BANK OF THAILAND

Digitalization on Financial Services and Implications for Monetary Policy in Thailand

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Abstract

This study analyzes the impacts of digitalization on financial services on monetary policy in Thailand. Our empirical findings show that an increasing usage of electronic payment (e-Payment) among Thai people has small substitution effect on cash demand. Cash usage continues to rise along with size of the economy. Therefore, e-Payment has no apparent effect on monetary policy at this moment. However, the effects will gradually materialize consistent with e-Payment usage and government policies. In terms of efficiency, the study finds that digital payment usage could reinforce the effectiveness of monetary policy transmission in several channels, especially the asset price channel. This is because people could shift their portfolio investment more conveniently with lower costs. Moreover, our scenario analysis of the coming digital currency shows that if the daily use of cryptocurrencies becomes more popular, especially those which are not tied their prices with national currency, their widespread adoption might lead to lower demand for local currency and yield negative impacts on monetary policy. Hence, the issuance of central bank digital currency is one option that central banks could prepare to preserve their credibility on maintaining monetary and financial stability for the country.

The opinions expressed in this paper are those of the authors, and do not necessarily represent those of the Bank of Thailand.

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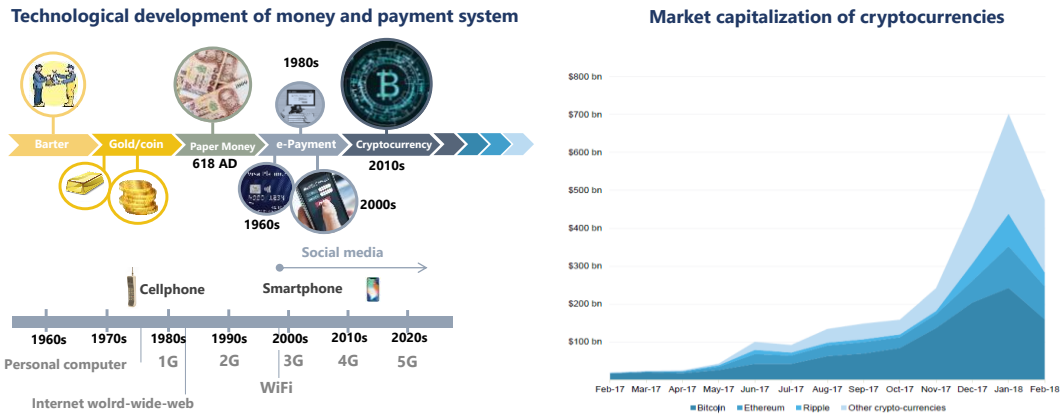
Digitalization on Financial Services and Implications for Monetary Policy in Thailand

1. Introduction

Financial innovations worldwide have been developed continuously, widely, and rapidly along with technological advancement that facilitated the evolution of money and payment platform in each era. Beginning with the era using money as a medium of exchange instead of the barter system, physical commodity money was replaced by precious metal money with intrinsic value. In the present day, money has been issued in form of fiat money such as banknotes and coins without intrinsic value but it has been declared with legal tender. Regardless of the form of money, in principle, money serves for three main functions, namely, (1) a medium of exchange, (2) a unit of account, and (3) a store of value. Apart from the evolution of money, payment systems have also been developed continually. Starting from centralized systems with financial intermediaries, especially the banking system which the banks act as intermediaries for depositing, withdrawing, and transferring money. Consequently, technological advancement has been developed for money transfer across banks under electronic payment (e-Payment) systems.

Nowadays, non-banks enter the financial services market with greater role. The technological advancement enables decentralized payment without any financial intermediary and also facilitates development of new financial products in substitution of cash, such as checks, credit cards, debit cards, and digital money (e-Money). To the present day, there has been new ideas in developing digital currencies instead of using fiat money. Moreover, cryptocurrencies, which are not considered legal tender and made by strong cryptography to secure and verify financial transactions, have been increasingly used through some peer-to-peer transactions (Figure 1) in form of valued-or-token-based form. The evolution of money and payment systems as mentioned need technological supports from telecommunication infrastructure such as high-speed internet, smart phone, 3G/ 4G/ 5G technology, distributed ledger technologies (DLT) or blockchain.

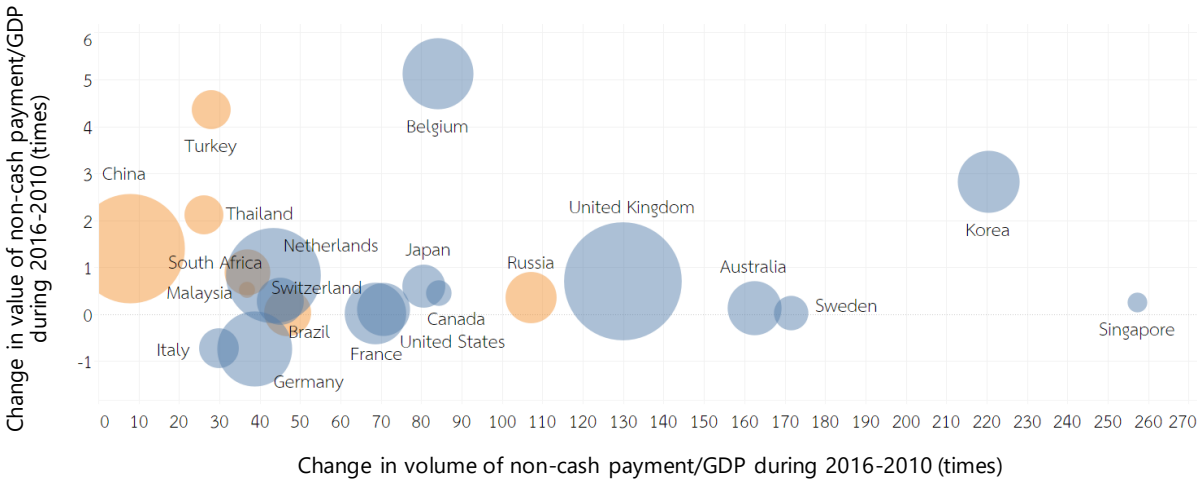
Figure 1 Technological development of money and payment system
Market capitalization of cryptocurrencies



Souce: GreySpark Partners; collected by authors

New financial innovations have led to a widespread use of new payment instruments instead of cash such as e-Payment. However, literatures have not yet clear conclusion on the substitution effect between e-Payment and cash, which depends mostly on the degree of technological adoption among the citizen. Figure 2 shows that value of e-Payment use is greater than the size of economy for some countries, for example Singapore, South Korea, Australia, Russia, and Canada. Specially, this evidence also happens in Sweden, which is one of the first countries moving to a cashless society with a sharp decline in demand for banknotes since the 1990s from 5% of GDP to 1.4% of GDP in 2017 (Bank of Canada, 2018). In addition, such trends have been found in other advanced economies such as Norway, Denmark, and England.

Figure 2 e-Payment use in selected countries



Note: (1) Size of bubble = value of non-cash payment/GDP in 2016.
(2) Data of China and Germany show changes from to 2015 and 2014, respectively, while Netherlands Switzerland and United States show changes from 2012 due to changing in data collection methods.
Sources: BIS statistics on payments and financial market infrastructures in the CPMI countries (Red Book), Bank of Thailand

Although e-Payment usages continue to increase in Thailand, cash usage remains popular. Cash-to-GDP ratio in Thailand has not significantly declined as happened in Sweden. Over the past five years, e-Payment use in Thailand has increased by 2% of GDP, while cash-to-GDP ratio remained around 9%. These evidences show that Thailand still be in the early stage in transition towards cashless society. However, given a pace of technological innovation in payment infrastructure, new payment instruments have been developed and widely used in many countries, including Thailand, such as internet banking, mobile banking, and electronic money (e-Money). Moreover, structural changes in Thai economy, for example, aging society and e-commerce trends, and development in payment infrastructure have contributed to long-term potential growth in Thailand. The policymaker, in particular, in the conduct of monetary policy, should aware of such changes and policy implications.

This paper aims to study impacts of digitalization in financial services for monetary policy in Thailand. The objectives of this study are, namely (1) to deepen understanding of new development of digitalization in financial services and its trend toward cashless society in the future, and (2) to assess impacts of digitalization in financial services on transmission and effectiveness of monetary policy in Thailand. Some empirical literatures in Thailand found that such impacts were limited. Moenjak (2001) found that using e-Money in substitution of cash could alter velocity of money and complicate monetary targeting framework by setting appropriate monetary level corresponding to economic activities. Regarding impacts on financial market, it might reduce central bank's assets used for intervention. However, the ability of central bank to determine short-term interest rates in the money market has been intact. Thanapornpan and Banchuen (2010) found that increasing use in debit cards had negative impacts on cash in circulation. However, small volume of debit card usage and its gradual popularity would not lead to a significant decline in cash usage that could subsequently have much implications on monetary policy.

This paper will analyze impacts of digitalization in financial services in central bank's perspectives, in particular, its implications for monetary variables and effectiveness of monetary policy. Such changes, both domestically and internationally, may cause a reduction in cash demand and subsequently affect the size of central bank balance sheet. Moreover, fast and convenient financial services could also lead to volatile cross-border capital flows. These issues should fall into monitoring area of central bank. In particular, the BOT has launched the National e-Payment Strategy Plan in 2016 aiming to promote e-Payment for greater use. The BOT plays a crucial role in developing the PromptPay system, a centralized payment infrastructure that could facilitate faster and more convenient payment at a lower cost.

The scope of this study and research questions cover two types of financial services in the digital age, including present and potential types, as follows:

(1) Electronic payment (e-Payment) is an electronic payment through financial intermediaries, both financial and non-financial institutions. This part includes three main types of retail e-Payment, namely card payment, internet banking and mobile banking, and e-Money. Thai people have been familiar with these kinds of retail e-Payment services with increasing trend in line with government policy and technological access.

Research Question: Does e-Payment substitute cash usage in Thailand? How much such changes do affect monetary variables, central bank balance sheet, velocity of money, money multiplier, and transmission mechanism of monetary policy?

(2) Digital currencies in this study cover potential use of cryptocurrency and digital currency issued by the central bank (central bank digital currency: CBDC) in Thailand. Although the CBDC has not yet currently issued in Thailand, private cryptocurrencies have become of greater use.

Research question: How does the greater use of cryptocurrencies among Thai people affect transmission mechanism of monetary policy? If these cryptocurrencies gain more

popularity overtime, how would it affect transmission mechanism of monetary policy? Are there any options for central bank to maintain monetary policy effectiveness?

The study consists of four sections. **Section 1** portrays overall development in Thai payment system and implication for monetary policy. **Section 2** studies development of Thai payment systems over the years, relationship of e-Payment and monetary variables, and its implications for monetary policy in theoretical and empirical perspectives. **Section 3** employs scenario analysis to assess potential impact of cryptocurrencies on transmission mechanism of monetary policy. This section also shows whether the central bank's digital currency (CBDC) could be used as a policy tool to maintain effectiveness of monetary policy. **Section 4** concludes.

