INTRODUCTION

Background of the Study

Currency is a given in any society. Looking through the course of history, it can be said that currency has progressed and developed substantially, in form, usage, and management. At present, technology has the ability to support systems enabling transfer of money that are nontraditional based like coins, cash, or cheque, thus opening the possibilities for growth opportunities and increase in business volume (European Payments Council, 2016). These digital financial services (e.g., payments, remittances, and credit) utilize electronic means of transferring money (Pazarbasioglu et al., 2020). Such services range from established instruments such as debit and credit cards primarily offered by banks, and new innovations like cloud computing, digital platforms, and distributed ledger technologies, spanning mobile payments, crypto-assets and peer-to-peer applications which are often referred to as fintech (Agur et al., 2020).

Cognizant of the importance of payment systems in the financial infrastructure of the country, the Congress enacted Republic Act No. 11127 otherwise known as "The National Payment Systems Act." Under the law, the role of the Bangko Sentral ng Pilipinas (BSP) is to oversee payments systems and exercise supervisory and regulatory powers over payment system operators, such as InstaPay and PESONet. In addition with this legislation, the government and BSP have articulated goals regarding the promotion of financial inclusion in the Philippines through the utilization of digital payments.

Amidst the prevalence of the Coronavirus disease (COVID-19), BSP (2020) highlighted the need for accessible, reliable, and convenient e-payment services. The pandemic has compelled citizens to get accustomed to the "new normal" which enforces restrictions and routines including reduced social contact, calling for limitations on transportation and people's movement and activities (Diokno, 2020). The necessity for the utilization of mobile-enabled

payments was emphasized in a 2015 report by Better than Cash Alliance as thirteen (13) retail payments in the Philippines are still heavily reliant on cash-based mode of money transfer with only 1% of the 2.5 billion monthly retail payments done electronically. Back in the year 2000, BSP started to acknowledge this need by enforcing regulations allowing banks and non-bank entities to offer e-financial services such as e-banking and e-money applications with the aim of propagating financial inclusion defined as the access to and use of formal financial services by excluded and underserved populations (Lauer & Lyman, 2015). Recognizing the vital role of the digital payment system in our economy, particularly during this time of pandemic, would contribute to the prevention of transmission of the disease from face-to-face and over-the-counter financial transactions. However, it remains a hurdle as awareness of and trust in digital payments have not been sufficiently established (BSP, 2020). Two out of three Filipinos are financially excluded, and, thus, do not own a digital wallet or account (Massally and Ricart, 2019). Under the present circumstances, the potential of the usage of digital payments in receiving social benefits, sending and receiving of remittances, paying bills, and saving formally is not maximized.

An analysis on financial inclusion data involving the extensiveness of formal financial services would be done to demonstrate improvements, if any, in financial inclusion across different parameters through time. The resulting outcome can provide support in identifying barriers and uncovering other factors limiting the adoption of digital means of payments. This could potentially instigate appropriate actions to be taken primarily by the government and other stakeholders to enable the Philippines to fully ride on the digital wave.

Objectives of the Study

The study aims to investigate the factors of financial inclusion and to understand their implications on the overall level of financial inclusion in the Philippines with the use of digital payment indicators as the main factors for the index. To be able to effectively generate insights

on the state of financial inclusion in the country, the following specific objectives were identified:

- To determine possible correlation among the financial inclusion index and digital payment indicators by conducting Principal Components Analysis using quantitative data
- To study and explain trends, changes, and inconsistencies in time-series data relevant to the FII
- To reveal areas for improvement and recommend actions to be taken by public and private stakeholders to accelerate the transformation towards digitalization of payments
- To effectively relay relationships or correlations of financial inclusion indicators with the use the correlation matrix, scree plot, and correlation circle

Significance of the Study

The results of the study can be used to draw insights for possible policy and regulatory enhancements on the current government programs being implemented relative to the digital payment system. This information would benefit the general public by helping them assess the advantages of using a digital payment system, not only for convenience, but also for collective health and safety. This research can likewise facilitate better understanding of the significance of the role of the digital payment system in promoting financial inclusion.

The hindrances the general public face towards digital payments like cyber fraud and lack of trust could be alleviated through statistics that signify the benefits of the digital payment system. This study can also be used by the financial community and by government regulators like the BSP in further enhancing their services to adapt to the new normal to cope not only with the current health crisis but also with any unforeseen challenges or circumstances to be able to contribute to the continued stability of the financial system.

Scope and Limitations

In this study, statistical analysis will cover financial inclusion data for the period 2011 to 2019, obtained from publicly available sources such as BSP and World Bank. These databases contain data relevant to the financial ecosystem, such as number of financial institutions, number of active accounts, and percentage of digital payment users in the country. In spite of the fact that the World Bank acquires its data from the central bank of the countries it covers, there were minimal discrepancies observed in the same dataset BSP and World Bank has compiled.

Acquisition of descriptive data through surveys, like the consumers' preference and issues in terms of online banking service adoption, would not be covered in the methodology and would be collated instead from previous related studies that will be analyzed. These surveys are generally country-wide with respondents of ages 15 years old and above. It is also important to take note that some of these data may not be regularly updated and would not reflect up to date conditions. Also, counting errors are considerably inherent in the recording of these data. Data covering the year 2020 are limited, and hence only the data recorded from the year 2011 to 2019 will be used for analysis. This study will also not consider disparity of financial services offered across regions but will instead focus on the Philippines as a whole.

REVIEW OF RELATED LITERATURE

There is a wealth of literature on digital payment systems but for the purposes of this research, focus will be on the impact of digital payments on financial inclusion. The review will cover research relevant to the state of the digital payment system in the Philippines and how it affects the country. In this segment, a deeper dive would be done on how digital payments came to be on a global and country-wide scale, its impacts and benefits, the policy and regulatory framework in the Philippines, financial inclusion, and the barriers in adapting this system.

Electronic Payment Systems

Electronic payment systems are considerably recent inventions. The first digital methods of payment were invented in the early 1990's. As a matter of fact, the Philippines was one of the first countries to pioneer this method in 2001. Since then, many networks have been established and maintained up to this day, such as PESONet and InstaPay. Even though digital payments have proven to be promising and beneficial in developed economies, the same can be difficult to sufficiently substantiate in the Philippine context as progress has been limited in the country's adaptation of the system (Massally and Ricart, 2019). Certain measures taken by the government through the years can be noted in their pursuit of digital financial services reaching a wider segment of the population.

Evolution of the payment system

Global Emergence of Mobile Banking and Payment

The introduction and emergence of a global financial environment, the changing customer demands and mobile usage, and shift in consumer behavior patterns are key contributors in the transition from cash to digital payments (Sinha and Adhikari, 2018). Mobile technology, in particular the rise of Internet usage and mobile phones, ushered in a new digital

age of payments. In a study by Gupta (2013), it was acknowledged that along with the development of technological advancements comes convenience and security provided to customers in developed countries and advanced economies, and opportunities presented to the vast majority of unbanked customers in players just starting to climb the developmental ladder.

In the year 1990 to early 2000s, the advent of mobile payment services, such as electronic payments and Internet banking, introduced mobile-enabled transactions or electronic commerce (e-commerce) all over the world (Dahlberg et al., 2008). Defined by Bezhovski (2016) as a payment service that utilizes the information and communication technologies including integrated circuit (IC) card, cryptography, and telecommunication networks, the electronic payment system played a crucial role in e-commerce as its backbone and provided lucrative opportunities to merchants and service providers. At present, the electronic payment system has taken numerous forms including credit cards, debit cards, electronic cash and check systems, smart cards, digital wallets, contactless payment methods and so on (Bezhovski, 2016). The banking industry's adaptation of mobile technology faces the challenge posed by emerging players offering innovative solutions to the market. These include PayPal or Square emerging as strong competitors that could undermine the traditional partnership between credit card companies and banks (Gupta, 2013). Another example of a new player in emerging markets is M-PESA of Kenya. Launched by Safaricom in 2007, M-PESA has users totaling to around two-thirds of Kenya's population (Muthiora, 2015). Other success stories include MTN in Uganda, Vodacom in Tanzania, FNB in South Africa, and GCash and SmartMoney in Philippines (Cobert et al., 2012).

