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Digital Cashless Payments and Economic Growth: Evidence from CPMI Countries

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Abstract: Research Question: This paper aims to investigate the relationships between digital payments and economic growth in 27 CPMI countries. Besides, it also studies the comparison of the impacts of digital payments between developed and developing countries. **Motivation:** Digital cashless payments have been widely discussed in recent years and the penetration of cashless payments around the globe is rising exponentially throughout the decade. Several studies have found that cashless payments have a positive impact on economic growth. However, the existing studies are mainly focusing on the European countries. Committee on Payments and Market Infrastructures (CPMI) is a new area to be explored because it consists of some countries that are seldom being investigated in the related fields previously. **Idea:** Analysis consists of GDP growth as the variable of interest and transaction volumes of debit cards, credit cards and e-money payments as the explanatory variables. Several control variables are used to capture other effects in the model. **Data:** Data are collected from various sources of database for the period of 2013-2019 covering a total of 27 countries/regions which consist of 18 developed countries and 9 developing countries in the CPMI membership. **Method/Tools:** This paper employs a fixed effect panel data model to analyse the relationship between digital payments and economic growth in (1) all CPMI countries, (2) developed CPMI countries, (3) developing CPMI countries. A comparative analysis is also performed between the developed and developing CPMI countries. **Findings:** Our findings are in line with the expectation, where all three digital payments are positively correlated to economic growth. However, only the e-money payment is statistically significant to the economic growth. Besides, the findings also indicate that the effects of digital payments on the developed economies are greater than the developing economies. **Contributions:** CPMI members have put in considerable efforts in facilitating cashless payments. The analysis of the relationship between digital cashless payments and economic growth in CPMI countries provides a review on the effectiveness of the initiatives taken by the member countries. Our findings are expected to offer some new insights related to digital cashless payments and contribute to the modern financial sector.

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JEL Classification: G50, O39

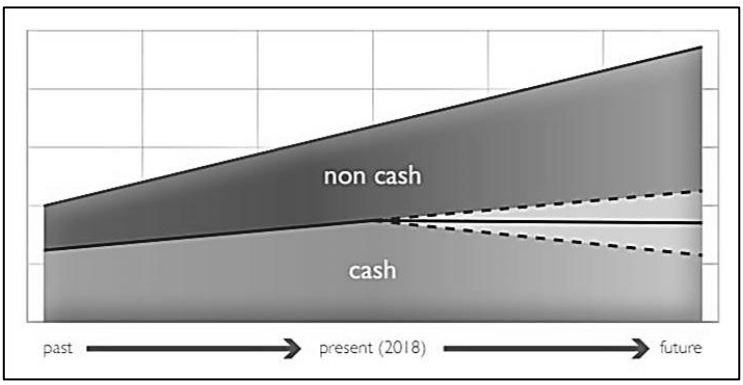
1. Introduction

1.1 Reseach Background

1.1.1 Cashless Payment

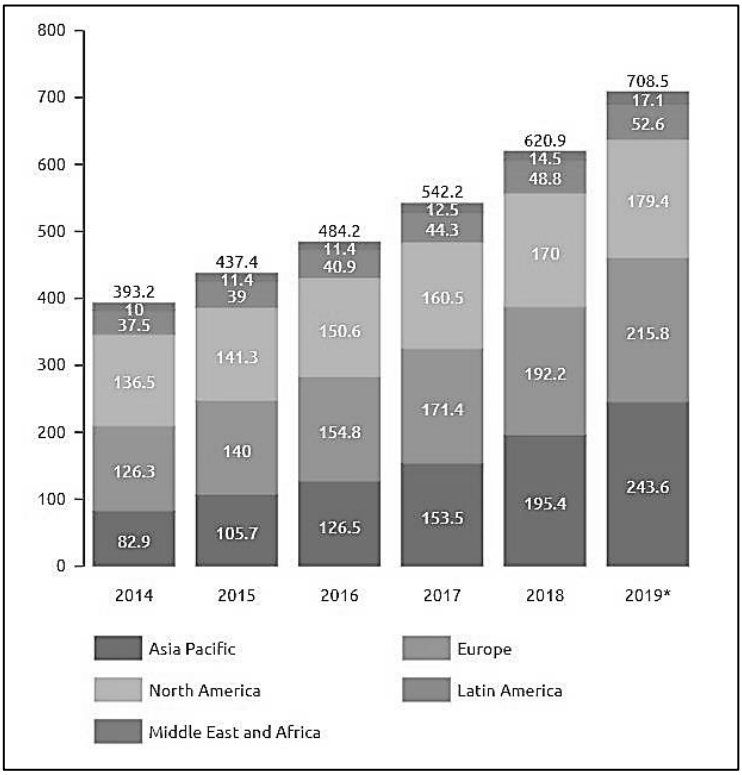
When payment is made without physical notes or coins but through the transfer between financial technologies, it is considered a cashless payment. When all the transactions within a country are made by cashless payments, the nation is considered a cashless society. A cashless transaction can be done via digital transfer payments and non-digital payments (Tee and Ong, 2016). There are several modes of digital transfer payments, which include the use of bank cards, e-wallets, internet banking, and other electronic payment applications, while non-digital payment refers to the use of cheques (Frankenfield, 2021). The history of cashless payment can be traced back to the 17th century when the first specimen of the handwritten cheque dated 1659 is found (Cheque & Creit Clearing Company, 2013). Then, in the 20th century, card payments rose as the charge cards, ATM cards, and Electronic Fund Transfer Point of Sale (EFTPOS) terminals were introduced accordingly (Moss, 2019). People start to engage in online payments and other contactless payments in the 21st century, especially when the various types of digital payment platforms were introduced.

Based on the World Cash Report 2018 by G4S Global (2018), the rates of cashless payment have grown impressively worldwide, and the increase in the cashless transaction volumes also shows that non-cash payment is overtaking cash as the most commonly used payment instruments (Figure 1). The World Payment Report by Capgemini (World Payment Report, 2020) finds that there is an upward trend in the non-cash transactions around the globe (Figure 2). Besides, the Worldpay (2021) also states that the cash usage worldwide reduced by 32% in 2020, which only accounts for just 1/5 of all face-to-face payments due to the electronic payments surge (Figure 3). Furthermore, along with the increase in e-commerce during the Covid-19 pandemic, digital and card payments accounted for around 80% of all e-commerce payment methods (Figure 4) (Worldpay, 2021).



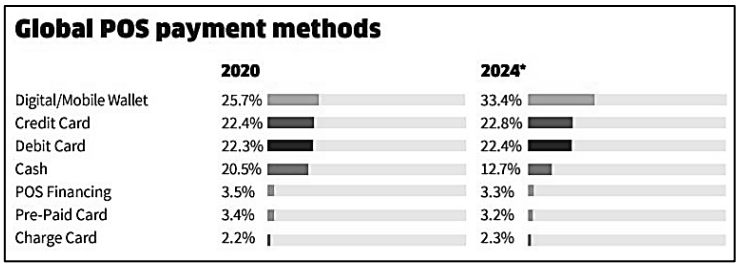
Source: World Cash Report 2018, G4S Global

Figure 1: Development of payment volumes, cash, and non-cash



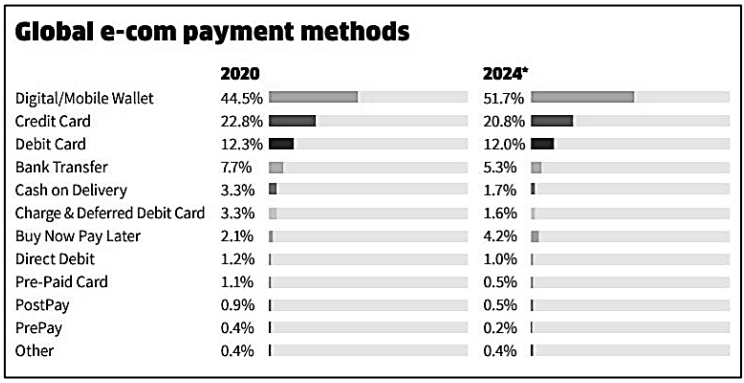
Source: World Payment Report 2020, Capgemini

Figure 2: Worldwide non-cash transactions (billions), by region, 2014-2019



Source: Worldpay (2021)

Figure 3: Global POS payment methods 2020 (current) and 2024 (forecast)



Source: Worldpay (2021)

Figure 4: Global e-commerce payment methods 2020 (current) and 2024 (forecast)

1.1.2 Cashless Payment and Economic Growth

As the globe is moving towards a cashless society, it is confidently believed that transformation from cash to cashless is beneficial to the nation's economy. The best indicator to measure an economy is the country's GDP. Based on the expenditure approach formula (equation 1.1), four key determinants will affect the country's GDP (Y), which are household consumption (C), private investment (I), government expenditure (G), and net import (NX). This equation states that there is a positive relationship between the GDP and each of the determinants.

$$Y = C + I + G + NX \quad (1)$$

The study by Lau et al. (2020) proposes that cashless payments can positively affect the country's GDP through the three channels – C, I, and G.