2. Development of Payment Systems in Thailand and Implications for Monetary Policy

2.1 Payment Behavior and Payment System Development

According to Thailand's Survey of e-Payment usage in 2017, cash remains the most preferred payment method. As shown in Table 1, Thai people transact in cash up to around 93% of all transactions. The ratios of other Asian countries vary, for instance, Singapore and South Korea were around 60% and 36%, respectively. In contrast, the cash ratios of developed countries, namely Norway, Sweden, and Denmark, were account for only 10% to 20%. The important reasons behind those countries' lower cash usage ratios are well-developed financial payment system as well as strong support from government policy.

Table 1 Cash payment transactions in selected countries

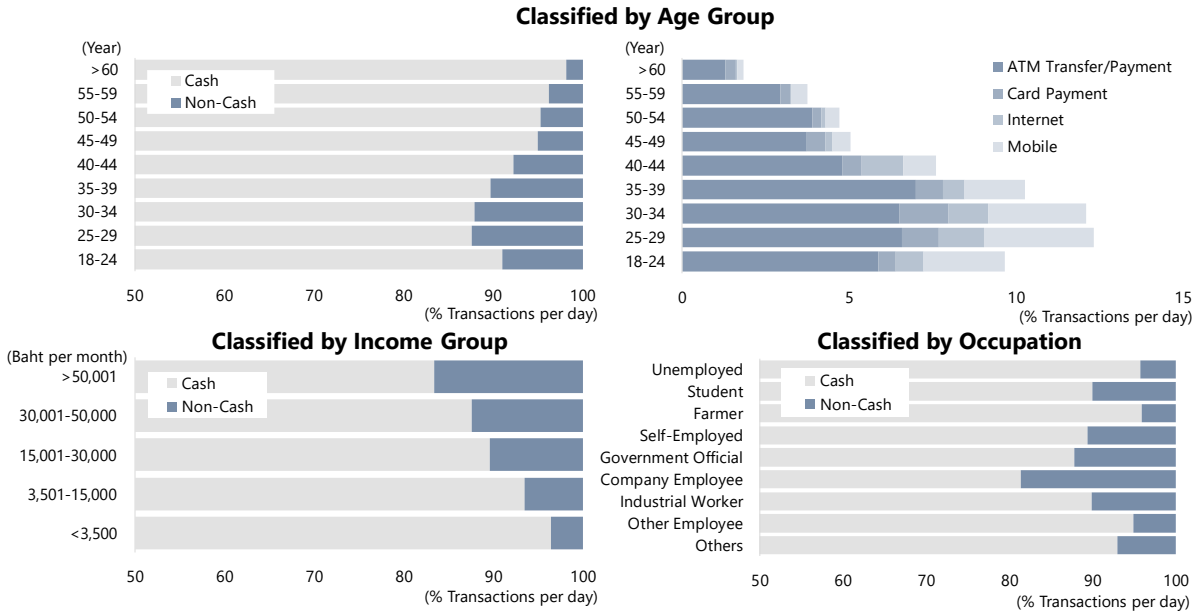
Countries	Survey year	Cash payment transactions [1/]	
		% of Total volume	% of Total value
Thailand[2/]	2017	93	-
Euro area total	2014-2016	79	54
Greece	2015-2016	88	75
Italy	2015-2016	86	68
Germany	2014	80	55
France	2015-2016	68	28
Finland	2015-2016	54	33
Netherlands	2016	45	27
Singapore[3/]	2015	60	-
United Kingdom	2016	44	15
South Korea[4/]	2015	36	29
United States	2016	31	8
Denmark	2017	23	16
Sweden	2019	13	-
Norway	2017-2018	11	6

Note: [1/] Most data, except for Thailand, Singapore, and South Korea, is based on the Norges Bank's 2017 Retail Payment Services Report. The report indicates that most countries collected data from sample-based household surveys, but varying in different survey methodologies, types of payment included in the surveys, and the dates when surveys were conducted.
[2/] Thai data is based on Thailand's 2017 Survey of e-Payment Usage conducted by the Payment Systems Policy Department, Bank of Thailand.
[3/] Singapore data is referenced by Singapore's 2016 Payments Roadmap Report
[4/] South Korea data is referenced by South Korea's 2015 Payment and Settlement Systems Report

Source: Norges Bank's Retail Payment Services Report 2017, Singapore's Payments Roadmap Report 2016, Bank of Korea's Payment and Settlement Systems Report 2015, and Thailand's Survey of e-Payment Usage in 2017, Bank of Thailand.

This survey also found that the major reason of high cash usage among Thais is the popularity of e-Payment usage limited to certain groups, particularly teenagers, students, and working-age people between 30-40 years old. These certain groups pay and transfer via ATM as well as internet and mobile banking. The survey also reveals that those with higher income, particularly private employees, government officers as well as entrepreneurs, use e-Payment more frequently than other groups (see Figure 2). Interestingly, the respondents who do not use e-Payment state the reasons that (1) they are still familiar with cash; (2) they have obstacles to access e-Payment points of services; and (3) they have no idea how to use.

Figure 3 Cash and non-cash payment transactions among Thai people in 2017



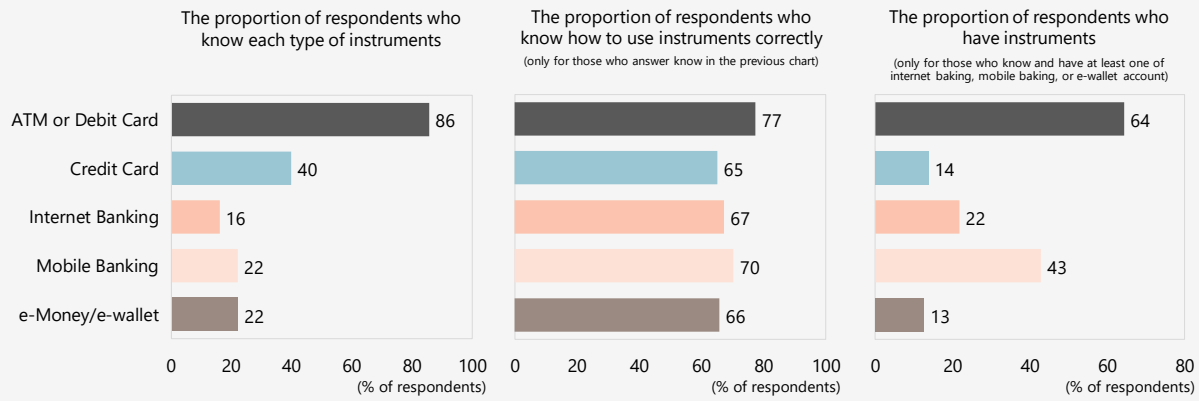
Source: Thailand's Survey of e-Payment Usage in 2017, Payment Systems Policy Department, Bank of Thailand

BOX 1: The Bank of Thailand's e-Payment survey in 2017

In 2017, the Payment Systems Policy Department of the Bank of Thailand conducted a survey to understand Thai people's awareness, understanding, and behavior in e-Payment usage. The sample size is 10,700 people, divided into approximately 5,100 men and 5,600 women. **In terms of awareness, more than 85% of respondents recognize at least one e-Payment instrument. The electronic card is the most well-known products**, especially ATM cards. Within this 85%, 20% know that internet and mobile payment exist. This 20% is concentrated mostly on young to middle age groups, such as graduate students, entrepreneurs, and government officers. **In terms of understanding, 60-80% of respondents reveal that they perfectly understand how to make e-Payment transactions.** However, some groups did not realize that debit cards can be used to pay at the point of sale.

More than 65% of respondents have at least 1 ATM card or debit card. This is consistent with the fact that most people prefer using cash since cash is still needed to withdraw from ATMs. However, more than 40% of sample group have one mobile banking account for online fund transfer and payment. Interestingly, e-Money or e-wallet account has the least possession since it is still in early stage of development, although the product has started to become more popular within the last few years.

Awareness and Understanding of e-Payment in Thailand



The proportion of respondents receiving and paying via various payment methods

	Cash	Bank Transfer	e-money	Cheque
Salary	65	34	0.1	0.7
Welfare	49	50	-	0.7
General Purposes	58	42	0.1	0.1

	Cash at service counter	Cash at bank or payment agent	ATM/CDM	Internet/mobile	e-money	Automatic debit or credit card pays	kiosk
Electricity Bill	80	18	0.3	0.6	0.1	0.9	0.1
Water Bill	77	20	0.3	0.9	0.1	1.0	0.1
Telephone Bill	34	30	1.5	3.4	1	1	29
Home internet Bill	39	50	1.3	4.7	0.7	2.4	2.3

Source: Thailand's Survey of e-Payment Usage in 2017, Payment Systems Policy Department, Bank of Thailand

In terms of usage behavior, there are several key findings. **Firstly, more than 60% of salary payments and general transactions are still in cash.** Most of respondents stated that it is required by the employer to pay wage in cash as cash is more convenient. In contrast, the rest of salary payment samples are paid by online transfer via bank account. It is worth noting that most of the government payments are via e-Payment because of the policy to promote e-Payment usage in the society. **Secondly, cash is the primary alternative for utility bill payments.** Most of the electricity and water-supply bill payments are mainly paid in cash at the service counter. Some are paid via banks and payment agents, such as the counter service at convenience stores. **Lastly, the proportions of telephone or mobile bill payments were equally distributed among channels.** These channels include provider's counter service, banks, provider agents, or kiosks. On the other hand, the payments for home internet service bills are mostly transacted via internet and mobile phones more than other methods.

In a nutshell, according to the BOT's e-Payment survey in 2017, the majority of payments and fund transfers are still in cash. Most people recognize e-Payment instruments, especially ATM and debit cards. Their understanding how to use these instruments are quite high, especially card and mobile payments, because they have already possessed these instruments. This finding is consistent with the government policy encouraging widely usage of these products.