Adoption of mobile money in the Philippines

The Philippines' central bank – the Bangko Sentral ng Pilipinas (BSP) – led in establishing added confidence and inclusion in the digital economy. In fact, the country was one of the first to pioneer digital payments, with the launch of mobile money in 2001. The first

initiative supporting the transition was by Smart Communications, Inc., a domestic telecommunications provider (Ganchero, 2008). The company launched SMART Money in collaboration with Banco de Oro. With the use of SIM Tool-Kit, the service enables customers to buy airtime, send and receive money domestically and internationally via mobile, and purchase items using a card. In a study focused on mobile money conducted by the Global System for Mobile Communications (GSMA), it was cited that in 2004, Globe Telecom launched GCASH, an SMS-based offering, which offers a similar nature of transferring money through a "mobile wallet" accessed entirely through a mobile phone. This is thought to be the first ever attempt of utilizing SMS for cash transfers in the world.

Currently, the combined efforts of BSP, the government and leaders across financial, retail, and regulatory sectors have a shared aim of further boosting digital payments (Hokans, 2015). Progress has been limited since then due to a handful of factors constraining growth (GSMA, 2012). The digital payment ecosystem is evolving rapidly. In the country, a similar phenomenon can be observed as those in advanced economies as competition within digital financial service providers starts to arise. The entrance of new fintech companies prompts new products and services with attention directed on improved consumer value and experience. As the country is still in transition to a relatively new mode of payment, the BSP and government assume major roles in working hand-in-hand as key enablers of mobile success (Massally and Ricart, 2019). Their roles are anchored on two fronts - enforcing progressive regulations and establishing a clear and adequate legislative framework.

Regulatory Framework for digital payments in the Philippines

The traditional banking model was the primary factor driving the payment ecosystem in the Philippines back then. The model seemingly provided numerous disadvantages to retail consumers and corporate employers as seamless transfer of money was a challenge (Massally and Ricart, 2019). Recently, there has been a growing interest in the financial technology

industry, made evident in investments made in the sector. These investments and statistics that indicate the country's strong base for boosting digital payments, with high levels of mobile penetration, made innovations in the industry continue to increase (Hokans, 2015). Even though improvements have been made, BSP's goal of attaining a cash-lite society has still not been attained.

The Government and Bangko Sentral ng Pilipinas

In a general sense, the Bangko Sentral ng Pilipinas has worked the most towards the perceived improvements in the system by making key decisions, particularly in enabling non-banks to offer financial services back in the year 2000. Major initiatives were taken as the country was placed on the Financial Action Task Force (FATF) list of non-compliant countries and territories in 2001 (GSMA, 2012). This has driven certain regulations conducive to mobile money since the BSP did have a strong financial inclusion mindset at that time. However, the Republic Act No. 11211 signed recently on 14 February 2019 emphasized BSP's mandate of achieving financial inclusion and boosting of financial literacy and consumer protection in the country. In the supply side, having the ability to offer e-financial services such as e-banking (for banks) and e-money applications were instrumental in reaching the unbanked and unserved/underserved population (Llanto et al., 2018). After more than 10 years of experience, however, mobile money has still not reached the majority of the population (Massally and Ricart, 2019). The government can also be acknowledged as one of the major drivers in the transition toward electronic payments. As mentioned in the study regarding the current state of digital payments in the country by Massally and Ricart (2019), measures taken by the government in their promotion of electronic payments are rooted on five main grounds. First, corporate and personal payments to national government for income taxes, customs duties, and health benefits added to a wide range of personal payments (P2G) and business payments (B2G) to local government units (LGUs) for property taxes, licenses and permits, are made

almost exclusively in cash. The United States Agency for International Development and the International Finance Corporation are especially focused on improving P2G at LGUs. Second, transparency, efficiency and costs of operations hinder them from effectively reaching their beneficiaries. This insinuates that a more comprehensive analysis of the costs of cash handling needs to be undertaken across both the business and government sectors. Third, facilitation of social welfare programs and other G2P such as the Pantawid Pamilya Conditional Cash Transfer (CCT) Program, a vital component of the Philippine government's poverty alleviation agenda, would result in beneficiaries having to open bank accounts or mobile money accounts. Fourth and fifth key factors are low levels of financial inclusion and economic growth and development.

To better enable the penetration of financial services and hasten the adoption of digital payments, the government has reformed the policy and regulatory environment. Until 2015, there was no clear established authority as to who governs digital payments, and financial institutions were regulated under differing laws and arms of the BSP (Massally and Ricart, 2019). To provide a framework for governance of payments, BSP's flagship initiative, National Retail Payment System (NRPS), was launched in 2015. Under the NRPS, BSP mandated the formation of an industry-led payment system management body (PSMB), distinguishing governance from clearing operations. Adopted in 2017 through Memorandum Circular No. 980, the NRPS comes consistent with Bangko Sentral regulations on risk management in relevance with the varying risks arising from the rapid evolution of retail payment activities of Bangko Sentral supervised financial institutions (Massally and Ricart, 2019). The same study mentioned that NRPS likewise supports the delivery of a variety of financial products catering to the needs of the citizens, with a particular focus on small-value, high frequency payers of the low-income segment. As more consumers avail of electronic payment services, the growth in transaction volume will help achieve economies of scale, which may further bring down cost

to the consumers (BSP, n.d.). BSP (n.d.) also mentioned that the organization itself oversees the creation of automated clearing houses (ACHs) between its members, while the clearing switch operators (CSOs) execute the clearing and settlement rules of the ACHs. BSP prioritized the formation of two ACHs, namely Batch EFT Credit or PESONet and Real-time Low Value EFT Credit or InstaPay, given their considerable potential in driving the usage of electronic payments.

PESONet

According to BSP (n.d.), the first ACH formed under the NRPS was the Philippine EFT System and Operations Network (PESONet). It can be regarded as an electronic alternative to paper-based check system and is a batch electronic fund transfer (EFT) credit payment scheme where the fund transfer and/or payment instructions will be processed in bulk and cleared at batch intervals. The PESONet is more inclusive platform for EFTs whether it may be a business-to-business (B2B), person-to-business (P2B), government-to-government (G2G) and person-to-government (P2G) collections and payments, or business-to-person (B2P) payments used in corporations, enabling them to credit salaries without the need for separate payroll accounts.

InstaPay

For small value transfers, InstaPay was established for real-time low-value EFT credit push payments for transaction amounts up to P50,000. InstaPay comes convenient in purchasing of retail goods, paying of toll fees and tickets, along with e-commerce, which shall enable, among others, Micro, Small and Medium Enterprises (MSMEs). The assigned CSO for InstaPay is BancNet for a two-year transitory period beginning from the time of its launch (BSP, n.d.).

Impacts of the digital payment system on the economy

The use of digital payments can have a positive impact on the economy of a country According to Better than Cash Alliance (n.d.), the digitization of payments significantly benefits the community through: (i) cost savings by means of increasing efficiency in the speed of transactions; (ii) transparency and security through promotion of accountability and tracking, lessening the risk of corruption and theft; (iii) financial inclusion by providing opportunities to financial services, like saving accounts and insurance products; (iv) women's economic participation by granting them opportunities to control their own finances and through other economic opportunities; and (v) inclusive growth by forming institutions in that promote the foundation of the economy.

On another scale, a number of stakeholders stand to gain from the use of digital payment systems. The BSP (n.d.) noted that digital payment system benefits the e-money issuers and digital payment providers such as by having: (i) more value in financial services (e.g., text-a-deposit and text-a-payment); (ii) improved ability to get new clients; (iii) better service delivery; (iv) decreased operational costs; (v) the capacity to leverage on telecommunications company/ telco and other non-bank agent networks; and (vi) increased credit information about the consumers. The government as well benefits from digitization of payments through increased transparency in government expenditures given traceability of the transactions, leading to less corruption. Another advantage the government reaps from the system is lower costs in distributing money for program funds, salaries, and social grants (Klapper & Singer, 2014)

Digital payments promote an efficient payment and settlement system which in turn can help improve the e-commerce of a country. The adoption of a digital payment system can promote e-commerce by lessening the cost of trading and making payments more efficient. The growth of e-commerce has been due to the advancements in digital finance technologies (Bezhovski, 2016). Based on a survey conducted by BSP about e-money in 2017, the primary

factors people consider in converting to digital payments are convenience, faster checkouts and low or no processing fees. Seventy-four percent of e-money users responded that convenience was the main reason in switching to digital payments, while 53% of the respondents who either have e-wallets, digital currency, or mobile apps, cited as reason, for faster transactions.