There are many other pieces of research studies on the economic benefits of cashless payments that support the statement mentioned above. According to Parmar (2018), one of the benefits of building a cashless society is the reduction of the risk of carrying cash. Without the physical cash, crimes such as robbery, burglary, and extortion can be effectively reduced. Besides, Bezhovski (2016), who studies the future of electronic payment systems, finds that electronic payments provide convenience and speed for the users when making transactions. In short, cashless payments increase the security and convenience for the users, thereby facilitating household consumption. Additionally, this also helps the businesses to reduce the costs such as the expenses on the security system and spending on storing cash (Hasan *et al*., 2012). Hence, this allows the merchants to increase profitability and consequently contribute to economic growth.

On the other hand, cashless payments also ensure a "black money-free nation" where the criminals are unable to bypass the financial institutions to make transactions (Parmar, 2018). Moreover, a cashless society can effectively combat corruption. It is because all the large transactions will be done digitally, and it provides an audit trail (Alaeddin *et al*., 2019). Furthermore, by building a cashless society, the collection of taxations is more effective as all the transactions are recorded, so it is easier for the government to monitor and track unscrupulous events (Parmar, 2018). Ultimately, this affects the nation's economy since the government expenditure can be increased when the tax revenue is increased and the cost of managing crimes is reduced (Shapiro and Hassett, 2012). In sum, it is strongly believed that there will be a positive relationship between cashless payments and GDP growth.

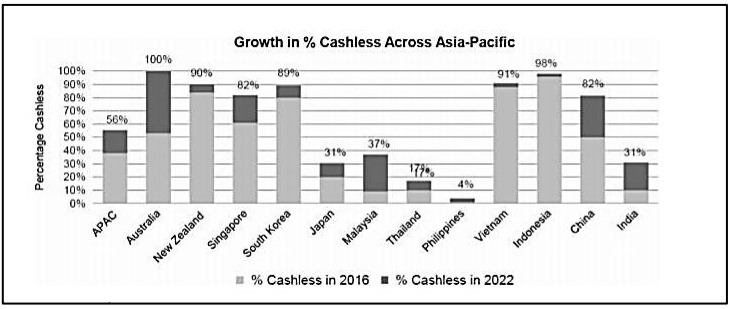
1.1.3 The CPMI Membership

The Committee on Payments and Market Infrastructures (CPMI) was previously named Committee on Payment and Settlement Systems (CPSS). It was first established in 1990 by the Group of Ten (G10) Countries Governors (Bank for International Settlements, n.d.) It consists of a group of experts on payment systems from different central banks who monitors the developments in the payment and settlement systems of the nation within the membership (Kenton, 2021). Hitherto, there are 28 central banks in the CPMI membership:

- Central Bank of Argentina
- Reserve Bank of Australia
- National Bank of Belgium
- Central Bank of Brazil
- Bank of Canada
- The People's Bank of China
- European Central Bank
- Bank of France
- Deutsche Bundesbank (Germany)
- Hong Kong Monetary Authority
- Reserve Bank of India
- Bank Indonesia
- Bank of Italy
- Bank of Japan
- Bank of Korea
- Bank of Mexico
- Netherlands Bank
- Central Bank of the Russian Federation
- Saudi Central Bank
- Monetary Authority of Singapore
- South African Reserve Bank
- Bank of Spain
- Sveriges Riksbank (Sweden)
- Swiss National Bank
- Central Bank of the Republic of Turkey
- Bank of England
- Federal Reserve Board of Governors
- Federal Reserve Bank of New York

Overall, the CPMI is an international standard-setter that aims to support financial stability by monitoring, giving advice and recommendations, as well as promoting the efficiency and safety of payment, settlement, clearing, and other arrangements (CPMI - overview, n.d.).

As the members of the CPMI that promote the development of payment systems, it is highly believed that these countries have implemented solid and secure cashless payment systems. According to the study by Frost and Sullivan (2017), Australia, Singapore, South Korea, China, and Indonesia are expected to lead the cashless payment market in APAC with a high percentage in the growth rate of cashless payment (Figure 5). Besides, Countries include Netherlands, Spain, Italy, Belgium, United Kingdom, Germany, and France are listed in the top 10 cashless countries in Europe (Rolfe, 2020).



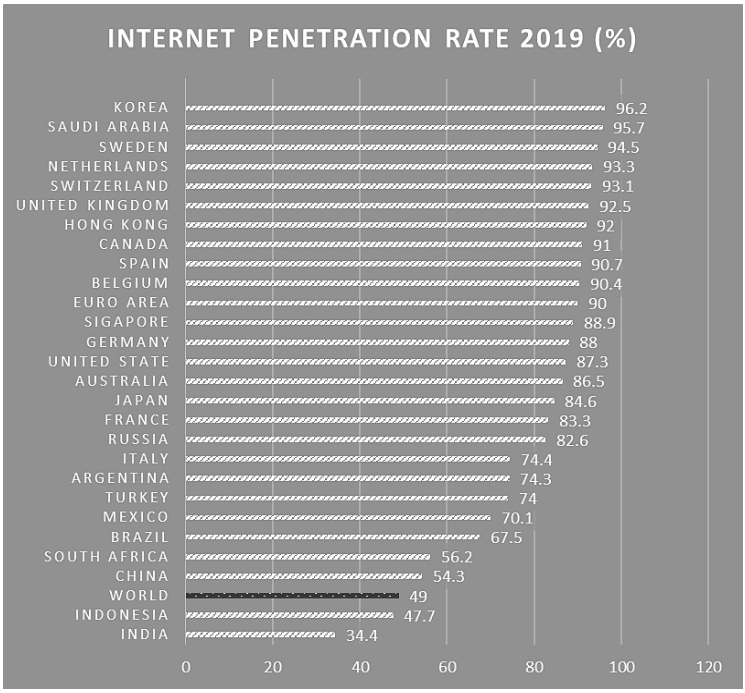
Source: Frost & Sullivan

Figure 5: Growth in % cashless across APAC 2016 (current) and 2022 (forecast)

1.2 Problem Statement

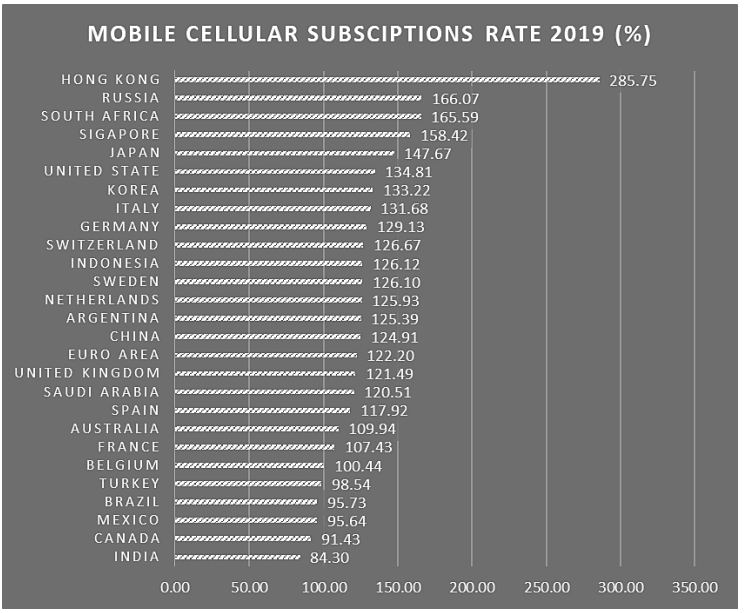
Researchers have studied the financial sector development and its impacts on the economy (Park and Shin, 2015; Cojocaru *et al*., 2016; Durusu-Ciftci *et al*., 2016). However, part of the financial sector development discussed widely in recent years is the innovation of the digital payment system (Lau *et al*., 2020). Thus, it is interesting to measure and examine the importance of digital cashless payments to the nation's economic growth by carrying out empirical research. To date, there are several empirical studies on the significance of cashless payment on economic growth. Most of the studies focus on European countries (Bolt *et al*., 2008; Hasan *et al*., 2012; Tee and Ong, 2016; Grzelczak and Pastusiak, 2020), India (Ravikumar *et al*., 2019; Sreenu, 2020), and Nigeria (Oyewole *et al*., 2013; Muyiwa *et al*., 2013).

