamed')]

# Replace NaN values with '0%' in columns ending with '%'
for col in df.columns:
    if col.endswith("% age 15+"):
        df[col].fillna('0%', inplace=True)

# Convert the string percentages to float in columns ending with '%'
for col in df.columns:
    if col.endswith("% age 15+"):
        df[col] = df[col].str.rstrip('%').astype('float')

# Replace NaN values with float 0 in the last 3 columns
last_two_cols = df.columns[-2:]
df[last_two_cols] = df[last_two_cols].fillna(0.0)

# Save the processed DataFrame as a new Excel file
df.to_excel('RQ41.xlsx', index=False, engine='openpyxl')

# Import required libraries
import statsmodels.api as sm

# Load the processed data from Excel
df = pd.read_excel('/content/RQ41.xlsx')
```

```
# Separate dependent and independent variables

Y = df['Made a digital in-store merchant payment for the first time after COVID-19 started (% who made a digital in-store payment (% age 15+)']

X = df[['Experience or continue to experience severe financial hardship as a result of the disruption caused by COVID-19: very worried (% age 15+)',

    ]]


# Create dummy variables for country and income group

country_dummies = pd.get_dummies(df['Country name'], drop_first=True)


# Add dummy variables to independent variables

X = pd.concat([X, country_dummies], axis=1)


# Save DataFrame with dummy variables to a new Excel file

X.to_excel('RQ41Dummy.xlsx', index=False)


# Add constant term to independent variables (necessary for statsmodels)

X = sm.add_constant(X)


# Create OLS model

model = sm.OLS(Y, X)


# Fit the model

result = model.fit()


# Get summary statistics

summary = result.summary()

print(summary)
```

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