Although the survey in 2017 indicates that Thai people still prefer using cash, Thailand is currently in transition to a cashless society as shown by the macro data **due mainly to 3 factors: (1) a rise in e-Payment adoption, (2) better ecosystem and payment infrastructure promoting e-Payment, and (3) government policies supporting e-Payment usage.**

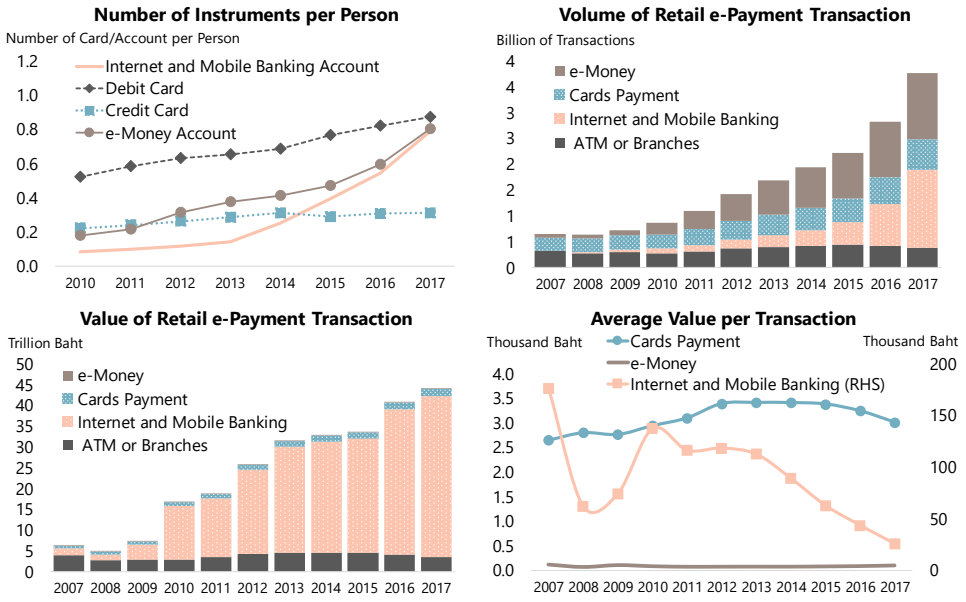
(1) A rise in e-Payment adoption

The adoption rate of e-Payment among Thai people continues to increase in terms of awareness, ownerships, and transaction. On awareness, Visa survey[1] reveals that awareness of Thai people in QR-based payment services reaches the highest at 74%, compared to the regional average of 48%. The survey also found that 87% of Thai respondents bought goods and merchandises via smartphones at least once a month, considering as the highest rate, again, in the region with an average of 77%. In term of ownerships, Figure 4 shows the two-fold increase of internet banking and mobile banking transactions within a year after the announcement of standardized QR code payment in early 2017. In term of transactions, the figure also shows that Thais use e-Payment instruments in daily life. The number of instruments per head over the past 5 years, including internet and mobile accounts, e-Money accounts, as well as debit and credit cards to number of populations increased dramatically.

Greater awareness and usage of e-Payment accelerated payment transactions. Since 2010, e-Payment value has grown on average 10.4% per year alongside an increase in e-Payment transactions by 3.7 times. The e-Payment usage has increased from 18 times/person/year in 2010 to 63 times/person/year in 2017. Among the top-three of retail payment, namely e-Money, internet and mobile banking, and card payment, payment via internet and mobile banking is the most popular channel, registering at around 90% of total value as shown in Figure 4. In particular, these payment channels increase further after the announcement of PromptPay services in early 2017 owing to lower fees for cross-bank transfers. Transfer amount per transaction has steadily decline mainly due to the reduction in transfer fee for transfer amount lower than 5,000 baht/transaction. Thai people tend to transfer money in lower amount via e-Payment more often in daily life, which is a key evidence towards a cashless society in Thailand (Figure 5).

[1] VISA (2017), "Rise of the Digitally Engaged Consumer", Consumer Payment Attitudes Survey, VISA.

Figure 4 Summary statistics of e-Payment usage in Thailand

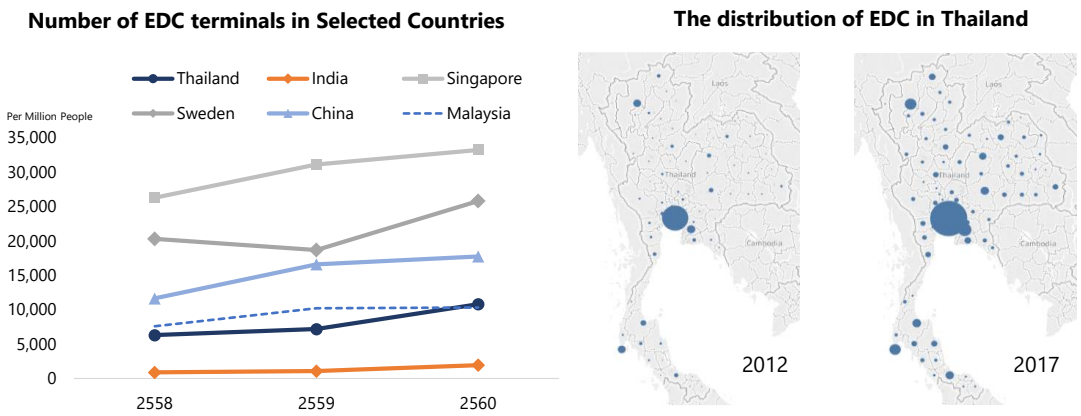


Source: Bank of Thailand and Authors' calculation

(2) Better eco-system and payment infrastructure promoting e-Payment

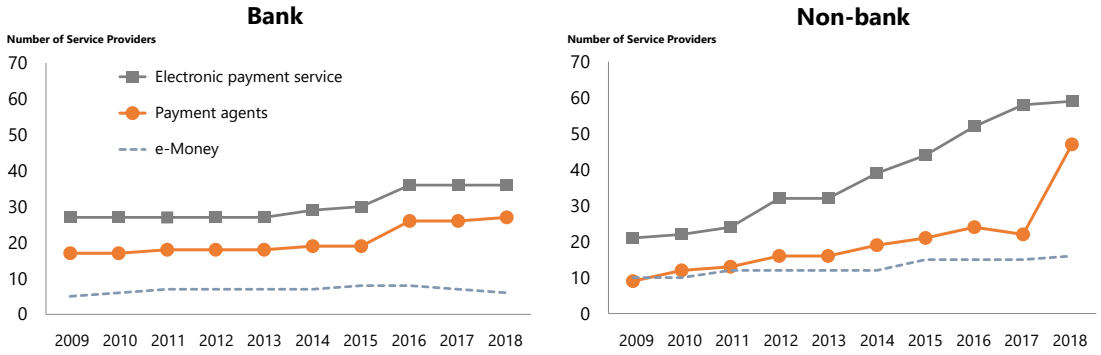
The overall eco-systems and payment infrastructure have been continuously developed and facilitate e-Payment usage across country. In 2017, Thailand has 10,803 units of Electronic Data Capture terminal (EDC) per million persons as shown in Figure 5. This number doubled over the past two years with impressive growth compared to other countries. Most of large-and-medium shops install EDC more than 7.7 billion terminals. Moreover, standard QR code payment has been widely accepted around three million points, including bank branches, ATM machines, and mobile broadband networks, which covered roughly 75% of the country. In addition, the number of e-Payment service providers, both banks and non-banks, has increased considerably, especially bill payment services paid by e-Money. The number of non-bank e-Payment service providers rose more than double over the past five years that could provide better access in payment services (Figure 6)

Figure 5 Number of EDC terminals in Thailand



Source: BIS, Bank of Thailand and Authors' calculation

Figure 6 Number of e-Payment services providers in Thailand

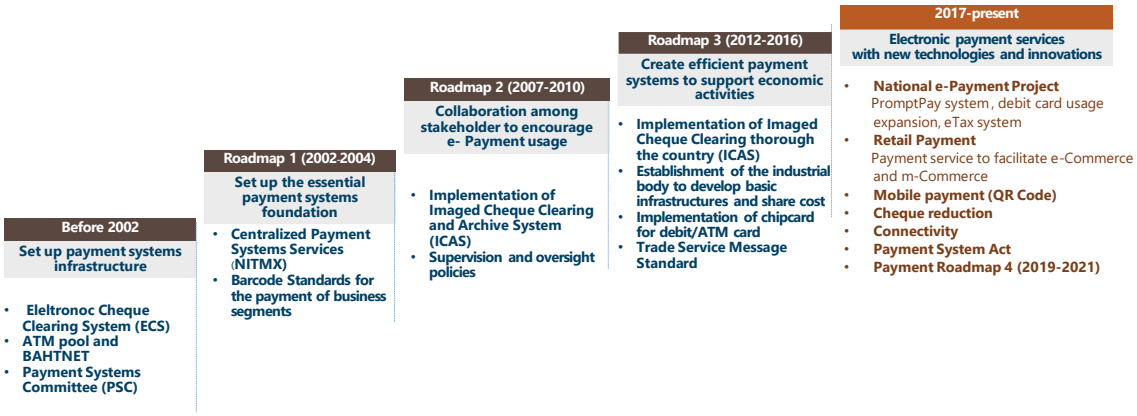


Source: Bank of Thailand and Authors' calculation

(3) Government policies supporting e-Payment usage

The Thai government policies also contribute to the growing usage of e-Payment. The Thai government and the BOT continue to develop a more efficient, secure, and resilient payment system (Figure 7). Over the years, public sector and various financial institutions have been in collaboration to support the implementation of "The National e-Payment Master Plan", including PromptPay, the central infrastructure to support new financial innovations, which can help reduce cost of payment system. Currently, the BOT is preparing the fourth Thailand's payment systems strategic plan, which will be implemented during the year 2019-2021 as a master plan to develop payment systems along with changing environments and new trends of financial innovations.

Figure 7 Summary of Thailand's payment systems strategic plan

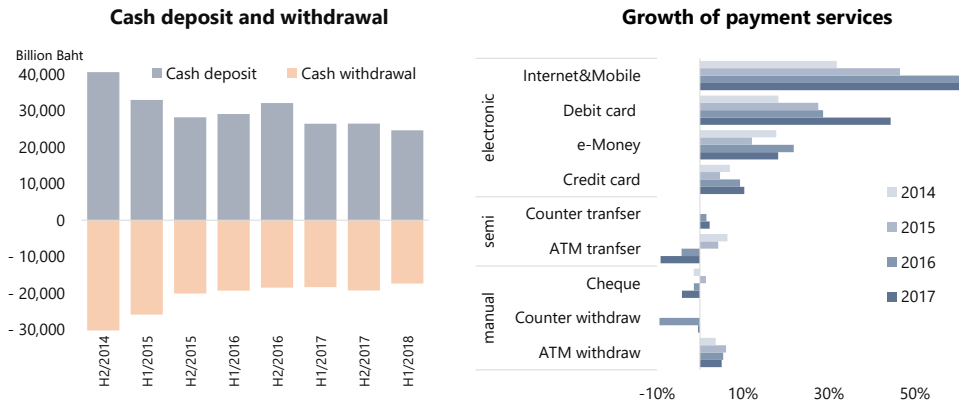


Source: Bank of Thailand

Considering the aggregated data of cash in circulation and payment transactions, the data indicates that (1) cash-related transactions have been decreasing continuously in recent years. During 2013-2017, the total withdrawals and deposits are substantially reduced more than half compared to the period before. Besides, semi-electronic transactions, such as payment and money transfer via bank branches and ATMs machines trended downwards. In contrast, electronic payments, such as mobile banking, becomes more significant (Figure 8). Unsurprisingly, this is consistent with the product life cycle of the Thai payment instruments during 2008-2018 (Figure 9). The payment via bank branches and cheques gradually decline.