The relationship between cashless payment and economic growth in CPMI countries is worth to be examined because there are some other countries that have not to be explored in the relevant area, such as Argentina, Brazil, Russia, China, and Singapore. On top of that, two reasons show that CPMI countries are worth to be studied as a whole. Firstly, CPMI countries have a high adoption of the internet. From Figure 6, the internet penetration rate in CPMI countries is mostly higher than the average world rate at 49% in 2019 (The World Bank, 2019). Besides, according to the statistics by The World Bank (2019), the mobile cellular subscriptions of CPMI countries are mostly higher than their population, which indicates that some citizens in the countries may hold more than one cellular device that allows them to access the internet (Figure 7). Therefore, it is strongly expected that cashless payments in CPMI countries are elevated due to the high level of internet adoption.



Source: The World Bank

Figure 6: Internet penetration rate in CPMI countries 2019



Source: The World Bank

Figure 7: Mobile cellular subscriptions rate in CPMI countries 2019

The second reason is that the members of CPMI have committed many efforts to monitor, promote, and enhance the countries' payment systems. As the trend of transiting into cashless payment, one of the priority concerns of CPMI members is the safety and integrity of cybersecurity and open digital payments (BIS Annual Economic Report, 2020). In 2016, CPMI and the International Organization of Securities Commissions (IOSCO) released specific policy guidance about cyber resilience for the financial market infrastructures (FMIs). The policy guidance aims to limit the cyber risk that may threaten the financial systems, especially the digital payment system (Guidance on cyber resilience for financial market infrastructures, 2016). In order words, the guidance has strengthened the protection and security of cashless payment. Furthermore, CPMI is also facilitating cashless payments in the nations as they find that the informal economy reduced when the usage of digital payments increased. Over the previous years, the central banks in CPMI have become more favourably towards the issuance of the Central Bank Digital Currency (CBDCs) to promote cashless payments further since it helps to eliminate the shadow economy (BIS Annual Economic Report, 2020).

In summary, the high usage of the internet and the improvement of cybersecurity is expected to increase the penetration of cashless payments in CPMI countries, resulting in a smaller informal economy as well as higher private consumption, thereby leading to economic growth in the countries. All in all, in light of the reasons above, it is necessary to analyze the nexus between cashless payments and economic growth in CPMI countries in order to validate the argument as stated above.

1.3 Research Questions

1. What are the impacts (positive/negative/unrelated) of digital cashless payments (debit cards, credit cards and e-money) on economic growth in CPMI countries?
2. What are the differences in the effects of digital cashless payments on economic growth in the developed countries and developing countries in CPMI, respectively?

1.4 Scope of Study

This paper mainly studies the digital cashless transactions volume and the GDP growth rate of 27 countries/regions in CPMI (there are two CPMI members from the United States). The digital cashless transactions mentioned above are done via credit cards, debit cards, and e-money. E-money refers to the transactions made through various e-wallets. The taken sampling period starts from 2013 until 2019 as these are the only available official data released by BIS.

1.5 Significance of Study

As mentioned above, cashless payments can be considered as "theoretically important" to economic growth as several studies find that cashless transactions enhance economic growth through the three main determinants of GDP. Nevertheless, in practice, there are other factors that affect economic growth directly or indirectly. Therefore, quantitative findings in this paper are crucial to proving the validity of the statement. By knowing the actual relationship between cashless payments and economic growth, the central banks in CPMI can check the effectiveness of the initiatives enforced by them and also take relevant actions to enhance their economic growth. For instance, if the result of this study shows that cashless payments are positively related to economic growth, the central banks can further promote the transformation from cash to cashless.

Additionally, in the context of microeconomics, this paper also aims to suggest the businesses on the transformation from traditional payment system to the digital payment system. From the aspect of users, cashless payments are convenient, efficient, and easy to use. This can be seen from the exponential increase in the usage of cashless payments every year. The result of this paper can help businesses to decide whether to install the digital payment system. Again, if the result proves that the theory mentioned above is valid, then the businesses can start to apply the cashless payment system since cashless payment increases household consumption.

1.6 Organization of Study

This paper consists of five sections: (1) Introduction, (2) Literature Review, (3) Method, (4) Findings and Discussion, and (5) Conclusion.

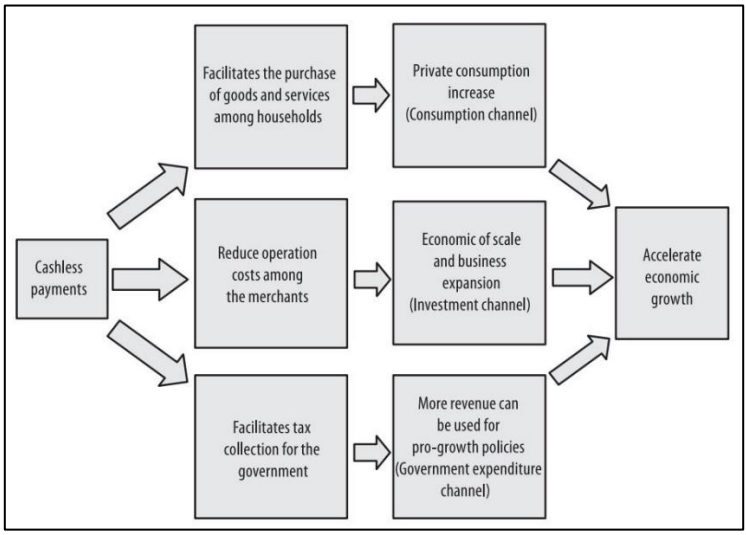
2. Literature Review

2.1 Transmission Channels of Digital Cashless Payments

Grzelczak and Pastusiak (2020) propose that the diffusion of innovation (DOI) theory which was developed by Rogers in 1995, can be used to analyze the impact of cashless payments on economic growth. This theory stated that the adoption of an innovation is mainly determined by its value, communication channels, social system, and time (LaMorte, 2019). On this basis, the diffusion of digital cashless payments should happen when the users find the improvement in the speed and convenience of making transactions and the businesses seek new profitable opportunities (Grzelczak and Pastusiak, 2020). In simpler words, people will only adopt digital payments when they find it is beneficial to them. Since the cashless payments adoption rates in CPMI countries are high, it is strongly believed that digital payments bring advantages to the users. As a result, those positive effects from the increase of cashless payments' usage can positively influence the nation's economy.

Lau *et al*. (2020) develop a transmission model in their study that explains how the positive effects of using cashless payment can lead to economic growth. As mentioned in Section 1, the model summarizes three channels of cashless payments on economic growth, which are

the household consumption channel, private investment channel, and government expenditure channel (Figure 8).



Source: Cashless Payments and Economic Growth: Evidence from Selected OECD Countries

Figure 8: Transmission channels of cashless payment on economic growth

The first channel is the consumption channel. This channel states that cashless payments increase household consumption, thereby accelerate economic growth. As people can make the payment as simple as one click on their mobile, it significantly increases the convenience of the transactions, thereby smoothing their consumption. As a result, Zandi *et al*. (2013) found that cashless payment boosted private consumption by around 0.7% in high-income countries and increased economic growth by 0.17% annually. On top of that, Adriana and Linnea (2020), who study the impact of cashless payments on Sweden's consumption, find that cashless payments can effectively reduce the pain of paying when spending. The "pain of paying" theory states that the process of handing over the money to others is like losing money; it can simultaneously cause a negative feeling and eventually lead to the avoidance or reduction of spending (Zellermayer, 1996). In the same study, they also find that there is a highly statistically significant nexus between the cashless payment percentage and the frequency of on-the-go (OTG) consumption (Adriana and Linnea, 2020). This means that higher cashless payments can lead to a higher frequency of OTG consumption. Besides, the report by Global Insight (2003) has studied the direct relationship between the share of electronic payments and real spending in many countries. The result shows that there is an average of 0.5% increase in the real consumer spending caused by a 10% increase in the share of electronic payments (The Virtuous Circle: Electronic Payment and Economic Growth, 2003). Obviously, when household consumption is increased by the use of cashless payments, it can enhance the nation's GDP growth.