Digital payment system likewise promotes financial inclusion, which to reiterate, is defined as the provision of convenient and affordable financial products and services to the people and businesses that accommodate their needs (e.g., transactions, payments, savings, credit, and insurance) (World Bank, 2018). Financial services have been generally more accessible and inexpensive to consumers due to the application of digital technologies to banking and financial transactions or e-finance. With the improvement of the e-finance in the country, the financially excluded or those who do not have access to different financial services can engage in mainstream banking and finance that will make the economy more financially inclusive (Llanto et al., 2018). Compared to traditional banks, digital financial services (e.g., digital payment platforms, e-money, and mobile money) provide more affordable basic services. Technological advancements have made it easier for low-income groups to access financial services (Razon, 2019).

According to the World Bank (2014), the integration of digital payments into the economy of a country is essential to economic growth. The notion that digital payments can give more access to the financially excluded, such as the poor, women and individuals who live in rural areas is supported, which can help them participate in the economy, thus, improving the economic growth of the country (Klapper and Singer, 2014). As pointed out by the AFI's Executive Director, Mr. Alfred Hannig (2017), inclusive economic growth is another important impact in the adoption of digital finance other than financial inclusion. Notable examples of how digital payments positively affected the economy of a country are Kenya and India. As previously mentioned, M-PESA, the digital payment system in Kenya, allowed

households to strengthen their risk-sharing networks which contributed to higher savings, higher consumption, and changes in profession for users. In India, on the other hand, digital systems are being used to distribute cash transactions and provide salaries for the workers. It also helps in decreasing corruption in the country by direct government to person transfer for program funds as digital payments are more accountable and easier to track (Karlan et al., 2016).

Opportunities and challenges in promoting the digital payment system

While the use of digital payment systems has been cited by a number of literatures to be beneficial to a country's economy, there are many opportunities and challenges in successfully implementing it. New advancements in technology can help in promoting the use of digital payments (BSP, n.d.). The number of internet users, smartphone users, and mobile phone subscribers has increased throughout the years. Sanchez (2020) published that in the Philippines, internet users have reached 73 million people as of January 2020, while there are about 74 million smartphone users as of 2019.

Although advancements in technology present opportunities to promote the use of digital payments, there are various impediments that prevent the country from fully leveraging on such technological advancements. Impediments to the digitization of payments include: (i) safety and reliability of the system; (ii) interoperability between bank and non-bank financial service providers; (iii) physical infrastructure, such as physical access to financial services, mobile phones, and cell towers; (iv) political economy issues; (v) knowledge about digital payments and proper financial literacy; (vi) improper and irregular use of accounts; and (vii) difference in mobile phone ownership between gender (Klapper & Singer, 2014). Massally and Ricart (2019) cited costs, lack of trust, and security risks as barriers which prevented people from converting to digital payments. It was observed in their study that the cost of using digital payments is the same as or even more than the current means, while possible security risks

include breaches in personal data, data theft, and hacking of the account. Further, they also highlighted that financial exclusion and poor mobile connectivity are the two vital issues regarding digital payments as two out of three people are financially excluded in the Philippines and that there are only 16,500 base stations for data services despite having 71% of the people subscribed to data services.

On another aspect, the lack of security and trust to the digital financial service providers are significant hindrances to the use of e-commerce transactions. Aside from security and trust issues, complexity is also an issue in the adoption of digital payment services as the presence of various methods of payment such as smart cards, online banks, and mobile payments often discourage people due to the lack of digital literacy. Moreover, other challenges faced by digital payments are cyber-crimes, such as hacking, data theft, and cyber attacks on financial data (Bezhovski, 2016).

Based on the study by Somasundaram (2020), improvement in safety and cybersecurity of financial transactions and simplification of the system can increase the promotion of digital payment systems. In the Philippine context, the government continues to face and work on these hurdles as the country is still in its early stage of transitioning to digital payments.

Financial Inclusion

According to World Bank (2018), financial inclusion is the availability of individuals and businesses to access a wide range of financial products and services. A study by Llanto (2015) looked into the state of microfinance and financial inclusion in the Philippines. In the study, it was stated that establishing financially inclusive ecosystems for the low-income group can be used as a strategy to improve the financial inclusion and the inclusive growth of the economy. The study shows that efficient financial services in the country could lead to a financially inclusive economy. Cognizant of the importance of financial inclusion in the country, BSP (2014), along with other organizations like Global Partnership for Financial

Inclusion and Alliance for Financial Inclusion, built a comprehensive financial inclusion data framework. The initiative created quarterly financial inclusion reports, a financial inclusion database, and spatial mapping and geocoding of access points. These serve as critical sources of information for analyzing financial inclusion development in the country and provide useful insights for policy measures and related initiatives.

Financial Inclusion Index. Financial inclusion index (FII) is a measure of financial inclusion at a specified place. Using an index allows for the measurement of multidimensional concepts into a comprehensive single number (Mojica & Mapa, 2015). These dimensions include access, usage, and penetration (Sarma, 2012). There have been numerous approaches to construct FII such as the parametric approach by Camara and Tuesta (2014) and nonparametric approach by Chakravarty and Pal (2010). The resulting FII would effectively capture and reflect information of the numerous indicators of FII in a single number ranging from zero to one. Zero means complete financial exclusion and 1 specifies complete financial inclusion (Sarma, 2012).

Tan (2014) defined the three aforementioned dimensions, access, usage, and penetration. Access pertains to the availability of formal financial services to its users. Indicators under access could include number of banks and other financial services given a specific number of individuals. Usage on the other hand refers to adequate utilization of financial services. It was emphasized that even though a population has access to such services but are unable to use them, it could adversely affect the inclusivity of the services. This indicates the significance of usage as a dimension of financial inclusion. Lastly, penetration reflects the number of users of financial services such as the proportion of people having a bank account. Understanding these three dimensions would help in comprehending the results of the study later on, like in what aspect the Philippines lags and progresses on.

Digital Financial Inclusion. Digital financial services are an efficient way to deliver key financial products and services to a lot of people, which promote inclusive financial systems (Pazarbasioglu et al., 2020). Using digital approaches can increase the accessibility of the financially excluded to financial services. Digital financial inclusion can be reached with the use of cost-saving digital platforms to reach underbanked and underserved populations. It entails four essential components, namely, digital transaction platforms, devices, retail agents, and additional financial services through the digital platforms (Lauer & Lyman, 2015). The adoption of digital payments could lead to a full range of digital financial services, which could lead to an inclusive digital economy in the country (Radcliffe & Voorhies, 2012).

Principal Components Analysis

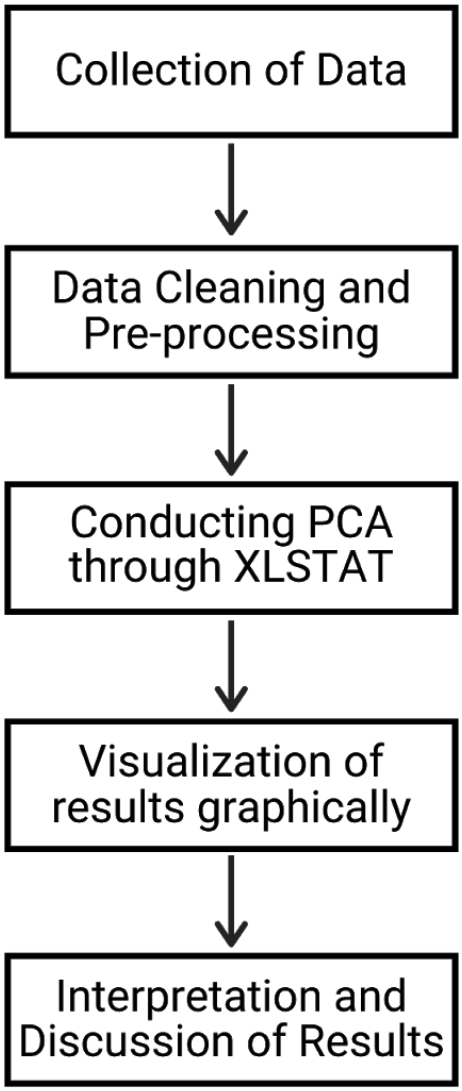
Principal Components Analysis (PCA) is a method used to reduce the dimensionality of large data sets in order to better interpret such data sets. PCA is a tool for analysing large data sets and transforming them into simplified values which are the Principal Components. The main function of PCA is to reduce the amount of variables in a data set, while minimizing the information loss and preserving as much information as possible (Jolliffe & Cadima, 2016). PCA can be computed either manually by equations or through data analysis tools and programs like XLSTAT. XLSTAT, an Excel data analysis add-on, supports conducting of PCA. The statistical software program has been growing in usage due to its compatibility with Microsoft Excel. PCA, when conducted through XLSTAT, provides simplicity to the process being a useful tool for performing multivariate analysis. XLSTAT as a platform for PCA can enable one to summarize, visualize and interpret results without the rigorous process of going through equations. Simplifying complexity of data by summarizing it into principal components that illustrate trends and correlations can be done with ease through XLSTAT (Vidal et al., 2020).