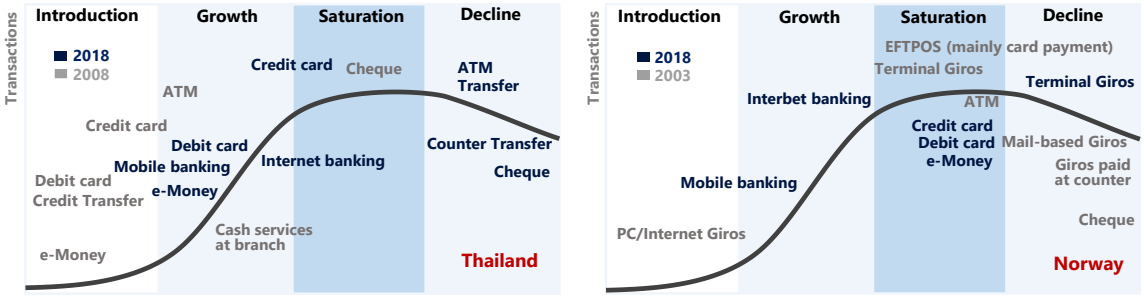
On the other hand, the payment instruments that depend on innovation or new technology, such as online fund transfer and e-Money, are on the rise and exponentially grow. This trend is in line with the cycle of payment system development in developed countries such as Norway. **This finding is partly contributed to slower growth of cash in circulation compared to the past.** In general, cash in circulation grows in line with the economy, inflation, and monetary policy conduct in each period. However, in the case of Thailand, the growth of cash in circulation decelerates over the recent years. We will further analyze implications of cash in circulation and its relationship with e-Payment in the next section.

Figure 8 Deposits, withdrawals, and use of payment services



Source: Bank of Thailand

Figure 9 Life cycles of e-Payment instruments in Thailand and Norway



Source: Gresvik and Owre (2003), Rungsun Hataiseree (2008)

2.2 Relationship between e-Payment and Monetary Variables in the Thai Context

International literature still has no conclusion about the relationship between e-Payment use and cash demand. Rui Qin (2010) and Amromin and Chakravorti (2007) found a negative relationship between these two variables. However, Bech et al (2018) and Kartika and Nugroho (2015) showed that cash demand is still high despite increasing usage of e-Payment worldwide. There are only a few countries which regarded as a cashless or less-cash economy. In particular, developed countries witnessed increasing cash demand after the 2008-2009 global financial crisis due to lack of confidence in the payment system and lower cost of cash holding pertaining to extra accommodative monetary policy. Nevertheless, Craig et al (1996) and Palley (2001) found that the widespread e-Payment usage could result in a decline in cash circulated in the economy. This could also affect monetary statistics such as monetary base, velocity of

money, and money multiplier. Moreover, it could have some implications for monetary policy. This section needs to understand development of monetary variables in Thailand over the years, and to analyze the relationship between e-Payment usage and currency in circulation in Thai economy. The key findings are as follows:

2.2.1 Monetary Variables

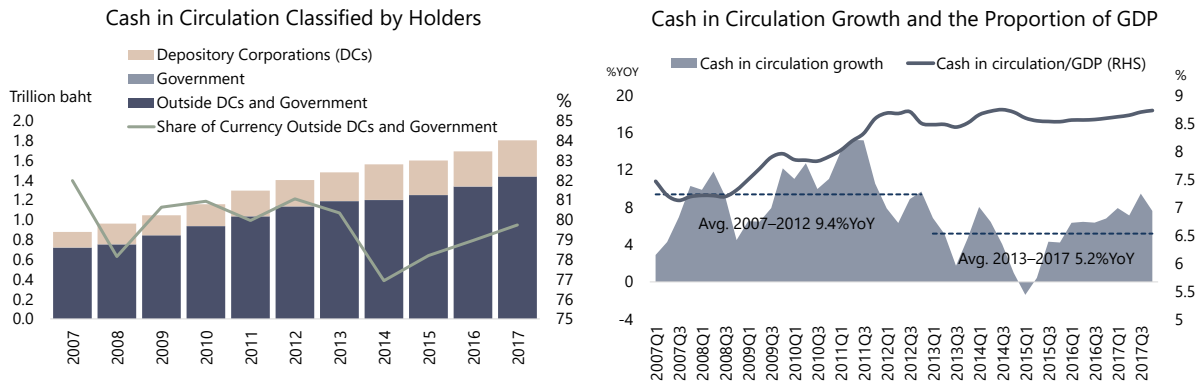
According to the quantity theory of money by the Classical economist, the nominal value of economic activities equals to quantity of money multiplied by velocity of money (the equation MV = PY), where M denotes quantity of money, V is velocity of money, P and Y are price level and real gross domestic product, respectively. The underlying assumption is that every variable except price depending on other factors. For example, Y reflects economic activities that is determined by supply factors. M is controlled by the central bank. V is stable in the short term which is determined by consumer spending behavior, including financial technology development.

Past studies found that financial technology development partly contributed to a rise of velocity of money and money multiplier, particularly e-Payment which facilitated bank deposit and money creation. However, these results were still debatable. Some economists viewed that these effects of e-Payment on monetary variables emerged under monetary targeting framework. Therefore, the result depended on monetary policy framework and the type of monetary variables in the central bank's interest. A few studies showed that e-Payment could affect central bank's ability to control money supply [Boeschoten and Hebbink (1996), Berentsen (1997)]. Meanwhile, some studies found slight impacts from e-Payment [Fressman (2002), Slovinec (2014)].

Understanding monetary variables in the context of Thai economy is therefore crucial to help policymakers to recognize and prepare for the changes. Key findings from the Thai data (Figure 10 and Figure 11) are as follows:

(1) Cash in circulation to GDP ratio stabilized around 9% over the past 5 years. Cash transaction grew slower than the past. Cash transaction showed upward trend with decelerating growth from 9.4% (average over 2007-2012) to 5.2% (average over 2013-2018). Cash transactions still grew but at a lower rate consistent with lower economic growth and inflation over the recent trend.

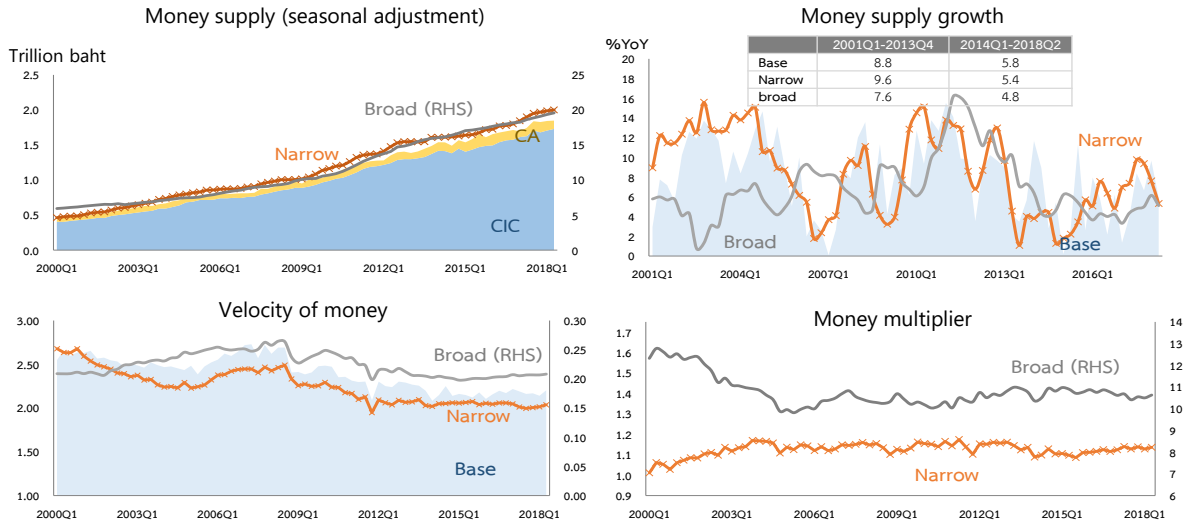
Figure 10 Cash in circulation in Thailand



Source: Bank of Thailand

(2) Monetary aggregates in Thai economy continued to increase in particular monetary base (M0) as cash in circulation kept on its rising trend. Meanwhile, velocity of money and money multiplier were stable from the past. Narrow money and broad money continued to expand at a slower pace consistent with economic growth. In 2014, narrow money and broad money dropped by half compared to the past average over 2001-2013 in line with the economic slowdown contributed by political uncertainties, softening exports momentum following the global economic slowdown, and weak domestic demand, including mild inflation.

Figure 11 Monetary variables in Thailand



	2001Q1-2013Q4	2014Q1-2018Q2
Base	8.8	5.8
Narrow	9.6	5.4
broad	7.6	4.8

Source: Bank of Thailand

However, it should be remarked that development of monetary variables in Thailand seems different from the case of cashless society in Sweden. Cash-to-GDP ratio in Sweden drastically dropped from 10% in 1950 to 1.4% in 2017and its velocity of money edged up significantly overtime. (Figure BOX II.1)

Hence, monetary variables in Thai economy has yet affected by growing e-Payment usage. This evidence also happened in other countries with more popular use in e-Payment such as Canada. This was partly due to**, first, e-Payment transactions in Thailand regarded as the beginning state of e-Payment development with limited groups of users. Second**, **Thai people make e-Payment transactions along with cash.** For instance, they still use physical money to top-up e-Money or e-wallet instead of transferring directly from deposit account. Therefore, monetary variables in Thai economy would have been affected gradually from e-Payment.

BOX II: Cashless Society in Sweden

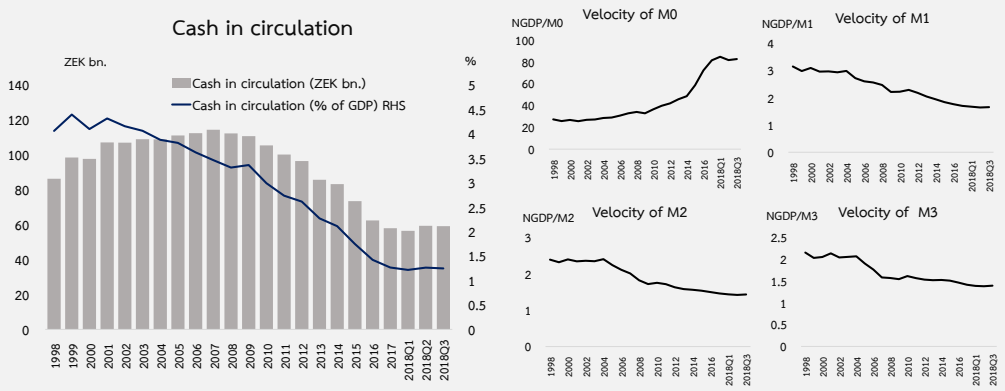
Sweden is one of the top cashless society in the world. In the past decade, the cash-to-GDP ratio has decreased by 2.5 times. Cash usage has continuously declined reflecting payment patterns in daily life. The Swedish uses cash only 13% of their daily payments. Regarding the cashless campaign, the Swedish government has launched some policies to reduce cash and promote e-Payment usage such as payment via debit cards, credit cards, e-Money, including money transfers and payments via internet and mobile phones.