Secondly, the model indicates that cashless payments can increase private investment and eventually improve economic growth. Multiple pieces of research have proven that the use of cashless payment can effectively reduce the cost of doing business and increase the profit for them. As previously described in Section 1, cashless payments can combat crimes since people and businesses are no longer carrying cash. This helps the merchants to prevent loss from robbery and theft. Furthermore, Global Insight (2003) reports that most of the merchants

who install digital payments are free from the costly materials, accounting services, and labour that need in paper-based processing. For example, all the cashier services are no longer require an employee to take charge. On the other hand, there are also the costs for digital payments, such as the expenses on the POS terminals, cybersecurity protection fees, card acceptance fees, and chargebacks. However, the costs are much lower compared to the non-digital payments. According to the report by VISA Inc. (2018) that studies the cost of digital payments and non-digital payments for SMEs, the average cost of using digital payments is 57% lower than non-digital payments. Moreover, there is also an increase of 8% in the SMEs' revenues after installing digital payments system (Digital Transformation of SMBs: The Future of Commerce, 2018). Additionally, electronic payments enable e-commerce for businesses (Deloitte, 2013). By doing e-commerce, the merchants, especially the SMEs, can expand the market size and increase their product awareness, thereby leading to economies of scale and ultimately increase their revenues. In short, the merchants can efficaciously increase their revenues, expand their business and consequently contribute more to the economic growth.

For the last transmission channel, Lau *et al*. (2020) state that cashless payments can help the government to increase revenues that can be used for government expenditure. Several studies have investigated the impacts of digital payments on the shadow economy, saying that increase in cashless payments is possible to eliminate the shadow economy. According to the International Monetary Fund (IMF), the shadow economy is also known as the informal, parallel, or underground economy. It is a part of the economy that includes illegal events and unreported transactions as well as incomes (Schneider and Enste, 2002). The economic events in a shadow economy such as money laundering, smuggling, and illegal trading are untraceable by the government. Nonetheless, one of the main characteristics of cashless payment is transparency where it can effectively increase the transparency of the financial system within the nation (Kumari and Khanna, 2017). This helps the government to track the generation of illegal transactions. Schneider (2013) finds that the usage of electronic payments in a country is negatively correlated to its shadow economy. In other words, the higher the usage of electronic payments, the smaller the size of the shadow economy. Moreover, he also concludes that the shadow economies in a country can be shrunk down by 5% if the penetration rate of electronic payments increases by 10% per annum for at least four years consecutively (Schneider, 2013). As the shadow economy becomes smaller, the tax collection can be done smoother since all the incomes are traceable by the government. A study by Immordino and Russo (2016) discover that value-added tax (VAT) evasion can be reduced by facilitating electronic payments. When the tax revenues increase, the government has more liquidity to spend on the investment and development of the country, eventually improve the GDP growth. All in all, it is strongly believed that digital cashless payments are able to accelerate economic growth by increasing household consumption, private investment, and government expenditure.

2.2 Literature Review of Previous Empirical Studies

Hitherto, several empirical studies discuss the statistical effect of cashless payments on economic growth. By looking at the papers in the last decade, most of them find that cashless payments are statistically positively related to economic growth. Hasan *et al*. (2012) analyze the relationship between electronic retail payments and economic growth across 27 European states from 1995 to 2009. The authors find that the technology of digital retail payments is correlated positively with real economic aggregates. The empirical result shows that electronic retail payments can increase the economy's efficiency, consumption, and trade and consequently accelerate economic growth. Besides, the same paper concludes that card payments have the strongest positive impact on economic growth.

Zandi *et al*. (2013) mainly focus on the impact of electronic payments in 56 countries around the world. From the study, electronic payments contributed $983 billion in global economic growth throughout the sampling period (2008-2012). In detail, electronic payments caused a 0.8% & 0.3% increase in GDP in emerging markets and developed markets, respectively. Moreover, the authors find that increase in card transactions boots the economic recovery by 0.2%. While Oyewole *et al*. (2013), who employs a multiple regression model to study the impacts of electronic cashless payments on Nigeria's economy, also states that there is a significant positive nexus between the e-payment system and Nigeria's economic growth. The paper finds that a unit change in the e-payment system can lead to three times change in the real GDP per capita in Nigeria. Furthermore, another research also studies the Nigerian economy states that there is a significant positive relationship is found between cashless banking and the Nigerian economy (Siyanbola, 2013). In 2016, Zandi *et al*. (2016) continued to study the previous topic from 2011 to 2015 but in a larger sampling size – 70 countries. This paper reiterates that electronic payments are positively related to economic growth. There is an average 0.18% increase in consumption and a 1% increase in GDP annually due to the increase in electronic payments. The authors conclude that each 1% increase in the electronic payments penetration rate can lead to an increase in consumption by around $104 billion and GDP growth by 0.04%. In addition, this paper also finds that there is a positive compounding effect in the advanced countries which have higher cashless penetration rate.

However, the research by Tee and Ong (2016) states that the impact of cashless payments on the European economy can only be effective in the long run where there is no immediate effect of the digital payments will be observed. This statement coincides with the study by Narayan (2019), which analyzes the relationship between Fintech and Indonesia's economic growth from 1998 to 2018. This paper finds that Fintech has a delayed positive effect on economic growth where the result shows there is no important effect of Fintech in the first year, but it contributes significantly to the economy starting from the second year. Yet, these results are contradicting with the study by Ravikumar *et al*. (2019) which analyze the impact of digital payments on economic growth in India from 2011 to 2019. Ravikumar *et al*. (2019) find that retail electronic payment has significant impacts on the real GDP in the short run. Interestingly, the study also reveals that digital payments will not contribute to India's economic growth in the long run.

In their latest study, Grzelczak and Pastusiak (2020), who examine the cashless payment and economic growth in selected Central, Eastern, and Western European countries in the years 2005 to 2018 find that card and e-money payments have a significant positive relationship to economic growth in the Western European countries. Meanwhile, in the Central and Eastern European countries that slightly lack of cashless technology and penetration, there is only card payment has a positive impact on economic growth. This outcome meets the suggestion by Zandi *et al*. (2016) as the cashless payments in advanced countries have a larger impact on economic growth. Furthermore, Aldaas (2020) finds a contrary result in India and Saudi Arabia. The paper states that non-cash transactions have a high and positive correlation to the Saudi Arabian economy but a low and negative correlation to the Indian economy. The author concludes that the positive impact of non-cash payments grows when the economy is moving from developing to developed stage due to the technology enhancement and cashless penetration. Again, this is corresponding to the study by Zandi *et al*. (2016) as aforementioned. Besides, Aldaas's result (2020) also shows that the positive relationship in Saudi Arabia is weakened in the short term where this statement goes in line with the outcomes from Tee and Ong's study (2016). In addition, the study by Sreenu (2020) analyzes the effects of cashless payment policy on the economic growth of India by employing the panel data cointegration test. The results of the test show that the use of e-payments is positively affecting economic growth in India. However, the study also finds that

the impacts may not be obvious in the short run, it suggests that the significance of using e-payments can be observed in the longer term.

On the other hand, Lau *et al*. (2020) test the nexus between cashless payments and economic growth in 15 OECD countries from 2007 to 2016. The study employs a random effect model to calculate the relationships. Interestingly, the result of this paper does not in line with the previous studies by other scholars. The authors find that only debit card payment has a positive impact on economic growth. In contrast, credit card and e-money payments are not related to economic growth. It is inferred that the positive effects of both payments are offset by their negative effects. Although the use of credit cards can significantly facilitate private consumption, it does increase debt accumulation among the users at the same time. This can slow down economic growth due to the increase in the default rate. For the case of e-money payment, Lau *et al*. (2020) conclude that the merchants and consumers may feel reluctant to spend massively via e-money due to the worries on the cybersecurity risk.

2.3 Hypothesis Construction

In the light of the above literature reviews on the transmission channels and previous empirical studies, a hypothesis framework is created to study the direct relationship between digital cashless payments and economic growth in CPMI countries (Figure 9).