Principal Components Analysis as an Indexing Strategy. Previous studies in developing a financial inclusion index used PCA for simplifying the multidimensional data sets that are used. Papers by Cámara & Tuesta (2014) and Nguyen (2020) both used PCA as a tool to obtain the weights of the dimensions of the index. Either a parametric method or a non-parametric method in constructing the indices. Non-parametric methods assign the weights of the variables exogenously, while parametric methods can be determined endogenously (Cámara & Tuesta, 2014).

Synthesis

Even though the Philippines was an early mover in enabling mobile payments to be available, certain circumstances have substantially slowed down the country's progress, reflecting on the low rates of financial inclusion and digital payment penetration. These factors include poor mobile connectivity, issues on privacy and cyber security, and low digital literacy to name a few. Due to these, the government and the country's central bank, BSP, have been working hand-in-hand in making necessary improvements on the regulatory framework as well as enforcing laws aimed at further propagation of digital financial services and financial inclusion. Taking a look at advanced economies, the perceived benefits of digitization of payments such as lower transaction costs, convenience, and transparency serve as key drivers in the country's shift to a more inclusive mode of payments. Indeed, the Philippines is just starting to climb the developmental ladder, suggesting more interventions to be made by those in the authority.

Process Flowchart



METHODOLOGY

Data Gathering

A total of two comprehensive secondary datasets predominantly collated through surveys were employed in the study. These two sources were obtained from both local and international players in the financial ecosystem namely Bangko Sentral ng Pilipinas and the World Bank, which both have a shared aim of tracking the country's progress towards financial inclusion and supporting private sectors, governments, and development organizations in propagating financial inclusivity.

The primary source of data utilized in the study are the quarterly published financial inclusion reports by the Bangko Sentral ng Pilipinas (BSP). According to BSP, the collection of financial inclusion data was through face-to-face interviews through a structured and peer-reviewed questionnaire by jurisdictions such as Comisión Nacional Bancaria y de Valores (CNBV) of Mexico, Bank of Tanzania and the World Bank, which all had conducted a similar nature of survey. The Inclusive Finance Advocacy Staff (IFAS) or BSP Center for Learning and Inclusion Advocacy (CLIA) worked interchangeably in designing the survey instrument. Data collection, encoding and processing were done by either the Social Weather Stations (SWS) or Nielsen Philippines. The general sample size of the surveys was 1,200 adults defined as individuals aged 15 years old and above which came from both the National Capital Region (NCR) and areas outside NCR (Balance Luzon, Visayas and Mindanao). Multi-stage probability sampling was used in identifying respondents. The survey had sampling error margins ranging from ±3% to ±3.5% for national percentages. In estimate, there is a fair distribution between respondents coming from urban and rural areas, from both sexes (male and female), and from different age groups. Also, the respondent distribution resembles the Philippine population, with Balance Luzon having the most number of respondents, followed by Mindanao, then Visayas and finally NCR. (BSP, 2015)

Another secondary source of data that served as the study's baseline is the Global Findex database from the World Bank consisting of nationally representative surveys of more than 150,000 adults aged 15 and above in over 140 economies. The database contained additional data on the use of financial technology, specifically the usage of mobile phones and other digital means in participating in financial transactions which can significantly contribute to the research as it is more aligned with the determined objectives.

Having identified the primary and secondary sources of data, appropriate coordinations have been made with the Bangko Sentral ng Pilipinas to request for financial inclusion-related data such as but not limited to, number of ATMS, number of commercial banks, number of active mobile money agent outlets, and demographics of financial consumers.

Organization and Cleaning of the Data

After the data was gathered, the data was organized and cleaned. The steps in cleaning the data in this study were: (i) inspection of the data by looking for unexpected, incorrect, inconsistent, and unwanted data like outliers and duplicates; (ii) fixing or removing the problems in the data discovered; (iii) standardization and conversion of the units of measurements; (iv) organization and proper arrangement of the data gathered in a spreadsheet software; and (v) verifying the data by re-inspecting the changes made (Elgabry, 2019). For the analysis of data, the data must be correctly processed and prepared to prevent the possible outcome of inaccurate results. Data cleaning was used to take out the unnecessary data for all the data to be properly analyzed (Sisense, 2020). After all of the data was cleaned and properly organized, the data was ready for analysis. For the cleaned data, refer to Appendix A, Table A.1.

The choosing of appropriate data or information for the study given the availability and completeness of data gathered was done. The data chosen to analyze was narrowed down to a few indicators or parameters that are deemed relevant to the study. Data was further assessed

for usability in analysis given the defined objectives of the study. Microsoft Excel was used for data cleaning, as suggested in the study by Elliott et al. (2006) as the data entry tool would aid in creating a cleaner, more accurate, and more appropriate data set that is well designed to answer research questions. Further, the data was normalized using z-score. Z-score utilizes mean, standard deviation, and the observed value to determine the distance of a data point from the mean, in standard deviation units. The variables were standardized to a distribution with a mean of 0 and a standard deviation of 1. Z transformation enabled comparison of inconsistent metrics by converting separate distributions into a standardized distribution. This is especially useful since the data points under each parameter are far apart from those of other parameters, ranging from tens to thousands.

Data Processing and Analysis

The chosen parameters that are considered to have an impact on financial inclusion (e.g. the banked population, number of ATM sites, etc) reported quarterly in the financial inclusion reports of the BSP and annually by the World Bank was pre-processed by Excel, as indicated in the last step. However, the data from BSP were for validation and those from the World Findex database were primarily used.

XLSTAT was used for its Principal Components Analysis (PCA) function. Similar to Vidal et al. (2020), PCA was conducted through XLSTAT to evaluate the relationship between attributes. Specifically, the primary focus for the study were the relationships between the financial inclusion index and the chosen digital payment indicators. Given that it is an add-in, it was activated first in order to integrate it to Excel. After activation, the XLSTAT tab showed up and under this tab is the Analyzing data/Principal Components Analysis command that was then used. Once the command was clicked, the principal component dialog box appeared where the data set to be analyzed was selected with the data format observations/variables table. The variable labels (the attributes) and observation labels (years) were specified as well in the

General tab in the PCA dialog box. Pearson correlation coefficient was selected to be displayed in the correlation matrix. Next, under the options tab, the activate "n" standardization option was ticked. The study did not utilize supplementary data, so the supplementary data tab was not used. Moving on, in the Data options tab, "do not accept missing data" was selected and lastly under Outputs tab, option for descriptive statistics was activated for relevant statistical information to be displayed such as correlation matrix, eigenvalues and eigenvectors, biplots, and correlation circle once the program was executed.

Presentation and Discussion of Results

In particular, the outputs from XLSTAT's PCA function that were used for interpretation were the correlation matrix, correlation circle, and the eigenvectors/eigenvalues. The negative or positive correlations between the chosen parameters and the FII have certain indications that were explored to determine the underlying reasons for these. Integration of existing qualitative researches and findings about factors behind financial inclusion was done to attain a deeper understanding on the topic of financial inclusion and digital payments system in the Philippines. Likewise, areas for improvement and corresponding actions to be taken by concerned bodies such as the government and BSP were determined.