In 2009, the Swedish government promptly acts on action against money laundering and financial aid of terrorism. The actions require the individual to explain the reason for withdrawing and depositing cash over 15,000 euros per transaction at the bank branch. Moreover, banks do not provide service in cash transactions. In addition, the Act (2007: 592) on Cash Register was issued by the National Tax Board stated that merchants must install a certified cash register device, for recording cash transactions and print out receipts for customers with cash payment. This information will be recorded in the certified control units for inspection. Any stores which violated this policy will be fined 10,000 SEK (about 40,000 Baht). This policy consequently speeded up the stores for greater use of e-Payment due to some installation costs of a cash register device and lower chances to be inspected later.

In addition, **the Swedish government has introduced some measures to promote e-Payment.** The customers can purchase goods and services via EDC at shops and other businesses without requiring a minimum value. In particular, the development of "Swish" application on mobiles is one key factor to facilitate easier, fast, and safe transfer money across banks. Money transfers could be made from customer to customer (C2C) in real-time. Money transfer could be made more conveniently by using mobile number registered with corresponding deposit account instead of using deposit account number. Furthermore, the services include transfer between e-commerce and mobile-commerce. Later on, "Swish" expands to provide money transfer service between individuals and businesses (customer to business: C2B) as well as between e-commerce businesses and e-commerce businesses via mobile phones (e-Commerce and mobile-Commerce).

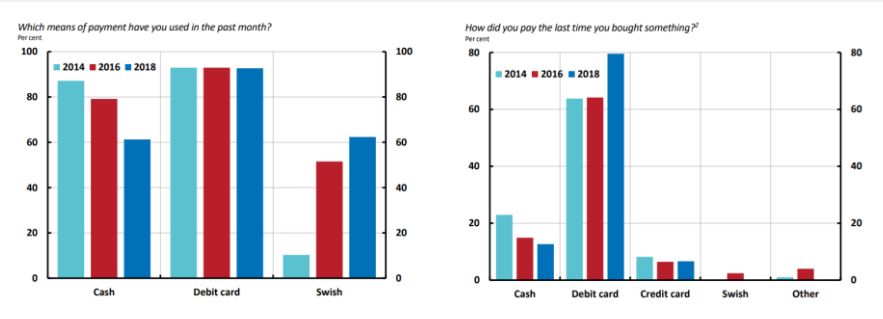
To monitor development in retail payment behaviors, the Swedish Central Bank (Sveriges Riksbank) has conducted a survey about 2,000 people every two years. The survey shows that Swedish people increased their debit card usage for daily payment and their Swish services usage for money transfer, from 10% in 2014 to 60% in 2018. Meanwhile, cash usage continued to decline **after the Swedish government introduced these two measures accordingly. The goal is consequently set to become the first cashless country in the world by 2030**.

Figure Box II.1 Cash in circulation and velocity of money in Sweden



Source: CEIC and Authors' calculation

Survey results of retail payment patterns in Sweden



Source: Payment patterns in Sweden Report 2018, Sveriges Riksbank

2.2.2 Relationship between e-Payment Usage and Money Demand in Thai Economy

Most international studies regarding impact of e-Payment usage on money demand (table 2) refer to money demand function assumed its substitution effect on money demand. However, the results are still inconclusive. Some studies found this negative relationship, but some did not. Most studies indicated the key determinants of money demand such as economic growth and opportunity cost of holding money instead of receiving returns on other financial investment. For the latter, most studies use interest rate in the financial market or policy rate as a proxy.

The latest study in Thailand, Hataiseree and Banchuen (2010) found that some types of e-Payment slightly reduced demand for cash. A 10% increase in debit card usage caused a 1.5% reduction in money demand. They also viewed that this substitution effect would not be significant in the future as long as Thai people still used cash in their economic activities.

Table 2 Literature on relationship between e-Payment and money demand

Author	Objective and methodology	Data	Key findings
Bech, Faruqui, Ougaard and Picillo (2018)	Study relationship between financial innovation and money demand in 3 motives (transaction, precautionary, and speculative); Panel regression	Advanced and emerging market economies (including Thailand); 2007 - 2016	• Financial innovation led to a decline in money demanding for transaction
Qin (2017)	Study relationship between e-Money and money demand in China; OLS regression	China; 1990-2010 (yearly)	• Negative relationship between e-Money and M0 (elasticity -0.13) • Positive relationship between e-Money and M1 (elasticity 0.74)
Kartika and Nugroho (2015)	Study relationship between e-Money and money demand in Asian-5 countries; Panel regression	Thailand, Singapore, Indonesia, Malaysia, and Philippines; 2010-2014 (quarterly)	• Positive relationship between e-Money and M1 (elasticity 0.1)
Sukmongkonsamoe (2015)	Study relationship between various kinds of e-Payment and money demand in European Union; Panel regression	European Union; 1997-2015 (quarterly)	• Negative relationship between a ratio of number of ATMs to 1 million people and cash in circulation (elasticity -0.07) • Positive relationship between e-Money and cash in circulation (elasticity 0.06)
Hataiseree and Banchuen (2010)	This research shown the relationship between e-Payment and money demand in Thai economy by OLS regression	Thailand, 2005-2010 (quarterly)	• Negative relationship between e-Money and cash in circulation (elasticity -0.15 to -0.14)

This paper aims to investigate whether the widespread use of e-Payment has contributed to a decelerating trend of cash in circulation by half in the Thai economy. Our study employs econometric model to explain Keynesian money demand function (cash in circulation) which depends on several factors:

$$\mathrm{CIC_t} = \alpha + \beta_1 \mathrm{CEI_t} + \beta_{2i} \mathrm{OPPCOST_{it}} + \beta_{3i} \mathrm{RETAILPAYMENT_{it}}$$

We use cash in circulation (CIC) as a dependent variable to represent money demand. Moreover, there are 3 groups of independent variables in this model. The first group reflects

economic activities variable such as coincident economic indicator (CEI[2]). The second group represents opportunity cost of holding money ($OPPCOST_i$) such as short-term interest rate (3-month deposit interest rate) and return on stock market investment (SET index return). The third group indicates e-Payment usage including total retail e-Payment, card payment, internet and mobile banking, as well as e-Money. The period of study covers data from 2010 to 2018. The key findings can be shown below.

Our model also found that e-Payment in Thailand significantly substitutes cash especially card payment as well as internet and mobile banking. The elasticity of substitution is approximately -0.05 to -0.1. In other words, if Thai people use retail e-Payment by 1% more, demand for money will decline by 0.05 - 0.1%. However, it should be noted that we did not find this substitution effect of e-Money due partly to an early stage of e-Money usage and its small transaction value. **Nevertheless, e-Payment has smaller impact than economic activities and opportunity cost of cash holding (Table 3).** Therefore, it can be concluded that **e-Payment usage led to a slight decline in money demand for Thai people with gradual substitution impact. The empirical result shows that money demand is mainly determined by economic activities consistent with the theory of money demand function.**

Table 3 Empirical results of money demand functions in Thailand

Variables	Model I	Model II	Model III	Model IV
Coincident Economic Index (CEI)	0.497 ***	0.517 ***	0.491 ***	0.211 *
Short-term interest rate	-0.012 ***	-0.014 ***	-0.012 ***	-0.013 ***
SET return	-0.085 ***	-0.090 ***	-0.083 ***	-0.087 ***
Retail e-Payment	-0.058 **			
Card payment		-0.089 ***		
Internet and mobile banking			-0.054 **	
e-Money				0.023
Constant	0.060 ***	0.060 ***	0.059 ***	0.048 ***
Adjusted R-squared	0.39	0.34	0.39	0.36

Note: ***, **, * = significant level at 0.01 0.05 and 0.1, respectively.
Estimated by Generalized method of moments (GMM) Approach. Data since Jan 2010 – Jun 2018
All variables are in real terms and log with first-difference form for taking care non-stationary issue.

2.3 Implication of e-Payment for Monetary Policy

Most of previous studies of e-Payment and monetary policy in Thailand and other countries were descriptive and focused on the effects of digital money (or e-Money). Key findings concluded that digital money usage led to a reduction in cash in circulation. This could complicate central bank's ability to control money supply under monetary targeting framework. Nevertheless, digital money usage will not affect monetary policy framework using short-term interest rate as operational target. In addition, findings from past studies can be summarized into 3 areas, namely monetary operation, central bank independence, and monetary policy transmission as follows.

[2] The correlation between coincident economic indicator (CEI) and gross domestic product GDP) in Thailand is 0.9. CEI is monthly data that is constructed by BOT, while GDP is quarterly data compiled by NESDB.

2.3.1 Monetary Operation

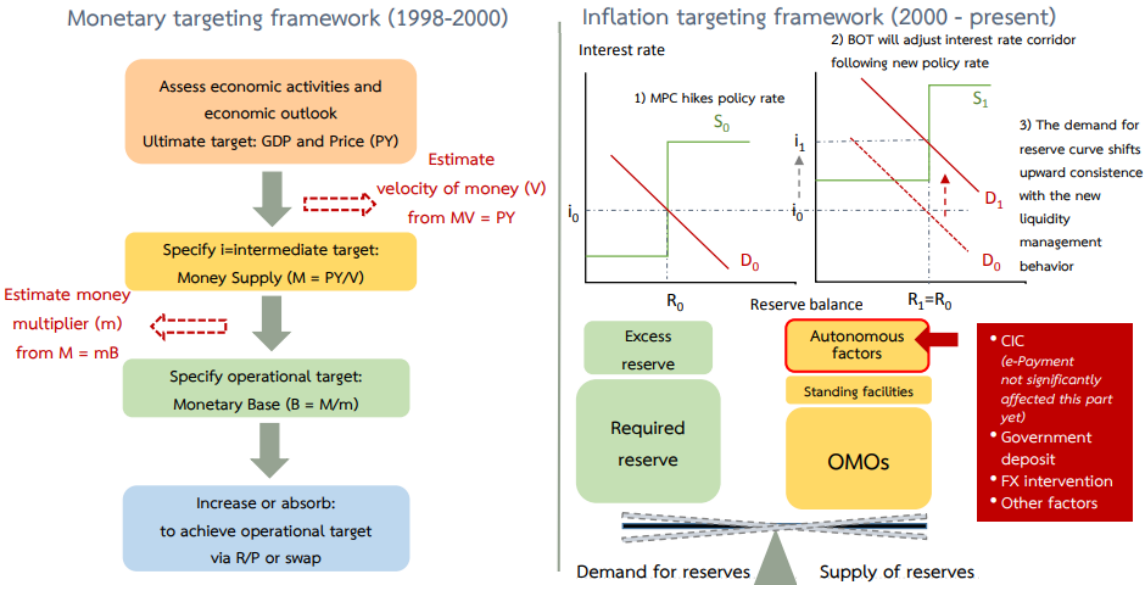
When payment system has been developed, monetary variables often alter accordingly. This consequently affected central bank's ability to control money supply under monetary targeting framework that required accuracy in forecast of velocity of money and money multiplier. [Nada popovska-Karmmar (2014), Qin (2017)].