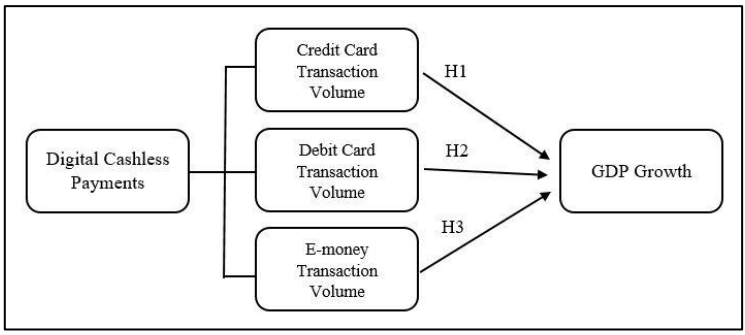


Figure 9: Hypothesis framework

The hypotheses are specified as follows:

Hypothesis 1:
H_0 = There is no significant relationship between debit card payment and GDP growth in CPMI countries.
H_1 = There is a significant relationship between debit card payment and GDP growth in CPMI countries.
Hypothesis 2:
H_0 = There is no significant relationship between credit card payment and GDP growth in CPMI countries.
H_1 = There is a significant relationship between credit card payment and GDP growth in CPMI countries.
Hypothesis 3:
H_0 = There is no significant relationship between e-money payment and GDP growth in CPMI countries.
H_1 = There is a significant relationship between e-money payment and GDP growth in CPMI countries.

Hypothesis 4:
H_0 = The impacts of digital cashless payment on economic growth in the developed countries are greater than the developing countries in CPMI.
H_1 = The impacts of digital cashless payment on economic growth in the developed countries are smaller than the developing countries in CPMI.

The first three hypotheses above are carried out to test the positive nexus between digital payments and economic growth in CPMI countries. Although there are contrary results in the previous empirical studies, it is still believed that digital payments have a positive impact on the economy in CPMI countries as most of the CPMI countries have high technology development as well as a high cashless penetration rate. Besides, the transmission channels as outlined earlier are also the main reason for the construction of Hypothesis 1 to 3. While the fourth hypothesis is developed to see the differences in the impacts of digital payments on economic growth in developed countries and developing countries in CPMI. As some of the previous researches have found that digital payments in developed countries are more likely to have a significant effect on their economy, it is worth investigating the situation in the CPMI countries.

3. Methodology

3.1 Empirical Model

A fixed effect panel data model is formed based on the variables extracted from the literature reviews and the hypotheses to measure the nexus between digital cashless payment and economic growth in CPMI countries. The empirical model is as below:

$$\mathrm{GD}P_{it} = \beta_0 + \beta_1 Credit_{it} + \beta_2 Debit_{it} + \beta_3 Emoney_{it} + \beta_4 Inflation_{it} + \beta_5 Population_{it} + \beta_6 Internet_{it} + \varepsilon_{it} \quad (2)$$

Where:

i	=	1, 2, 3 … 27, the number of the countries;
t	=	1, 2, 3 … 7, the number of the time-series;
GDP	=	GDP growth rate in CPMI countries;
Credit	=	credit card transaction volume growth rate in CPMI countries;
Debit	=	debit card transaction volume growth rate in CPMI countries;
Emoney	=	e-money transaction volume growth rate in CPMI countries;
Inflation	=	inflation rate in CPMI countries;
Population	=	population growth rate in CPMI countries;
Internet	=	internet penetration rate in CPMI countries; and
ε	=	the common residual from the combination of cross-section and time series.

Equation 2 indicates the variables used to determine the relationship between digital payments and economic growth. It includes the dependent variable, independent variables, control variables, and residual errors. GDP growth rate is the indicator of national economic condition. As the dependent variable in the model, it is used to measure the impact of digital payments on economic growth. The independent variables consist of three variables as mentioned in the hypothesis construction, which are the credit card, debit card as well as e-money payments. These independent variables are measured by their transaction volume growth rates. On top of that, there are three control variables included in the model. The control variables are used to enhance the validity of the estimation by reducing the distractions

of extraneous and other confounding variables (Bhandari, 2021; Ng, 2014). The three control variables – inflation rate, population growth, and internet penetration help the model to grasp the impact of inflation, changes in demographics, and the influence of technology enhancement within the nation. Many pieces of research have used these control variables to measure the determinants of economic growth (Lau et al., 2020).

3.2 Data Collection

The data taken in this paper cover the period from 2013 to 2019. There are a total of 27 countries/regions in the sample which consist of 18 developed countries and 9 developing countries in CPMI membership (Table 1). The list of developed countries is set based on the "List of Advanced Economies" published by the International Monetary Fund (IMF) in 2020. Most of the data are collected from various databases and the central banks (Table 2).

Table 1: List of sampled countries/regions (Sampling period: 2013-2019)

Regions	Countries
Developed countries/regions	Australia, Belgium, Brazil, Canada, Euro Area, France, Germany, Hong Kong SAR, Italy, Japan, South Korea, Netherlands, Singapore, Spain, Sweden, Switzerland, United Kingdom, United States
Developing countries/regions	Argentina, China, India, Indonesia, Mexico, Russia, Saudi Arabia, South Africa, Turkey,

Table 2: List of collected data and source

Variables	Descriptions	Measurements	Source
	Dependent Variable		
GDP	Gross domestic product	Annual growth %	WDI
	Independent Variables		
Credit	Credit card transaction volume	Annual growth %	BIS, RBA,
Debit	Debit card transaction volume	Annual growth %	ECB, BdeM,
E-money	E-money transaction volume	Annual growth %	BdeE, Riksbank
	Control Variables		
Inflation	Inflation rate	Annual growth %	WDI, TE
Population	Population rate	Annual growth %	WDI, TWB
Internet	Internet penetration rate	Annual growth %	

Notes: WDI: World Development Indicator, BIS: Bank of International Settlement, RBA: Reserve Bank of Australia, ECB: Europe Central Bank, BdeM: Banco de México, Bank of Mexico, BdeE: Banco de España, Bank of Spain, Riksbank: Sveriges Riksbank, Central Bank of Sweden, TE: Trading Ecomomics.com, TWB: The World Bank.

3.3 Econometric Methodology

First and foremost, stationarity test is carried out to test the stationarity of the dataset. This is followed by the diagnostic tests that are conducted before the regression analysis with the aim to ensure the validity of the dataset and enhance the robustness of the results. Regression is then used to analyze the relationship between digital cashless payments and economic growth.

3.3.1 Stationarity Test

In this paper, a set of panel unit root tests that consists of four individual unit root tests is conducted to identify the existence of unit roots. The panel unit root tests include the Levin-Lin-Chu (LLC), Im-Pesaran-Shin (IPS), Augmented Dickey-Fuller (ADF), and Phillips-Perron (PP) tests. The LLC unit root test assumes that the panel dataset is balanced, and it is used to identify the common unit root in the dataset (Levin *et al*., 2002). While the other three unit root tests are used to detect the individual unit root in the dataset. All the tests state a null hypothesis of a unit root and an alternative hypothesis of stationary data. First differencing or second differencing are applied if the data are found non-stationary.

3.3.2 Diagnostic Tests

Three types of diagnostic tests are conducted to ensure the validity of the regression analysis. Firstly, the Variance Inflation Factor (VIF) test is conducted to determine the existence of multicollinearity. The VIF test is used to identify and quantify the correlation among the variables. When the value is close to 1, the correlation among the variables is weak (Daoud, 2017). In contrast, the variables are highly correlated when the value is larger than 5 (Daoud, 2017). Secondly, the Likelihood Ratio (LR) test is used to check the existence of heteroscedasticity in the model. The LR test is normally used to measure the normality; it is very sensitive to the deviation from normality (Zyl, 2011). Thus, it is also suitable to be used as a diagnostic test for a constant variance in residuals over a time series (Zyl, 2011). Lastly, the Durbin-Watson (DW) test is carried out to identify the existence of autocorrelation. Basically, the dataset is considered normal when the value is between 1.7 to 2.3. Before testing the panel data regression, remedial measures are performed if the problems mentioned above are found.

3.3.3 Panel Data Regression

The static panel method is employed to quantify the nexus between digital cashless payments and economic growth in CPMI counties. Three regression analyses are conducted with the same model: Regression 1 - Overall impacts of digital payments on economic growth in all CPMI countries, Regression 2 - Impacts of digital payments on economic growth in developed CPMI countries, Regression 3 - Impacts of digital payments on economic growth in developing CPMI countries. Before running the regression analysis, the Hausman test is conducted for the model selection on the Fixed Effect (FE) or Random Effect (RE) model.