RESULTS AND DISCUSSION

After inputting the normalized data and selecting the necessary commands in the PCA function of XLSTAT, output was generated, specifically the correlation matrix, correlation circle, and the eigenvalues that are the focus for interpretation in the study.

Variables	ATM	BANK	E-MONEY	VOL-IN	VOL-OUT	VAL-OUT	VAL-IN	REA	AEA	CBB	ATMP	FII
ATM	**1**	**0.981**	**0.733**	**0.811**	**0.959**	**0.907**	**0.905**	0.598	-0.429	**0.976**	**0.996**	**0.983**
BANK		**1**	**0.708**	**0.901**	**0.990**	**0.952**	**0.951**	**0.725**	-0.350	**0.932**	**0.961**	**0.964**
E-MONEY			**1**	0.441	0.656	0.539	0.536	0.185	**-0.754**	**0.697**	**0.728**	0.638
VOL-IN				**1**	**0.925**	**0.960**	**0.963**	**0.951**	0.008	**0.723**	**0.761**	**0.812**
VOL-OUT					**1**	**0.962**	**0.961**	**0.774**	-0.246	**0.902**	**0.932**	**0.950**
VAL-OUT						**1**	**1.000**	**0.851**	-0.092	**0.855**	**0.877**	**0.909**
VAL-IN							**1**	**0.857**	-0.090	**0.850**	**0.873**	**0.905**
REA								**1**	0.278	0.496	0.535	0.613
AEA									**1**	-0.433	-0.460	-0.370
CBB										**1**	**0.986**	**0.978**
ATMP											**1**	**0.981**
FII												**1**

ATM: Number of Automated Teller Machines (ATMs), **BANK:** No. of Banks (head office, branches, and other offices), **E-MONEY:** Number of active mobile money agent outlets, **VOL-IN:** Volume of E-money transactions (inflow), **VOL-OUT:** Volume of E-money transactions (outflow), **VAL-OUT:** Value of E-money transactions (outflow), **VAL-IN:** Value of E-money transactions (inflow), **REA:** Number of registered mobile money accounts, **AEA:** Number of active mobile money accounts per 100,000 adults, **CBB:** Number of commercial bank branches per 100,000 adults, **ATMP:** Number of ATMs per 100,000 adults, FII: Financial Inclusion Index
NOTE: Values in bold are different from 0 with a significance level alpha=0.05

Table 1. Pearson's correlations values between financial inclusion indicators

The linear matrix of the Pearson (r) correlations between the variables are displayed in Table 1. However, point of focus would be the last column which shows the correlation coefficients between the financial inclusion index and the parameters. The Pearson correlation coefficient ranges from -1 to 1, indicating the strength of the relationship of the variables (Schober, et al, 2018). Hinkle et al. (2003) provided an interpretation for the size of the Pearson correlation coefficients shown in Table 2 which is the basis for interpretation of the size of the correlation coefficients shown in Table 1.

Size of Correlation	Interpretation
.90 to 1.00 (−.90 to −1.00)	Very high positive (negative) correlation
.70 to .90 (−.70 to −.90)	High positive (negative) correlation
.50 to .70 (−.50 to −.70)	Moderate positive (negative) correlation
.30 to .50 (−.30 to −.50)	Low positive (negative) correlation
.00 to .30 (.00 to −.30)	Negligible correlation

Table 2. Interpretation of Pearson correlation coefficient by Hinkle et al, 2003

With this in mind, there is a very high positive correlation between the FII, number of ATMs (r = 0.983), number of banks (r = 0.964), volume of e-money transactions outflow (r = 0.950), value of e-money transactions inflow (r = 0.909) and outflow (r = 0.905), number of commercial bank branches per 100,000 adults (r = 0.978) and number of ATMs per 100,00 adults (r = 0.981). Meanwhile, there is a high positive correlation between the FII and volume of e-money transactions inflow (r = 0.812) and moderate positive correlation for number of active mobile money agent outlets and number of registered mobile money accounts per 100,000 adults (r = 0.613). Conversely, there is a low negative correlation between the FII and number of registered mobile money accounts per 100,000 adults (r = -0.370).

Based on the results, it can be noticed that all of the parameters under access, namely ATMs and banks, have very high positive correlations between the FII. It can be said that the reason why the indicators, number of ATMs and banks, have the highest correlation is that over the counter (OTC) transactions and physical cash are still preferred and are more widely used compared to e-money accounts in the Philippines (BSP, 2019). Banks and ATMs play an important role in providing financial services throughout the country. Moreover, cash and OTC are perceived as inexpensive and convenient because they are deeply entrenched. Additionally, these two indicators have been used as significant factors in the building of financial inclusion indices in other studies (Mojica & Mapa, 2015).

The volume and value of e-money transactions have a high to very high correlation to the financial inclusion index. The high correlation may be attributed to various initiatives of the banks and government in promoting the use of Automated Clearing Houses such as the

PESONet and InstaPay. The creation of the National Retail Payment System led to more consumers using electronic payment services (BSP, n.d.).

Lastly, there is a low to medium correlation with parameters relating to mobile money. Such findings may be caused by different factors impeding the use of digital payments, such as a bad digital infrastructure, poor mobile connectivity, and a lack of financial literacy. This supports the finding of Klapper and Singer (2014) which states that although advancements in technology present opportunities to promote the use of digital payments, there are various impediments that prevent the country from fully leveraging on such technological advancements, such as the improper and irregular use of mobile money accounts. This is also linked to the non-usage of these e-money accounts in the context of the marginalized and informal sectors because their manner of saving, borrowing, or getting loans remains mainly informal (BSP, 2019). Further, a report on financial inclusion by BSP (2019) also stated that the Philippines still lags behind other regions in terms of per capita ownership of mobile money accounts and payment instruments.

	F1	F2	F3	F4	F5	F6	F7	F8
Eigenvalue	9.474	1.946	0.375	0.138	0.039	0.015	0.012	0.001
Variability (%)	78.954	16.214	3.125	1.146	0.327	0.123	0.103	0.007
Cumulative %	78.954	95.168	98.293	99.440	99.767	99.890	99.993	100.000

Table 3. Eigenvalues of factors

Moving on, Table 3 displays the eigenvalues which aim to depict the amount of information summarized in every dimension (Saguansat, 2012). The dimensions or principal components are arranged in decreasing order of how much of the initial variability each was able to reflect. Generally speaking, eigenvalues pertain to the factors which are linear combinations of the initial variables. To add to that, all factors are uncorrelated (r = 0). To explain the idea succinctly, the first principal component is a linear combination of the initial variables which captures the most amount of variability in the data set. The second principal component explains the remaining variance not represented in the first principal component.

The same concept, capturing the remaining variance with noncorrelation to the previous component, applies to the succeeding factors. Conclusively, all the factors or principal components are uncorrelated. As shown in Table 3, the first principal component F1 explained 78.95% of the variability, followed by F2 covering 16.21% of the variability and F3 depicting almost 3.12% of the variability.

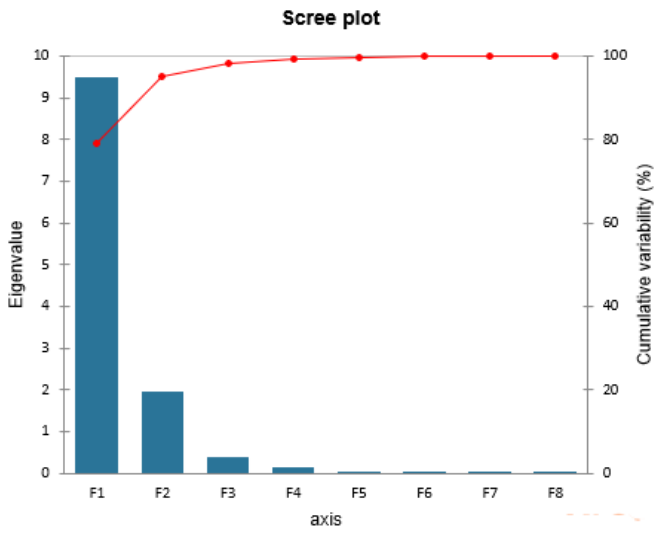


Chart 1. Scree plot

Chart 1, the scree plot, further illustrates the variability represented by each factor (Saguansat, 2012). The first two principal components correspond to 95.17% of the variability which is a high percentage of the variance, indicating that the maps based on the three factors are accurate projections of the initial multi-dimensional table. To determine the individual financial inclusion indicators that constitute each factor, specifically F1 and F2, the plot of the loadings of the variables shown in Table 4 provide the correlations between the FI indicators and the two principal components (F1 and F2). The loading of a variable is an index that indicates the strength of the correlation between a parameter and the principal component it is under. A larger value (loading > 0.6) for the loading implies a stronger correlation while the opposite is true for a smaller value (loading < 0.6).