In Thailand, the Bank of Thailand (BOT) had conducted monetary policy under monetary targeting framework during 1998-2000. At that time, BOT firstly assessed economic and financial conditions as well as projected economic growth outlook in order to set the ultimate target (nominal GDP: PY). BOT then had to forecast velocity of money and money multiplier. Finally, BOT absorbed or injected monetary base as the operating target level to achieve the indicated ultimate target. The greater use of e-Payment could make monetary variables more volatile and affect the BOT's monetary policy operation to control level of money supply as the indicated intermediate goal.

At the present, BOT conducts monetary policy under flexible inflation targeting framework using short-term interest rate as an operational target. Broader use of e-Payment has yet to restrain the BOT's monetary operations. When the Monetary Policy Committee (MPC) determines to change the policy interest rate, it is not necessary for the BOT to inject or absorb liquidity in the money market immediately. It has been widely perceived that any transaction between BOT and commercial banks will be undertaken in the open market operations at the new policy interest rate. Furthermore, at the end of the business day, BOT can also inject or absorb liquidity at any necessary amount in the money market using standing facility instrument to assure that the policy rate is held at the new level determined by the MPC. **Hence, regardless of how much the development of payment system could alter monetary variables, this factor will not affect the BOT's monetary operations to signal the policy interest rate to the financial markets and the economy.** (Figure 12)

Going forward, when change in the policy interest rate passes through its impacts to the economy, demand and supply of commercial banks' reserve can also adjust. Therefore, BOT needs to assess whether the supply of reserves consistent with the demand for reserves in order to ensure that short-term money market rates move along with the policy rate. At this point, the BOT's forecast capability, particularly forecast of autonomous factors, will be slightly more challenging since e-Payment usage has been growing fast. **However, if e-Payment use has concrete effects on less-cash usage behavior, this could help the BOT's ability to forecast trend of these autonomous factors.**

Figure 12 Monetary policy framework (from 1998 to present)



Source: FAQ issue 32 (Roong Mallikamas, 2011) and Authors processing

2.3.2 Central Bank Independence

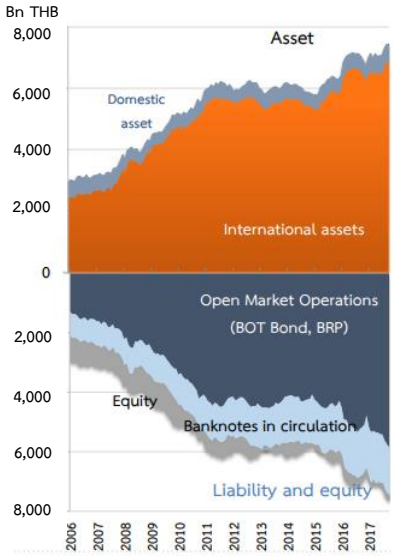
Previous studies found that a broader use of digital money can affect central bank independence in 2 ways. First, central bank's balance sheet might shrink [Barentsen (1997), Rogoff (2014)] due to a decline in cash in circulation (liabilities decrease). At the same time, asset backed for printing banknotes, such as foreign currencies and gold, might also decline (assets decrease). These could weaken central bank's ability to conduct policy. In the worst case, central bank might have to ask government for capital injection to pursue its own missions. Second, seigniorage revenue will decrease in line with a decline in cash in circulation [BOK (2005), Fung et al (2014)]. This may also reduce central bank's income to adequately run its own operation. According to the Bank for International Settlements (BIS) survey in 2000, however, the report indicated that none of any central bank whose balance sheet affected by a decline in cash in circulation.

In case of Thailand, firstly, a greater use of e-Payment over the past decade results in a slight decline in cash usage. Meanwhile, the size of BOT's balance sheet continues to expand, driven particularly by a larger composition of liquidity absorption compared to other components in liabilities side such as cash in circulation (Figure 13). **Secondly, seigniorage income in Thailand stabilizes around 0.1% of GDP since 1990, and it has not yet seen its declining trend over the past years.** The calculation of interest income can be made from the BOT's balance sheet following a concept of central bank's banknote printing without any cost of interest payment. At the same time, central bank can earn from investment returns on international reserves as asset-backed for issuing banknotes.

However, it is worth monitoring further whether the ratio of interest-bearing component of liabilities would trend up despite no clear evidence yet from broader usage of e-Money and less use in cash. Since this situation could occur if people change behavior by directly transferring money from bank accounts to e-Money wallet instead of cash withdrawal. According to the Payment system Act B.E. 2560, the e-Money issuers need to deposit all float money at the commercial banks in segregate accounts. Therefore, banks need to deposit 1% of these e-Money deposit at the BOT under reserve requirement regulation without receiving any interest payment. Then, banks can utilize excess amount over minimum reserve requirement for making loan or invest in the short-term money market to earn interest income, such as lend in the open market operations (OMOs) with BOT

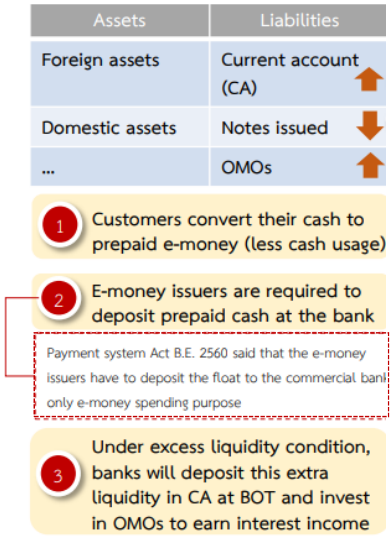
Looking ahead, if the process mentioned above causes any reduction of cash in circulation, a major component of non-interest-bearing liabilities in the BOT balance sheet. At the same time, a proportion of interest-bearing component of liabilities arising from open market operations would then rise. (Figure 14) Moreover, this could reduce seigniorage income (Figure 15) and subsequently affect central bank operations unless there is no other income to offset.

Figure 13 BOT's balance sheet



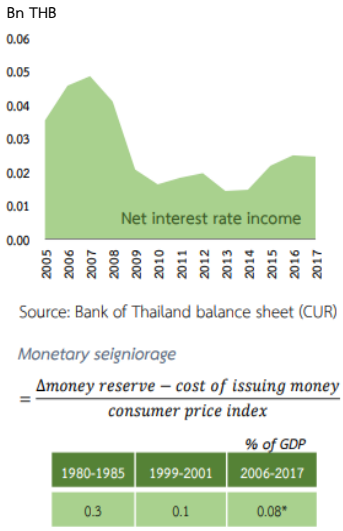
Source: Bank of Thailand

Figure 14 Change in balance sheet



Source: Bank of Thailand and Authors' calculation

Figure 15 Seigniorage



Source: Bank of Thailand balance sheet (CUR)

Monetary seigniorage

$$= \frac{\Delta money\ reserve - cost\ of\ issuing\ money}{consumer\ price\ index}$$

% of GDP

1980-1985	1999-2001	2006-2017
0.3	0.1	0.08*

Source: BOK (2005), BOT, and Author' calculation

2.3.3 Effectiveness of Monetary Policy Transmission

Previous studies found that using digital money or e-Money will affect monetary policy transmission in several ways, as follows.

Credit channels might be more effective because lenders can analyze borrowers' e-Payment behaviors and risks in their lending process as well as classify types of borrowers using information-based lending data. This could help financial institutions to set loan interest rates in accordance with qualifications of each borrower. In this regard, banks can extend loan directly toward any targeted group (Nantawan, 2018). Moreover, in the case of e-Money, it will cause people to reduce cash usage by keeping money in form of current and saving accounts

instead. This could help support the process of money creation in the banking system (Thammarak, 2011). Therefore, it is essential to monitor increasing role of non-bank digital money service providers as alternative financing that could subsequently affect monetary policy effectiveness. However, the size of impacts will be subject to the central bank regulations.

Exchange rate channel might be more effective because e-Payment supports domestic and international trade, especially e-commerce platform. In addition, exchange rate could also play more role in its pass-through effects on prices and economic activities. However, this channel could lead to dollarization issue if international traders spend foreign currencies more for payment. This case could diminish effectiveness of monetary policy that pass through its impact via local currency.