4. Findings and Discussion

4.1 Descriptive Statistics

Table 3 indicates that the descriptive statistics of the balanced panel dataset from Regression 1 that consists of 189 observations. From the table, E-MONEY has the highest average growth rate at 38.824% throughout the sampling period in CPMI countries. The mean of E-MONEY is more than the total mean of both card payments; its transaction volume increases exponentially as the maximum value of E-MONEY has up to more than 2000%. This shows that digital currency has become the main cashless payment instrument in CPMI countries. Therefore, it is expected that e-money payment has the most significant relationship with economic growth. This observation is similar to the study by Lau et al. (2020), who also find that e-money payment has the highest average growth rate in the selected OECD countries. On the contrary, CREDIT has the lowest average growth rate at 15.948%. The mean of CREDIT is slightly lower than the DEBIT (18.544%). This may be resulted by the obligation of paying debt when using credit cards to make payments. For instance, it is found that Americans prefer using debit cards instead of credit cards to avoid debt (Backman, 2017).

Table 3: Descriptive statistics (Regression 1)

	N	Mean	Median	Maximum	Minimum	Skewness	Kurtosis
GDP	189	2.311	2.139	8.486	-3.546	0.507	4.292
DEBIT	189	18.544	14.396	104.344	-10.052	2.004	9.961
CREDIT	189	15.948	11.765	94.612	-64.000	1.023	10.921
E-MONEY	189	38.824	12.398	2102.198	-97.369	9.822	109.84
INFLATION	189	3.683	1.812	53.8	-2.093	4.762	29.516
POPULATION	189	0.807	0.752	3.031	-0.328	0.557	3.865
INTERNET	189	4.731	2.702	56.591	-19.048	2.861	17.397

Notes: *N refers to the number of observations.*

Table 4 and Table 5 show the descriptive statistics for Regression 2 and Regression 3, respectively. Both the developed and developing countries in CPMI have a similar condition in the transactions growth rate of digital payments. The highest mean among the independent variables is E-MONEY, followed by DEBIT and CREDIT. Notably, the average growth rate of e-payments in developing countries is much higher than the developed countries. In contrast to the previous studies, it is expected that the impacts of digital payments on economic growth in the developing CPMI countries are greater than that of the developed CPMI countries. Besides, it can be seen that the average growth rate of GDP in developing countries is also larger than the developed countries. This may be explained by the "catch-up effect" where developing countries tend to grow faster than the developed countries due to the law of diminishing returns (Fuente, 2000). As most of the developed economies have achieved a relatively steady stage compared to the developing economies that are still at the rising stage, they tend to have slower but more stable growth in their economies.

Table 4: Descriptive statistics (Regression 2)

	N	Mean	Median	Maximum	Minimum	Skewness	Kurtosis
GDP	126	1.816	1.95	4.837	-3.546	-1.214	6.639
DEBIT	126	14.043	11.792	56.14	-10.052	1.825	7.269
CREDIT	126	12.133	10.531	83.505	-64	0.253	13.444
E-MONEY	126	35.99	6.87	2102.198	-97.368	8.466	78.863
INFLATION	126	1.443	1.276	9.03	-1.144	2.357	11.508
POPULATION	126	0.625	0.624	1.721	-0.328	0.147	2.562
INTERNET	126	2.307	1.845	17.93	-9.223	0.953	7.418

Table 5: Descriptive statistics (Regression 3)

	N	Mean	Median	Maximum	Minimum	Skewness	Kurtosis
GDP	63	3.302	2.819	8.486	-2.565	-0.08	2.173
DEBIT	63	27.545	22.334	104.344	2.061	1.88	9.15
CREDIT	63	21.779	16.35	94.619	2.061	1.928	7.645
E-MONEY	63	44.493	27.425	230.403	-16.751	1.525	4.865
INFLATION	63	8.145	4.899	538	-2.093	2.837	11.13
POPULATION	63	1.172	1.164	3.031	-0.049	0.41	3.967
INTERNET	63	9.578	6.536	56.591	-19.048	1.796	8.992

4.2 Stationarity Test

Table 6 shows the results of the panel unit root tests. Notably, all the variables have at least three out of four tests rejecting the null hypothesis in which the probability values are lower than 0.05, except for POPULATION. All the unit root tests for POPULATION fail to reject the null hypothesis. This means that population growth data is non-stationary.

Table 6: Panel Unit Root Test

Panel Unit Root Test H_0 = Unit root				
Variables	P-value			
	LLC	IPS	ADF	PP
GDP	0.0000	0.0009	0.0000	0.0000
DEBIT	0.0000	0.0067	0.0024	0.0000
CREDIT	0.0000	0.0010	0.0002	0.0000
E-MONEY	0.0206	0.3649	0.0024	0.0000
INFLATION	0.0000	0.0000	0.0000	0.5263
POPULATION	0.3781	0.9998	0.9628	0.1487
INTERNET	0.0000	0.0000	0.0000	0.0000

From Table 7, all the probability values of POPULATION drop below 0.05 after applying the second differencing. The unit root is eliminated and the dataset is now stationary.

Table 7: Panel Unit Root Test (second differencing on POPULATION)

Panel Unit Root Test H_0 = Unit root				
Variables	P-value			
	LLC	IPS	ADF	PP
GDP	0.0000	0.0009	0.0000	0.0000
DEBIT	0.0000	0.0067	0.0024	0.0000
CREDIT	0.0000	0.0010	0.0002	0.0000
E-MONEY	0.0206	0.3649	0.0024	0.0000
INFLATION	0.0000	0.0000	0.0000	0.5263
D(POPULATION,2)	0.0000	0.0000	0.0178	0.0002
INTERNET	0.0000	0.0000	0.0000	0.0000

4.3 Diagnostic Tests

As stated in Section 3, the VIF test is conducted to identify the presence of multicollinearity. From Table 8, all the values of centered VIF are below 2, suggesting that the variables are not correlated, and there is no multicollinearity in the datasets of all regressions.

Table 8: Variance Inflation Factors Test

Variance Inflation Factors Test VIF ≈ 1, no correlated; VIF > 5, highly correlated			
	Centered VIF		
	Regression 1	Regression 2	Regression 3
DEBIT	1.2172	1.0885	1.6517
CREDIT	1.6363	1.0505	1.4686
E-MONEY	1.0242	1.0870	1.2047
INFLATION	1.0044	1.1239	1.1841
D(POPULATION,2)	1.0048	1.0281	1.1979
INTERNET	1.0871	1.1234	1.1705

Next, Table 9 shows the result of the Heteroscedasticity LR test. The null hypothesis of the test states that all the residuals in the model are homoscedastic. As observed, all the probability values of the likelihood ratio are higher than 0.05, suggesting that heteroscedasticity is absent in the datasets.

Table 9: Heteroscedasticity Likelihood Ratio Test

Heteroscedasticity Likelihood Ratio Test H_0 = Residuals are homoscedastic			
	P-value		
	Regression 1	Regression 2	Regression 3
Likelihood ratio	0.9839	1.0000	0.9248

The last diagnostic test is the DW test, which is conducted to detect the existence of autocorrelation (Table 10). Unfortunately, the values of the DW statistics of all regressions are approximate 1. This indicates that there are negative autocorrelations among the variables. The presence of autocorrelations may lead to inconsistency and bias on the estimated variance of the regression coefficients, thereby causing the hypothesis test to be invalid (Asteriou and Hall, 2011). Therefore, the lagged dependent variable (LDV) is added to the model. Based on the study by Keele and Kelly (2006), it is proved that the inclusion of a LDV may eliminate the residual serial correlation when the dependent variable is stationary. Notably, the values of DW statistics are between 1.7 and 2.3 after the LDV is added. When the value of DW statistics is approximately 2, it indicates that the autocorrelation is mostly remedied.

Table 10: Durbin-Watson Test

Durbin-Watson Test DW ≈ 2, no autocorrelation; DW ≈ 0, negative autocorrelation; DW ≈ 4, positive autocorrelation			
	DW stat		
	Regression 1	Regression 2	Regression 3
Durbin-Watson	0.8218	1.2167	1.0565
LDV = GDP(-1)	1.9204	1.7191	2.0978

Notes: LDV refers to Lagged Dependent Variable.

4.4 Panel Data Regression

As aforementioned, the Hausman test is conducted to select the appropriate model for the estimation of this study. Table 11 reveals the result of the test. All the probability values of the test are less than 0.05, which reject the null hypothesis of a Random Effect model. Stated differently, the Fixed Effect model is appropriate for all the regressions. It suggests that the differences between cross sections can be accommodated from different intercepts; the dummy variable technique is used to capture the differences (Zulfikar, n.d.).