	F1	F2
ATM	0.981	-0.150
BANK	0.998	-0.023
E-MONEY	0.691	-0.595
VOL-IN	0.904	0.381
VOL-OUT	0.989	0.072
VAL-OUT	0.965	0.236
VAL-IN	0.963	0.242
REA	0.731	0.633
AEA	-0.320	0.902
CBB	0.939	-0.205
ATMP	0.962	-0.202
FII	0.970	-0.086

Table 4. Loadings of the individual FI indicators

Evident in Table 4, high positive correlations (>0.6) can be observed between F1 and the FI indicators except for AEA having a loading of -0.321. On the other hand, the loadings of the variables under F2 were in majority lower. Only AEA had a positive correlation with F2 (loading of 0.902) which is logical since the F1 was not able to exhibit much information about the said variable as supported by the variable being negatively correlated with F1. VOL-IN, VOL-OUT, VAL-OUT, VAL-IN had very low or no correlation with F2 having loadings lower than 0.408. ATM, BANK, E-MONEY, CBB, ATMP, and FII have negative correlations with the F2 component (loadings -0.150, -0.023, -0.595, -0.205, -0.202, -0.086 respectively).

Conclusively, eleven (11) of the variables (ATM, BANK, E-MONEY, VOL-IN, VOL-OUT, VAL-OUT, VAL-IN, REA, CBB, ATMP, FII) can be grouped within the first principal component (F1) indicating that they can be grouped as one variable due to their positive correlations with F1. AEA was negatively correlated with F1 which suggests that as the value for that decreases, it would lead to the increase of F1 and the eleven variables. REA and AEA are the only ones grouped in F2 because of its positive high loading greater than 0.6. Similarly, this has the same implication that as the grouped variables increase in value, the other group decreases.

The study by Llanto et al. (2017) supplements the circumstance of AEA being inadequately represented by F1 even though the first principal component accounted for 78.95% of the variability of the original data. The said researchers studied financial inclusion indicators and have observed that the share of active e-money accounts among registered accounts has decreased from 2015 to 2016, insinuating that adoption of digital payments should be improved. Even though Llanto et al. (2017) only evaluated data for 2015 and 2016, assessing the cleaned data in Appendix A, Table A.1. utilized in this study, the number of active e-money accounts significantly fluctuated throughout the years covered. This further gives an explanation as to why it was not covered by F1. Moreover, the grouping of FII and the other ten parameters infers strong auto-correlation, supporting the initial knowledge that indicators used for computing the index of financial inclusion include conventional parameters. These include banks per 10,000 adults, other FSPs per 10,000 adults, banks per 100 sq. km, other FSPs per 100 sq. km, deposit accounts per 10,000 adults, deposit-to-GDP ratio and credit-to-GDP ratio under the three dimensions, access, usage and penetration, used by the BSP as stated in their Report on the State of Financial Inclusion in the Philippines (2017). However, digital payment parameters must also be considered in computing the FII since findings reveal that the grouping of eleven of the variables, six of which are related to digital payments (E-MONEY, VOL-IN, VOL-OUT, VAL-IN, VAL-OUT, REA), means that the six variables are autocorrelated to the rest, signifying that these six have an influence on the FII. This substantiates findings of past studies by Bezhovski (2016), World Bank (2014), and especially BSP (n.d.) indicating how different segments of the population benefit from the digital payment system, thus making digital finance-related indicators being points of consideration in computing the FII.

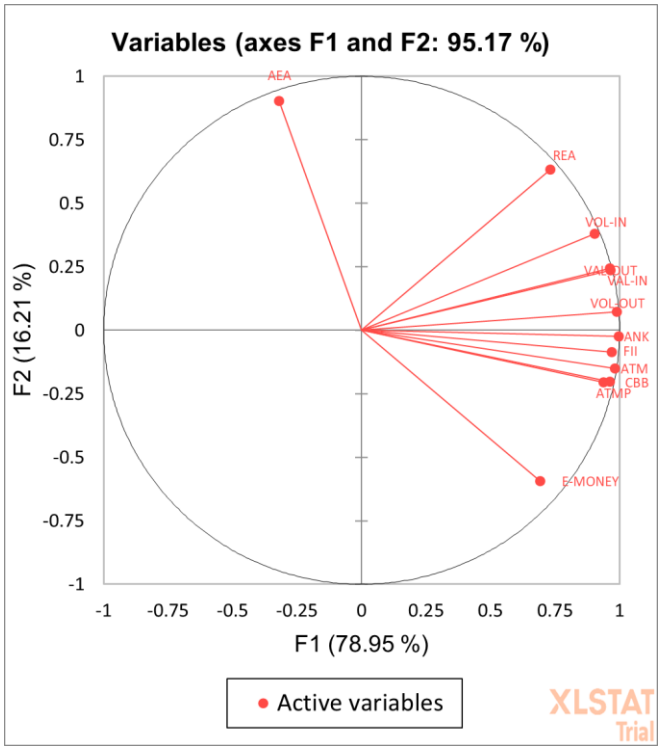


Figure 1. Correlation circle; Plot of the loadings of the variables

Figure 1 shows a map, the correlation circle. The correlation circle shows projection of the initial variables in the factors space (Saguansat, 2012). The angle between the vectors is an approximation of the correlation between the variables. When two variables are far from the center, then consequently close to each other, they are significantly positively correlated (r close to 1). If they form a right angle, they are not correlated (r close to 0) Lastly, if they form an angle close to 180 degrees, then they are significantly negatively correlated (r close to -1). Another point of significance is the length of the line of each variable. A longer line that is consequently closer to the circle reflects the variable's importance. Also, the angle between the line and each axis demonstrates how the variable specified is correlated to the principal component identified in the axis. The sign of the correlation, positive or negative, can be identified from where the line lies, either on the positive or negative side of the PC axis.

Essentially, the interpretation for the correlation circle is directly connected to the loadings displayed in Table 4. As shown in Figure 1, BANK and VOL-OUT are evidently the closest to the F1 axis due to their high loadings (0.998 and 0.989 respectively) indicating that

the two parameters are strongly correlated to the principal component F1. Moreover, long lines with high loadings as meant by small angle in reference to the F1 axis and a positive correlation to F1 were observed for ATM, FII, VAL-OUT, VAL-IN, ATMP, CBB, VOL-IN, REA, and E-MONEY (loadings of 0.981, 0.970, 0.965, 0963, 0.962, 0.939, 0.904, 0.731, and 0.691 correspondingly). Further, AEA line lies on the negative portion of F1 due to its negative correlation (loading of -0.320) with F1. However, with respect to F2, the AEA line was close to the F2 axis meaning it has high positive correlation with F2 (loading of 0.902). Lines for REA, VOL-IN, VAL-OUT, VAL-IN, and VOL-OUT can likewise be found on the positive portion of the F2 axis but are rather farther (forms angles of less than 90 degrees) suggesting that the said variables have low positive correlation with F2 as supported by their loadings (0.633, 0.381, 0.236, 0.242, and 0.072 respectively). Meanwhile, E-MONEY, CBB, ATMP, ATM, FII and BANK lines are positioned on the negative part of the F2 axis, signifying that these are negatively correlated with the F2 component (loadings -0.595, -0.205, -0.202, -0.150, -0.086, and -0.023). Moreover, the indicator AEA is significantly negatively correlated to the FII as it is near to the center and forms an angle close to 180 degrees with the FII vector. On the contrary, ATM, BANK, E-MONEY, VOL-IN, VOL-OUT, VAL-OUT, VAL-IN, REA, CBB, ATMP are far from the center and each forms an angle of less than 90 degrees with the FII vector, signifying high positive correlations between these variables and the FII, as previously shown in Table 1 for the actual values (r close to 1).