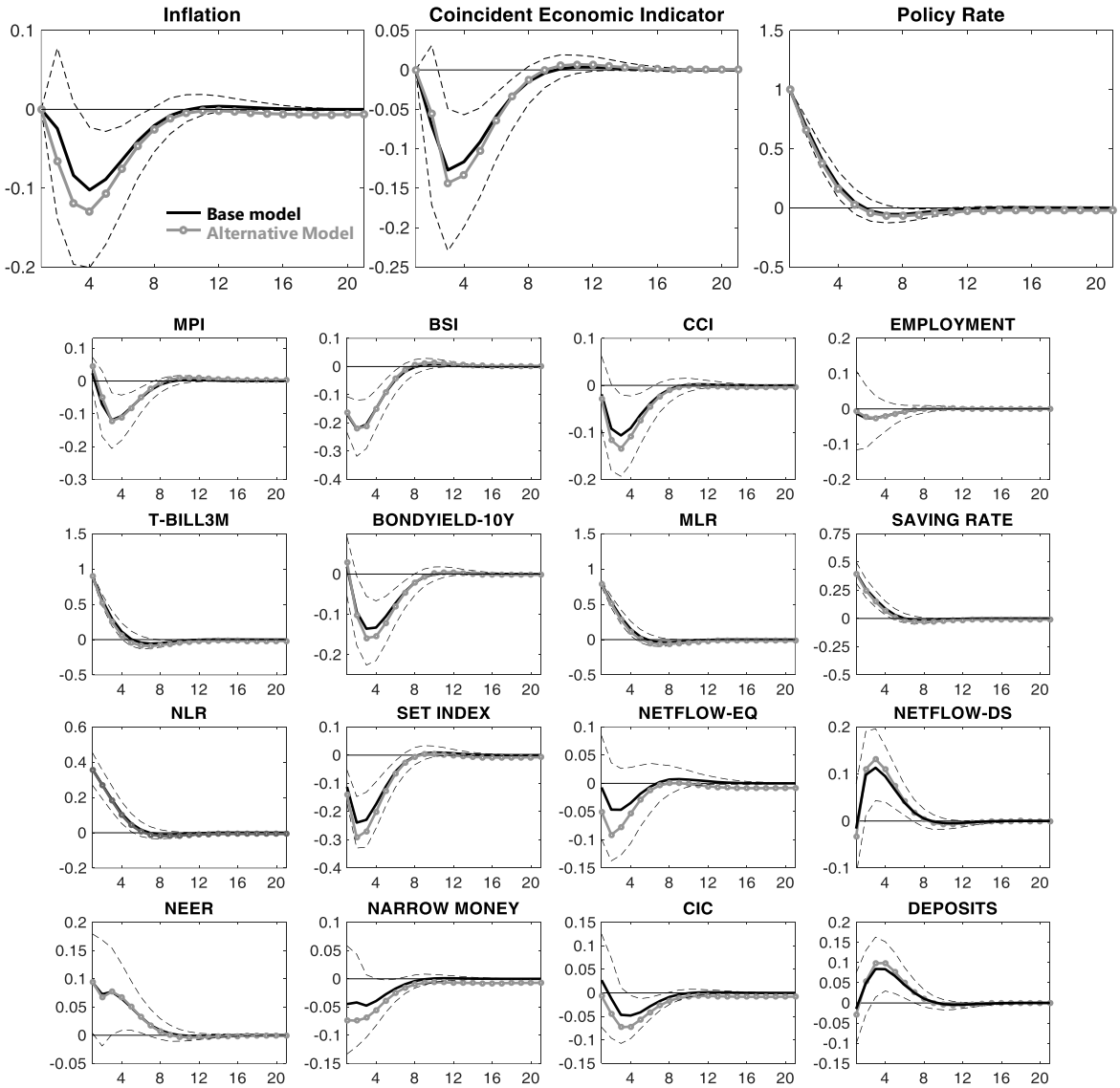
Asset price channels might be more sensitive to changes in policy interest rates (IMF 2004) due to lower cost of payment, both transaction costs and opportunity cost. People can adjust their portfolios easily and fast to invest for higher returns from alternative assets following the policy rate movement. This adjustment could flatten money demand curve.

In this paper, the empirical study of monetary policy transmission mechanism will employ the Factor-Augmented Vector Autoregression (FAVAR) model developed by Bernanke et al (2005) for the US case. Later, the model was employed for Thailand's case by Ahuja et al (2008) over 2006-2018. In our study, we will compare two models, which is (1) the base model using three variables including inflation, economic growth and policy interest rate, and (2) the alternative model added e-Payment variable. **Our empirical study showed that e-Payment supports monetary policy transmission in several channels.**

(1) The interest rate channel has no impact. This is partly because adjustment in the interest rate channel also depends on other factors, such as commercial banks' financial structure, sensitivity of deposit and loan amounts to policy rate adjustment, and competition in banking industry.

(2) The credit channel is slightly more effective partly owing to more loans extension with better loan pricing strategies based on risk profiles of each borrower. The banking process will be improved by 2 ways. **First, the opportunity cost of sparing cash significantly declines for commercial banks** (especially cash at ATM for withdrawal transactions). Thus, banks can expand more loans from this smaller amount of cash holding. This is reflected by a substantial decrease in the narrow money, especially cash in circulation (CIC), and an increase in e-Payment usage. **Second, commercial banks can improve their credit approval process using information-based lending database.** The data include financial transactions via e-Payment such as internet/mobile banking which can reduce operating costs and better understand customer behaviors and their risk profiles. Therefore, commercial banks can significantly expand credits. For instance, Kasikorn Bank launches K-PLUS SME applications for easier credit access using machine learning to analyze customer behaviors and artificial intelligence (AI) to improve credit approval process. This process can promote better financial access with lower rates for good borrowers.

Figure 16 Impulse response of selected variables to policy rate shock (+100 basis points)



(3) The asset price channel is more effective. People can easily reallocate assets due to lower transaction costs that could consequently impact their wealth. This finding is also consistent with the result from econometric estimation of money demand equation in section 2.2.2. The estimation also find that money demand depends on economic growth, short-run interest rates, stock market index, and e-Payment usage. Money demand can be explained by interest rate slightly rose from -0.010% to -0.018% (Table 4) amid an increasing trend of e-Payment usage.

Table 4 Elasticity of money demands to interest rate

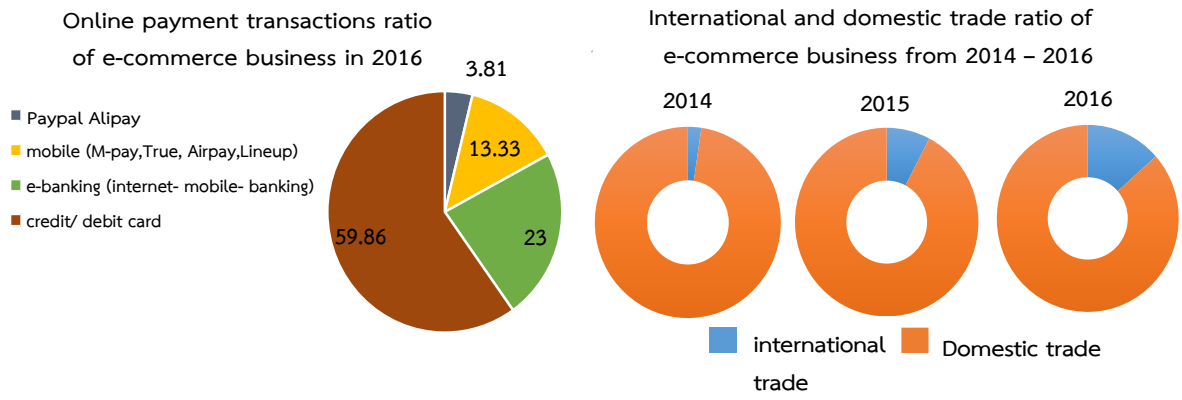
Period	2555-2558	2556-2559	2557-2560	2558-2561
Elasticity	-0.010	-0.010	-0.013	-0.018

Source: Elasticity in this table calculated by 3-years rolling GMM model I, Authors' calculation.

(4) The exchange rate channel is expected to be more effective as e-Payment could reduce cross-border transaction costs, partly shown by a large volume of capital flows especially in the capital market. However, there is no apparent impact on the exchange rate. Furthermore, e-Payment also supports domestic and international trade, especially electronic commerce (e-Commerce). The survey organized by the Electronic Transactions Development Agency found that the e-Payment system contributes to support Thai e-Commerce business (Figure 17). The data shows that the proportion of international trade significantly increased in the past three years. International studies mentioned that the use of e-Payment or e-Money in form of foreign currencies may reduce the popularity of the local currency and thus reduce the effectiveness of monetary policy. However, dollarization is not an issue for monetary policy in Thailand since transfer payment for domestic e-commerce needed to be transacted via bank account in local currency.

(5) The expectation channel might not be clearly impacted as it is mainly subject to private sector's perspectives on the path of policy interest rate and economic outlook.

Figure 17 Online payment transactions of e-commerce business



Source: Electronic Transactions Development Agency (ETDA)

In Part 2, our study shows that Thai people continue to use cash for daily life despite an increasing trend of e-Payment. Cash-to-GDP ratio in Thailand has not yet declined as observed in some developed countries, and the **impact of e-Payment usage on money supply is still limited. It could enhance effectiveness of monetary policy in some channels, although the impacts are fairly insubstantial. This is partly because the payment system has been gradually developed in accordance with greater public awareness and access.** However, other studies indicated that the central bank should regularly monitor e-Payment and cash usage behaviors to assess implications of monetary policy. The role of non-bank service providers, especially large players from abroad, could disrupt behavior of cash usage for Thai people, which consequently affects monetary policy. **Issues worth monitoring are, namely seigniorage income, change in central balance sheet structure of liabilities side, effectiveness of monetary policy, financial stability issues arising from faster bank run in the digital age, and broader use of cryptocurrencies as means of payments.**

3. Digital Currency

In recent years, large traditional companies have been replaced by newcomers having disruptive technology. For instance, Kodak experienced financial difficulty because the company was unable to adapt its business model quickly enough to compete with the digital camera.[3] Nokia went bankrupted because it was unable to catch up with the smartphone trend.[4] In the digital age of financial services, the key question arising from these past experiences, therefore, is "what kind of disruptive technology will affect the central bank's missions or completely replace the central banking?"

Most of the central bank's missions relate to "money" which has been continuously developed from cash - in the form of tangible coins and banknotes - to intangible digital money in the applications on mobile phones, e.g., Line Pay or TrueMoney in Thailand, as explained in Section 2. **Yet, such digital money has not altered or affected the central bank's missions as such digital money products are still in the fiat-backed form.**

However, the latest technology trend creates the newest form of money on the electronic system known as "cryptocurrency" - the holder can make financial transactions without intermediaries (decentralized system). If cryptocurrency is widely used, there is no need to rely on the central bank's printed banknotes, nor the banking system and the full payment system under controlled by the central bank. This is why central banks around the world have paid their attention to and closely monitor this new technological trend, especially the world's first cryptocurrency – "Bitcoin".

In this section, we aim to analyze the consequences of cryptocurrency and central bank digital currency (CBDC) from the perspectives of monetary policy. We focus on their implications for the effectiveness of monetary policy transmission at the present and future to stand ready for any upcoming changes and to adapt for the best utilization of this new technological trend.

3.1 Cryptocurrency

Cryptocurrency is a form of digital currency with a special usage mechanism called "cryptography" that requires an access code to prevent counterfeit. It also uses a consensus system among users to inspect validity of each transaction as mentioned in Barrdear and Kumhof (2016). Cryptocurrency is the innovation compatible with the distributed ledger technology (DLT) or blockchain technology, so the exchange in cryptocurrencies does not require any financial intermediary.[5]

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[3] See more details at https://hbr.org/2016/07/kodaks-downfall-wasnt-about-technology

[4] Bouwman, Harry & Carlsson, Christer & Carlsson, Joanna & Nikou, Shahrokh & Sell, Anna & Walden, Pirkko (2014). How Nokia Failed to Nail the Smartphone Market.

[5] See more detail at FAQ Issue 126 DIGITAL CURRENCY SERIES VOL.2: CRYPTOCURRENCIES AND FRIENDS: Innovation, Development, Risk and Regulation

Impacts on Monetary Policy

Cryptocurrency will significantly affect the transmission mechanism of monetary policy in the case that **people adopt and widely use it in everyday life.** When they demand less in using local currencies (in Thai case, the Thai Baht), monetary policy conducted by the central bank will be less effective. This is mainly because the policy interest rate will impact economic activities related to domestic unit of currency. This study will evaluate impacts of cryptocurrency on the current monetary policy and in the coming future.