Table 11: Hausman Test

Hausman Test H_0 = Random Effect Model			
	P-value		
	Regression 1	Regression 2	Regression 3
Cross-section random	0.0001	0.0026	0.0000

4.4.1 Impacts of Digital Payments on Economic Growth in All CPMI Countries

Finally, Table 12 indicates the result of Regression 1 – the overall impacts of digital payments on economic growth in all CPMI countries. Typically, the coefficients and probability values are observed to interpret the relationships between each of the independent variables and economic growth. Based on the table, all digital cashless payments (DEBIT, CREDIT and E-MONEY) are positively related to economic growth in CPMI countries. Notwithstanding the positive coefficient, only e-money payment has a significant relationship with economic growth. Both card payments have no significant relationship with economic growth in CPMI countries as the probability values are larger than 0.1, which fails to reject the null hypotheses 1 and 2. The R-squared value is at 0.8431, which implies that over 84% of the changes in the dependent variables are successfully explained by the independent and control variables.

Table 12: Fixed Effect Panel Data Regression 1

Fixed Effect Panel Data Model Dependent Variable = GDP				
Independent/Control Variables	Coefficient	Standard Error	t-Statistic	Probability Value
C	2.9217	0.3415	8.5547	0.0000
DEBIT	0.0084	0.0112	0.7483	0.4561
CREDIT	0.0114	0.0070	1.6421	0.1038
E-MONEY	0.0009	0.0005	1.7880	0.0769
INFLATION	-0.2193	0.0327	-6.6971	0.0000
D(POPULATION,2)	-0.0062	0.3451	-0.3212	0.7487
INTERNET	-0.0062	0.0147	-0.4194	0.6759
GDP(-1)	-0.0642	0.0927	-0.6927	0.4902
R-squared = 0.8431				

The result of the regression model shows that economic growth in CPMI countries is statistically affected by e-money payment. Thus, alternative Hypothesis 3 is supported. As observed, economic growth in CPMI countries will increase by 0.0009 percent when the

transaction volume of e-money payment increases by 1 percent. This result conforms with the study by Grzelczak and Pastusiak (2020), who also find that e-money payment facilitates economic growth in Western European countries. However, some of the previous studies have a contrasting result (Hasan *et al*., 2012; Zandi *et al*., 2013). They find that e-money payment is not as important as card payments in the relationship with economic growth. Lau *et al*. (2020) also reveal that e-money payment has no significant effect on economic growth in some OECD countries. These contrasting results may be due to the different sampling periods. The sampling periods taken by Grzelczak and Pastusiak (2020) as well as this paper are later than the three studies above, which focus on the late 2010s. In contrast, the sampling period taken by those three studies is before the year 2016. According to the World Payments Report by Capgemini (2018), e-money usage is proliferating in the late 2010s, especially in the wake of the fast development of the e-commerce market and the technology advancement. Several studies (Zandi *et al*., 2016; Grzelczak and Pastusiak, 2020; Aldaas, 2020) also find a positive relationship between digital payments and technology development. As the technology becomes more advanced in the late 2010s, the transaction of e-money payment is more secured, thereby increasing the usage of e-money. In fact, this statement is supported by the data collected in this paper, where the transaction volume of e-money has the highest average growth rate in CPMI countries from 2013 to 2019. Briefly, in the light of the development in the e-commerce market and technology, the usage of e-money payment increases and ultimately boosts private consumption and economic growth.

On the other hand, Table 12 shows no significant nexus between card payments and economic growth in CPMI countries. These results are contrary to the previous researches, where most of the earlier studies have found that debit card (Lau *et al*., 2020; Hasan *et al*., 2012; Zandi *et al*., 2013) and credit card payments (Hasan *et al*., 2012; Zandi *et al*., 2013) accelerate economic growth. There are a few reasons that may explain the outcome of the regression analysis. For debit card payment, one possible explanation for failing to reject the null Hypothesis 1 may be the substitution effect between e-money payment and debit card payment. The major payment method varies over time; Hasan *et al*. (2012) propose that cheque payment is being substituted by card payments since the 2000s due to the convenience of using cards. While debit card and e-money payments have similar functions where both of them help the users to store money and make transactions conveniently. However, the similarities stop there. E-money payment provides faster transactions and various rewards to the users. According to Pachpande and Kamble (2018), debit card payment requires access to the POS terminals or an ATM counter while e-money payment can be done anywhere, anytime without carrying the cards. Besides, consumers nowadays tend to use e-money payments to collect loyalty points in order to claim the rewards provided by the merchants or e-wallet applications. Lee *et al*. (2020) who study the factors affecting e-wallet adoption, have found that rewards that are used by retailers to retain customers' loyalty to have a positive significant relationship with e-wallet adoption. Therefore, in this context, it can be deduced that e-money payment has substituted debit card payment in the late 2010s. Remarkably, this argument corresponds with the descriptive statistics in Table 3, where the mean of the E-MONEY is more than double compared to DEBIT. Thus, the effect of debit card payment on economic growth is shrunk due to its decreasing usage in CPMI countries during the sampling period.

For credit card payment, its function is slightly different from debit card and e-money payments. A credit card does not pay from the user's saving account, but it charges to the user's credit line. One of the reasons that null Hypothesis 2 cannot be rejected is the low usage of credit cards as mentioned in Section 4.1, where some people seldom use credit cards to avoid paying debt. The second reason may be the offsetting effect of the positive and negative impacts of credit card payment as proposed by Lau *et al*. (2020). The credit card provides an

immediate credit to the users, causing an increase in their purchasing power and subsequently increasing the aggregate demand in the economy, thereby facilitating economic growth (Zandi *et al*., 2016). Nevertheless, it also brings negative effects to the economy on the other hand. The accumulated household debt increases when the usage of credit card payments increases. Several studies (e.g. Lombardi *et al*., 2017; Samad *et al*., 2020) have proved that household debt is negatively related to economic growth in the long run. According to the Global Financial Stability Report by IMF (2017), the increase in household debt is likely to boost unemployment and drag down economic growth in three to five years. Therefore, it is inferred that the immediate positive effect of credit card payment is offset by its negative effect in the long run, leading to the insignificant relationship between credit card payment and economic growth in CPMI countries.

In general, the overall result of the regression analysis is moderately in line with the hypotheses made in this study. As mentioned above, all the digital payments are found positively correlated with GDP growth. This validates the estimation of this paper, in which digital payments can positively influence economic growth through the three transmission channels as described in Section 2. However, only one out of three alternative hypotheses is achieved, which is the significant relationship between e-money payment and economic growth. Other than the reasons stated above, the insignificant relationships and low coefficients of the other two hypotheses may be explained by the conclusion obtained by several scholars including Tee and Ong (2016), Narayan (2019), Aldaas (2020), and Sreenu (2020) who conclude that cashless payment will only have a significant effect on economic growth in the long run. This is because the transformation to a cashless society will not be achieved in near future, so the impact of cashless payments will be affected by the current payment method (Tee and Ong, 2016). This limits the impact of cashless payments on economic growth in the short run. Besides, Tee and Ong (2016) and Sreenu (2020) also find that the adoption of one type of cashless payment will be affected by another type of cashless payment in the short run. This explains the results of this study, where the decrease in bank card usage leads to an increase in e-money usage, thereby causing a significant relationship between e-money and economic growth in the short run.

4.4.2 Comparison Between The Impacts of Digital Payments on Developed Economies and Developing Economies in CPMI

Table 13 shows the regression analysis for the relationship between digital payments and economic growth in 18 developed CPMI countries. As expected, all digital payments have a positive effect on economic growth. Remarkably, it is found that debit card and e-money payments have a p-value below 0.1, suggesting a statistically significant (albeit weak) relationship with economic growth in the developed countries.

Table 13: Fixed Effect Panel Data Regression 2

Fixed Effect Panel Data Model Dependent Variable = GDP				
Independent/Control Variables	Coefficient	Standard Error	t-Statistic	Probability Value
C	3.4431	0.3806	9.0471	0.0000
DEBIT	0.0391	0.0170	2.2935	0.0253
CREDIT	0.0054	0.0049	1.1095	0.2716
E-MONEY	0.0007	0.0004	1.6733	0.0908
INFLATION	-0.6827	0.0898	-7.6055	0.0000
D(POPULATION,2)	-0.1368	0.2333	-0.5863	0.5598
INTERNET	-0.0260	0.0244	-1.0657	0.2907
GDP(-1)	-0.0497	0.1048	-0.4745	0.6369
R-squared = 0.8147				

On the other hand, Table 14 indicates the outcomes of the regression analysis for the relationship between digital payments and economic growth in 9 developing CPMI countries. Similarly, all digital payments are positively correlated to economic growth. However, none of these digital payments is found to have a significant relationship with economic growth in the developing countries.