Supplementary material and/or Additional information. For the cleaned data, normalized data, and other supplementary output from PCA, refer to the appendix at the end of the paper.

CONCLUSION AND RECOMMENDATIONS

Findings of this study provide valuable insights into the state of financial inclusion in the Philippines and present avenues for policy improvements. This will consequently pave the way for a more inclusive financial system supportive of the country's aspiration to achieve economic growth amid the fast-changing digital environment.

First, the high positive correlation between conventional indicators (banks and ATMs), frequently used by researchers and financial institutions alike to determine the FII, indicates that the majority of Filipinos still opt for physical channels in making payments or engaging in financial transactions. While such a mindset is understandable, this also demonstrates the need to improve financial literacy of Filipinos by educating them on the use of digital financial services and the advantages it offers, particularly in terms of convenience especially in this time of health crisis. This would entail participation not only of the government such as the BSP as the driver of financial inclusion initiatives, but also participation of financial service providers to reach out to the majority of the populace especially the underbanked and underserved sectors of the society. Use of simpler or vernacular language may be more appropriate in promoting the use of digital financial services.

On the other hand, one indicator, the number of active mobile money accounts among registered ones, was significantly negatively correlated with FII. This reveals opportunities for improvements in the penetration of digital modes of payments by developing the digital infrastructure. As such, policies or programs that tackle the improvement of internet connectivity in the country are called for. To add, policy reforms targeting the marginalized and informal sectors are also suggested because individuals comprising these sectors usually engage in informal means of saving, borrowing, or getting loans. Their non-usage of digital modes payments likewise contributes to the negative correlation observed. Notwithstanding, six of the eleven indicators grouped in the first principal component that are digital finance

indicators, suggest that these have a considerable influence on the FII due to their autocorrelation. This suggests that digital financial indicators be part of the dataset needed in computing the FII. As for the construction of the correlation circle, the projections generated in the study are of good quality since two principal components were able to characterize 95.17% of the initial variability of the data.

In the attainment of a cash-lite society, BSP and the Philippine government have taken corresponding initiatives and regulations such as the establishment of NRPS and the enactment of Republic Act No. 11211. Such efforts are recognized, but more still needs to be done. Further research on financial inclusion is suggested to attain a deeper understanding of the state of financial inclusion relative to the Philippines. While this research has provided significant insights on the financial inclusion in the Philippines especially on the impact of digital payments, future research could integrate more indicators linked with the digital payment system. Moreover, including data from the year 2020 could also be done as there is a presumed major change in the values of these digital financial indicators. This is attributable to the sudden emergence of the Coronavirus disease, causing a sizeable proportion of the population to turn to digital modes of payment due to restrictions in movement and transportation. Lastly, other methods can be explored to determine and analyze the impacts of the digital payment system on financial inclusion and compare the corresponding results with the results obtained from PCA.

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Task List

Code	Description of task	Preceding Tasks	Estimated duration (in days)
A	Collection of Data	-	14
B	Data Selection	A	7
C	Data Cleaning and Standardization	B	21
D	Selection of Multivariate Technique	C	21
E	Learning Principal Components Analysis	D	14
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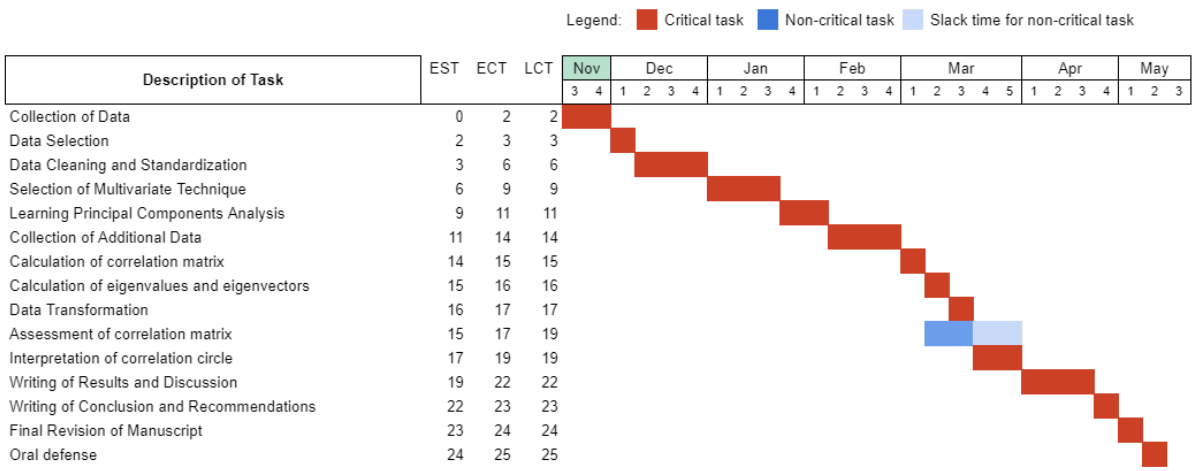
Gantt Chart



Link to spreadsheet:
https://docs.google.com/spreadsheets/d/1g4kTrZpr9FTPy15260VuRFwA0uhz2WzS1AM18Tm8eio/edit?usp=sharing

Appendix A.

Cleaned data collated from World Bank and resulting data from Z-score normalization

Table A.1. Cleaned data spanning finance-related parameters

YEAR	ATM	BANK	E-MONEY	VOL-IN	VOL-OUT	VAL-OUT	VAL-IN	REA	AEA	CBB	ATMP	FII
2011	10658	9015	11912	31	127	267	268	13341.49	10903.83	7.657381	16.80462	0.622
2012	12224	9375	15136	39	150	305	308	14335.6	11651.87	7.933654	18.8511	0.624
2013	14528	9884	10620	43	162	346	350	12106.69	8076.88	8.240555	21.92552	0.663
2014	15692	10315	13435	55	218	386	386	16088.12	10211.1	8.616383	23.18432	0.683
2015	17314	10710	19270	60	267	460	456	13524.36	9309.188	8.763675	25.043	0.701
2016	19081	11129	20636	67	299	478	478	16087.42	9929.803	8.837694	27.04162	0.705
2017	20276	11744	40198	73	317	481	482	11873.05	2972.242	8.994506	28.13506	0.711
2018	21278	12316	26455	119	406	544	546	30903.44	6849.656	9.020872	28.89884	0.734
2019	21777	12820	22975	178	449	740	745	54706.03	11680.91	9.071995	28.97211	0.74

Table A.2. Resulting data after normalization

ATM	BANK	E-MONEY	VOL-IN	VOL-OUT	VAL-OUT	VAL-IN	REA	AEA	CBB	ATMP	FII
-1.586110227	-1.374402804	-0.8852516189	-0.9174516583	-1.227921101	-1.244752091	-1.241938844	-0.4941735407	0.6602788447	-1.78562079	-1.687799138	-1.506139561
-1.193275772	-1.099063344	-0.5354380442	-0.746320779	-1.024902197	-0.9793498368	-0.9637198127	-0.4238734995	0.9288894737	-1.245509496	-1.228040151	-1.459796805
-0.6153124342	-0.7097639413	-1.025437456	-0.6607553394	-0.9189792902	-0.6929947736	-0.6715898294	-0.5814943512	-0.3548390873	-0.6455207294	-0.5373457753	-0.5561130685
-0.3233205398	-0.3801214211	-0.7200015959	-0.4040590205	-0.4246723935	-0.4136239802	-0.4211927008	-0.2999413108	0.4115292577	0.08921971795	-0.2545457414	-0.09268551142
0.08356163606	-0.07801284699	-0.08688676705	-0.297102221	0.007846141219	0.1032119876	0.06569060472	-0.4812416031	0.08766536045	0.3771742875	0.1630223925	0.32439929
0.5268173726	0.2424516911	0.06132828971	-0.1473627016	0.2903072251	0.2289288446	0.2187110722	-0.2999908124	0.3105194666	0.521880784	0.6120292274	0.4170848014
0.8265856835	0.7128232686	2.183863385	-0.01901454214	0.4491915848	0.2498816541	0.2465329754	-0.5980165686	-2.187842702	0.8284468702	0.857679743	0.5561130685
1.077939531	1.150307077	0.692707071	0.9649880137	1.234786474	0.6898906537	0.6916834262	0.7477471806	-0.7955179422	0.8799921692	1.02926936	1.089054759
1.20311475	1.535782321	0.3151167361	2.227078248	1.614343556	2.058807541	2.075823109	2.430984506	0.9393173287	0.9799371863	1.045730083	1.228083026