Table 14: Fixed Effect Panel Data Regression 3

Fixed Effect Panel Data Model Dependent Variable = GDP				
Independent/Control Variables	Coefficient	Standard Error	t-Statistic	Probability Value
C	3.9670	0.9886	4.0128	0.0005
DEBIT	0.0053	0.0219	0.2429	0.8101
CREDIT	0.0563	0.0552	1.0207	0.3172
E-MONEY	0.0033	0.0048	0.6881	0.4977
INFLATION	-0.1996	0.0487	-4.0978	0.0004
D(POPULATION,2)	-1.8379	7.2144	-0.2548	0.8010
INTERNET	-0.0016	0.0233	-0.0671	0.9470
GDP(-1)	-0.1800	0.1749	-1.0289	0.3134
R-squared = 0.8890				

By comparing both Regression 2 and Regression 3, it can be concluded that the impacts of digital payments on the developed economies are greater than the developing economies. Thus, null Hypothesis 4 cannot be rejected. This result is contradicting to the earlier expectation in Section 4.1, where the average growth rate of digital payment transaction volumes in the developing countries is much higher than the developed countries in CPMI. However, it goes in line with the results from previous studies such as Zandi *et al.* (2016) and Aldaas (2020), who also find that cashless payments in advanced countries have a larger impact on economic growth.

One of the possible reasons that developed countries have a lower growth rate in digital payments may be due to its maturity stage in the e-payment market. For example, cashless payments have been popular in the developed countries such as the United States and the United Kingdom since 20 years ago, but they have slowly started to be known in developing countries in the 2010s, which is almost one decade behind the developed countries in term of the information technology (Sacco, 2020). According to Pelletier *et al*. (2014), it is found that developing countries tend to have faster growth in digital payments compared to the developed countries. This is because the financial services in developing countries tend to be more expensive, causing many citizens to use digital payments rather than banking services.

In spite of the faster growth rates, digital payments in developing CPMI countries are found to have no influence over economic growth. This may be resulted by the lower internet penetration rates in the developing CPMI countries. Looking at Figure 6, most of the developing countries such as Indonesia, India, South Africa and Mexico are found to have a lower internet penetration within the nation. Although the growth rates of digital payments in these countries are rapid, there are still many rural areas inside the country that have no access to the internet. Therefore, it is inferred that the transaction volumes of digital payments in these developing countries account for only a tiny proportion of their GDP, thereby digital payments have no significant relationship with economic growth.

5. Conclusion

5.1 Closing Remarks

This paper studies the relationships between three types of digital cashless payments and economic growth in CPMI countries from 2013 to 2019. Most of the existing articles mainly

focus on European countries or a single country, the results of those findings may not be applicable to the CPMI countries due to the differences in the economic model, technology, payment habit and so forth. By employing new evidence, this paper is able to provide new insights on the impacts of digital cashless payments on economic growth in CPMI countries which include APAC countries such as Singapore, China, Indonesia, Japan, and South Korea that are seldom investigated by previous studies. Besides, the sampling period of this study is also later than the previous papers, thus providing the latest findings in this research area which is varied from the previous results because of the changing consumer payment habits and technology development over time.

The empirical results of this paper show that all three digital payments – debit cards, credit cards and e-money are positively correlated to GDP growth in CPMI countries. Particularly, there is a significant relationship between e-money and economic growth which means that e-money payment is found to facilitate the economy of CPMI countries. In contrast, both card payments are found to have no significant relationship with economic growth due to the substitution effect and the offsetting effect as described in the last section. Besides, it is believed that the impacts of digital payments on economic growth will be stronger in the longer period since no country has fully transformed into a cashless society to date. On the other hand, the results also indicate that the impacts of digital payments on economic growth in the developed countries are greater than in the developing countries in CPMI. Debit card and e-money payments are found to have a significant relationship with the economic growth in developed CPMI countries. In contrast, for the developing CPMI countries, none of the digital payments are found to have a significant relationship with economic growth.

5.2 Implications and Recommendations

E-money payment is found to have a significant nexus with economic growth. This result indicates that the initiatives implemented by the CPMI countries are necessary, especially in the era that is adapting rapidly to the development of information technology. As aforementioned in Section 1, the central banks have put a lot of efforts into the improvement of the cybersecurity of digital payments to decrease the rates of cybercrimes and advocate the usage of digital payments. In spite of that, the efforts that have been enforced to date may seem to be not as effective as expected in terms of spurring the economic growth. Thus, the central banks in CPMI membership should take additional actions in the future to enhance the positive impacts of digital payments on economic growth.

The primary action that should be implemented by the central banks is to bring up the awareness of using digital payments to the public, especially the older generations. Vaportzis *et al*. (2017) who study older adult perceptions of technology find that there are several barriers that stop the elder generations to use the new technologies. One of the main barriers is the lack of instructions and guidance. The study states that most of the younger people tend to directly complete the digital tasks for the elderly when asked for assistance, instead of guiding them to complete the digital tasks. Besides, the study by Liébana-Cabanillas *et al*. (2015) also reveals that the older population tends to avoid the use of mobile payment due to their lower technology propensity and the higher requirement of the influence from other people. Therefore, the central banks should join hands with different parties such as the government, mass media, and education institutions to propagate the essentials of using e-payments by providing the public with guidance and instructions on using those digital payment applications. For example, the Singapore government becomes an exemplar and is doing well in guiding its senior population to use e-payments and empowering them to use the technology confidently and securely in their daily life. The Infocomm Media Development Authority (IMDA) of Singapore convened volunteers to assist the senior users in using the applications and learning about different modes of e-payments (Leonards, 2019).

Moreover, the central banks are highly recommended to encourage the merchants in the nation to adopt the digital payment system for their customers. As described previously, implementing a digital payment system can bring various benefits to retailers. However, the developing country in CPMI such as India is facing relatively low adoption of the digital payment system by the small retail stores. Several studies (Seethamraju and Diatha, 2018; Ligon *et al*., 2019; Priya and Fathima, 2021) find that many small retail stores in India still refuse to adopt digital payment system even though the government has made substantial efforts to decrease the use of cash. Seethamraju and Diatha (2018) conclude that the main factor of the low adoption is the low confidence in changing the consumer habits which may threaten their survival due to the loss of loyal customers. Besides, Ligon *et al*. (2019) provide the reasons from another aspect. Their study shows that most of the small retailers refuse to use the digital payment system due to the taxation policy. As the transaction records are trackable after digitalizing the payment system, the merchants may be required to register for the goods and services tax (GST). The charging of GST may cause the business to become more competitive and the retailers are required to pay more taxes. To facilitate the adoption of digital payments by the retailers, the policymakers can provide subsidies to the retailers in order to satisfy the costs of the installation of the system. Most importantly, raising the consumers' awareness of using digital payments is essential so that the retailers are confident to adopt the system.

5.3 Limitations and Future Research

There are some limitations of the study that may affect the accuracy of the results. The available period of data is only from 2013 to 2019, which is relatively short. The short sampling period may weaken the precision of the estimation. Moreover, our study does not include the presence of the Covid-19 pandemic which has the severe impacts on the economy since 2020. According to several pieces of studies (such as Sornaganesh *et al*., 2020; United Nations Conference on Trade and Development, 2020; KPMG, 2020), the usage of digital payments is boosted during the Covid-19 pandemic due to the lockdown in many countries and the rise of various e-commerce activities. The results could have been significantly changed if the effect of the Covid-19 pandemic is accounted into the dataset. In addition, this paper only studies three types of digital cashless payment methods due to the limitation of the available data. Nevertheless, there are many other types of digital payment methods such as internet banking, charge cards, direct debits, pre-paid cards, etc. The inclusion of more types of digital payment methods will increase the preciseness and the robustness of the impacts of digital payments on economic growth.

Future research may analyze the effects of digital payments on each of the determinants of GDP (i.e. household consumption, private investment and government expenditures). This will provide a more direct relationship and insights of the impacts of digital payments as they first affect the determinants of GDP before influencing the economic growth via the transmission channels of digital payments as mentioned in Section 2.

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