Appendix B

Supplementary data from PCA with data input including data points from 2019

Table B.1. Eigenvectors

	F1	F2	F3	F4	F5
ATM	0.319	-0.107	-0.171	0.023	0.132
BANK	0.324	-0.017	0.050	-0.071	0.210
E-MONEY	0.225	-0.426	0.558	0.611	0.025
VOL-IN	0.294	0.273	0.287	-0.217	0.049
VOL-OUT	0.321	0.052	0.048	0.057	0.569
VAL-OUT	0.313	0.169	0.023	0.101	-0.522
VAL-IN	0.313	0.174	0.039	0.080	-0.527
REA	0.238	0.454	0.373	-0.273	0.098
AEA	-0.104	0.646	-0.253	0.658	0.184
CBB	0.305	-0.147	-0.417	0.139	-0.099
ATMP	0.313	-0.145	-0.280	0.031	0.057
FII	0.315	-0.062	-0.338	-0.164	0.076

Table B.2. Factor loadings

	F1	F2	F3	F4	F5
ATM	0.981	-0.150	-0.104	0.008	0.026
BANK	0.998	-0.023	0.031	-0.026	0.042
E-MONEY	0.691	-0.595	0.342	0.226	0.005
VOL-IN	0.904	0.381	0.176	-0.080	0.010
VOL-OUT	0.989	0.072	0.029	0.021	0.113
VAL-OUT	0.965	0.236	0.014	0.037	-0.103
VAL-IN	0.963	0.242	0.024	0.030	-0.104
REA	0.731	0.633	0.229	-0.101	0.019
AEA	-0.320	0.902	-0.155	0.244	0.036
CBB	0.939	-0.205	-0.256	0.052	-0.020
ATMP	0.962	-0.202	-0.172	0.011	0.011
FII	0.970	-0.086	-0.207	-0.061	0.015

Table B.3. Correlations between variables and factors

	F1	F2	F3	F4	F5
ATM	0.981	-0.150	-0.104	0.008	0.026
BANK	0.998	-0.023	0.031	-0.026	0.042
E-MONEY	0.691	-0.595	0.342	0.226	0.005
VOL-IN	0.904	0.381	0.176	-0.080	0.010
VOL-OUT	0.989	0.072	0.029	0.021	0.113
VAL-OUT	0.965	0.236	0.014	0.037	-0.103
VAL-IN	0.963	0.242	0.024	0.030	-0.104
REA	0.731	0.633	0.229	-0.101	0.019
AEA	-0.320	0.902	-0.155	0.244	0.036
CBB	0.939	-0.205	-0.256	0.052	-0.020
ATMP	0.962	-0.202	-0.172	0.011	0.011
FII	0.970	-0.086	-0.207	-0.061	0.015

Table B.4. Contribution of the variables (in percentage)

	F1	F2	F3	F4	F5
ATM	10.161	1.155	2.909	0.052	1.746
BANK	10.510	0.028	0.249	0.508	4.405
E-MONEY	5.044	18.169	31.173	37.292	0.060
VOL-IN	8.623	7.448	8.257	4.699	0.242
VOL-OUT	10.325	0.270	0.227	0.325	32.343
VAL-OUT	9.825	2.871	0.054	1.015	27.237
VAL-IN	9.797	3.021	0.150	0.644	27.729
REA	5.642	20.607	13.930	7.435	0.954
AEA	1.078	41.786	6.387	43.287	3.398
CBB	9.303	2.161	17.419	1.945	0.984
ATMP	9.766	2.099	7.842	0.095	0.323
FII	9.925	0.384	11.402	2.703	0.579

Table B.5. Squared cosines of the variables

	F1	F2	F3	F4	F5
ATM	**0.963**	0.022	0.011	0.000	0.001
BANK	**0.996**	0.001	0.001	0.001	0.002
E-MONEY	**0.478**	0.354	0.117	0.051	0.000
VOL-IN	**0.817**	0.145	0.031	0.006	0.000
VOL-OUT	**0.978**	0.005	0.001	0.000	0.013
VAL-OUT	**0.931**	0.056	0.000	0.001	0.011
VAL-IN	**0.928**	0.059	0.001	0.001	0.011
REA	**0.535**	0.401	0.052	0.010	0.000
AEA	0.102	**0.813**	0.024	0.060	0.001
CBB	**0.881**	0.042	0.065	0.003	0.000
ATMP	**0.925**	0.041	0.029	0.000	0.000
FII	**0.940**	0.007	0.043	0.004	0.000

Table B.6. Contribution of the observations (in percentage)

	F1	F2	F3	F4	F5
2011	24.683	2.572	15.578	0.321	2.062
2012	15.565	2.665	8.003	15.020	1.563
2013	6.471	0.350	2.969	46.145	16.328
2014	1.597	0.345	15.352	0.324	0.872
2015	0.012	0.516	14.566	4.729	6.283
2016	0.906	0.168	20.210	16.842	2.463
2017	5.600	53.828	16.387	2.061	6.813
2018	13.328	0.960	0.308	14.536	52.757
2019	31.838	38.596	6.627	0.023	10.859

Table B.7. Squared cosines of the observations

	F1	F2	F3	F4	F5
2011	**0.954**	0.020	0.024	0.000	0.000

2012	**0.933**	0.033	0.019	0.013	0.000
2013	**0.872**	0.010	0.016	0.090	0.009
2014	**0.672**	0.030	0.256	0.002	0.002
2015	0.014	0.126	**0.686**	0.082	0.031
2016	**0.442**	0.017	0.390	0.119	0.005
2017	0.323	**0.637**	0.037	0.002	0.002
2018	**0.954**	0.014	0.001	0.015	0.016
2019	**0.795**	0.198	0.007	0.000	0.001

Values in bold correspond for each observation to the factor for which the squared cosine is the largest

Table B.8. Factor scores

	F1	F2	F3	F4	F5
2011	-4.588	0.671	0.725	-0.063	0.085
2012	-3.643	0.683	0.520	0.431	0.074
2013	-2.349	-0.247	-0.317	-0.756	-0.240
2014	-1.167	0.246	-0.720	-0.063	0.055
2015	0.101	-0.301	-0.701	0.242	-0.149
2016	0.879	-0.172	-0.826	0.457	0.093
2017	2.185	-3.070	0.744	0.160	-0.155
2018	3.371	-0.410	0.102	-0.424	0.431
2019	5.210	2.600	0.473	0.017	-0.196

Figure B.1. Observation Chart

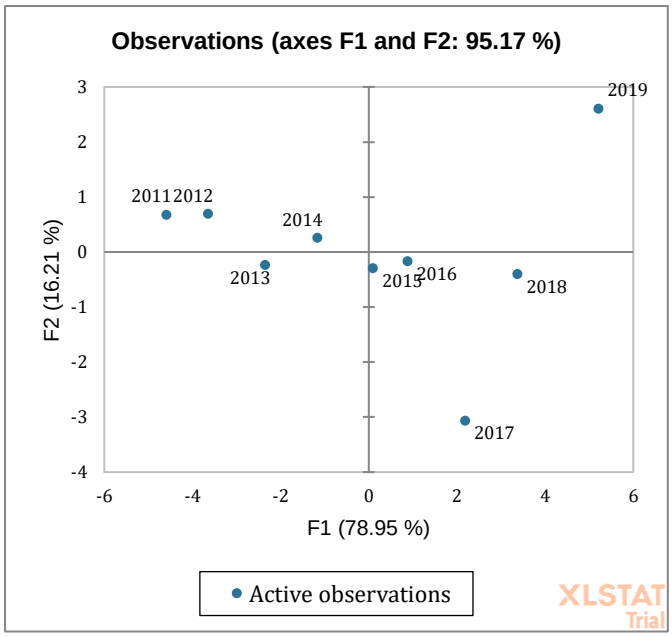


Figure B.2. Biplot among Principal Components F1 and F2