3.1.1 Impact on Monetary Policy at the Present

From this study, we find that **cryptocurrency has not significantly affected the monetary policy transmission yet**. This is because the cryptocurrency does not meet all the three functions of "money", which are the followings.

(1) Medium of exchange: Cryptocurrency must be legal tender and widely used as a medium of exchange for goods and services. In the Thai context, **cryptocurrency is not qualified as the medium of exchange** due to no widespread use as means of payment. There are only a few places receiving cryptocurrency payment. Moreover, it cannot be legally paid for debt.

(2) Store of value: Cryptocurrency must be used as a store of value or wealth. In the Thai context, **cryptocurrency is not qualified as a store of value** due to highly fluctuated values within a day. At the end of 2018, their prices mostly dropped from the beginning of the year.[6]

(3) Unit of account: In the broad definition, this refers to (1) pricing goods or services in unit of cryptocurrency, for example, a restaurant setting menu prices in terms of cryptocurrency, or (2) pricing goods or services in the Thai Baht, paid by cryptocurrency quoting on the real-time Baht movement. **In the Thai context, this function of cryptocurrency is ambiguous.** Only a few shops set prices in unit of cryptocurrency based on the Baht movement. In addition, it is hardly seen any direct price setting in unit of cryptocurrency.

3.1.2 Impact on Monetary Policy in the Future

This study conducts scenario analysis to evaluate the possibilities of cryptocurrency development in the future and its potential impacts via 5 monetary policy transmission channels. We allow each scenario to take place at the same time, regardless of lending and borrowing behaviors in cryptocurrency.

This study portrays scenarios in 3 possible forms of cryptocurrency usage: (1) wholesale (2) retail, and (3) new asset class. The summary of impact on monetary policy is as follows:

[6] https://www.ccn.com/bitcoin-price-plunges-to-new-year;y-low-at-3456-whats-causing-it/

Case 1: Wholesale Use

The usage of cryptocurrency in this scenario is for business transactions. Cryptocurrency has several advantages over the current payment system, which still plays an important role nowadays, e.g., faster and more accurate payment transaction with lower transaction cost. Additionally, the blockchain technology with a smart contract can support way to track the source of cryptocurrency. At the present, this form of cryptocurrency usage has been used in a limited circle such as in Ripple company for cross-border money transfer.

Cryptocurrency usage for business transactions tends to grow continuously due to the outstanding feature of the blockchain technology that can enhance business efficiency. **However, its impact on monetary policy transmission would be limited due to a small circle used among business transactions.** When the companies receive payment in cryptocurrency, they often exchange into the Baht immediately to earn interest since holding cryptocurrency has no interest paid by the cryptocurrency issuers. (Table 5)

Table 5 Impacts on the effectiveness of monetary policy transmission
Case 1: The wholesale use of cryptocurrency

Transmission channel	Impacts on monetary policy effectiveness
Interest rate	**No change**
Credit	**No change**
Asset price	**No change**
Exchange rate	**No change**
Expectation	**No change**

Source: assessed by authors

Case 2: Retail Use

A widespread use of cryptocurrency in daily life could happen in 2 cases.

(1) Cryptocurrency value fixed with the Baht: For example, the price of goods at 40 Baht can be paid at 40 X-Coin. **In this scenario, the use of cryptocurrency is fairly much like e-Payment usage** mentioned in Section 2 but supported by different technologies. The holder can exchange cryptocurrency into the Baht at a fixed exchange rate. Therefore, the impact on monetary policy transmission is quite similar to the impacts of e-Payment usage as analyzed in Section 2.3.3.

(2) Cryptocurrency value not fixing with the Baht: For example, if technology development could allow Bitcoin to possess all functions of money that could be more advantageous over local currency in terms of speed, convenience, and anonymity. **In this case, impact on monetary policy transmission is similar to the dollarization case. Individuals would prefer to use cryptocurrency as a main currency for daily transactions, resulting in less effectiveness in the monetary policy transmission.** (Table 6)

Table 6 Impacts on the effectiveness of monetary policy transmission
Case 2: The retail use of cryptocurrency (not fixing its value with the Thai Baht)

Transmission channel	Impacts on monetary policy effectiveness
Interest rate	**Less effective:** Proportion of the Baht holding reduces, resulting in smaller impacts of policy rate transmission to the financial markets.
Credit	**Less effective:** Demand for loan in the Baht reduces, resulting in a decrease of Thai Baht loan supply to business and household.
Asset price	**Less effective:** Individuals hold more cryptocurrencies, whose values are not affected by policy interest rate adjustment, causing less effectiveness to household wealth.
Exchange rate	**Less effective:** Demand for the Baht reduces, causing lower transactions in exchange of the Baht for foreign currencies. This could lessen impact of policy rate adjustment on the Baht movement and impact on setting price competitiveness (via exchange rate).
Expectation	**Inconclusive:** It depends on views of private sector on the policy rate path and economic outlook.

Source: assessed by authors

Case 3: New Asset Class

The use of cryptocurrency in this case is for investment such as company's fundraising through Initial Coin Offering (ICO) or Security Coin Offering (SCO). **This case is quite different from the first two cases above for payment usage.** Some investors hold cryptocurrency assets in various forms for speculation, but this is still quite a few cases.

However, development in cryptocurrency assets would possibly have a substantial effect on monetary policy transmission. A larger number of investors and higher market liquidity could reduce volatility of cryptocurrency values to some extent. In this case, it will affect monetary policy transmission, especially the asset price channel. (Table 7)

Table 7 Impacts on the effectiveness of monetary policy transmission
Case 3: Cryptocurrency as a new asset class

Transmission channel	Impacts on monetary policy effectiveness
Interest rate	**No change**
Credit	**No change**
Asset price	**Inconclusive:** If the central bank cuts the policy rate, individuals still have alternatives for their savings via cryptocurrency assets. (Hawkins 2017) The value of these digital assets may either increase or decrease, depending on their qualities.
Exchange rate	**No change**
Expectation	**No change**

Source: assessed by authors

Regardless of its possibility, two of the three cases of scenario analysis discussed earlier, indicate that the future development in financial services, specifically cryptocurrency, can reduce the effectiveness of monetary policy significantly. The size of such impacts depends on individual and business demand for cryptocurrency. This would be subject to further development of cryptocurrency. Therefore, central banks should stand ready for the upcoming trend of cryptocurrency. One interesting option is whether the central banks need to issue its own digital currency to compete with private cryptocurrency or not.

3.2 Central Bank Digital Currency (CBDC)

CBDC is a digital form of central bank money that possess all 3 functions of money, namely a medium of exchange, a store of value, and a unit of account, which can be accepted as a legal tender.

In general, a digital form of central bank money commonly refers to reserve balances, which banks held at the central bank, and e-Money that depositors keep in deposit accounts at financial institutions. However, in the context of international research and this study, the digital form of central bank money precisely refers to CBDC which is electronic central bank money backed by the distributed ledger technology (DLT).

3.2.1 Impact of CBDC on monetary policy

According to the BIS Committee on Payments and Market Infrastructures Markets Committee (CPMI, 2018), the overall effects of CBDC on an effectiveness of monetary policy transmission mechanism depend on 2 major factors. **The first is accessibility.** If CBDC is universally accessible, impacts on monetary policy transmission to the real economy would be faster than restricted access to financial institutions only. **The second is interest-bearing feature.** If central bank pays interest rate on CBDC, it would affect structure of interest rates in the financial markets and their pricings. CBDC will be more sensitive to policy rate adjustment because it will become an alternative choice of investments and savings for people. Therefore, issuers of other financial products need to adjust interest rates more quickly in corresponding to any change in policy rate in order to attract and keep their investors.

To assess how CBDC could affect the transmission of monetary policy, our study refers to framework of Meaning et al (2017). **In the first step**, we consider degree of accessibility to CBDC as well as degree of substitution between the CBDC and other financial assets in balance sheets of central banks, financial institutions, and individuals. **In the next step**, we then assess the impact on monetary policy transmission mechanism through 5 main channels, namely (1) interest rate, (2) credit, (3) asset price, (4) exchange rate, and (5) expectation channels.

At present, central banks worldwide have been working on conceptual research on CBDCs. There are only few central banks preparing to launch the CBDC, while empirical study of its impacts on monetary policy transmission mechanism is still unclear so far. Thus, our study proposes a conceptual scenario analysis to look forward into the future, similar to the framework in Section 3.1. We analyze CBDC's impact on monetary policy from 3 different CBDC

design scenarios, namely (1) wholesale CBDC (2) unremunerated retail CBDC, and (3) remunerated CBDC. The results can be summarized as follows:

Case 1: Wholesale CBDC

The main objective of issuing wholesale CBDC is to enhance efficiency of the interbank payment system. Therefore, wholesale CBDC is designed to be non-remunerated and has limited access to a circle of financial institutions which are members of central bank payment system only.

Currently, settlement between financial institutions' reserve accounts at the central bank is transferred in digital form via central bank payment infrastructure such as the BAHTNET in Thailand.[7] Financial institution members in the BAHTNET can turn funds in their reserve accounts into cash over the office hour from 8.30 a.m. to 5.30 p.m., except bank holidays. In contrast, with the DLT, financial institutions can transfer wholesale CBDC during off-hours without intermediaries. Moreover, wholesale CBDC can be converted into physical money at a fixed rate of 1:1. Hence, wholesale CBDC is practically closer to digital money in reserve accounts which has high degree of substitution to fiat money. With these advantages, financial institutions, will increase their holding in reserve account in the form of wholesale CBDC and reduce amount of reserve money. (Table 8)

Table 8 Changes in balance sheets of economic agents
Case 1: Wholesale CBDC

Central bank	
Asset	Liability & Equity
Bonds	Reserves
International reserves	- CBDC ⬆
	- Cash ⬇
	Othre liabilities
Other assets	Equity

Commercial bank	
Asset	Liability & Equity
Credit	Loan
Bonds	Deposit
Reserve at Central bank	Equity
- CBDC ⬆	
- Cash ⬇	
Other assets	

Household and Firms	
Asset	Liability & Equity
Deposit	Loan
Bonds	Other Liabilities
Cash	Equity
Other assets	

Source: assessed by authors

This study assesses that the presence of wholesale CBDC does not alter the traditional mechanism of monetary policy (Table 9) because (1) it has similar characteristics to cash and e-Money except the use of DLT and (2) regarding its non-interest bearing feature, policy rate change would not affect price and opportunity cost of holding wholesale CBDC. As a result, economic agents are indifferent between holding wholesale CBDC and e-Money.

Issuance of wholesale CBDC can be considered as a way to promote efficiency of payment infrastructure due to its lower cost of fund transfer, increased transaction security for domestic and cross-border transfer in trading, payment, and settlement among financial securities.

[7] **BAHTNET** is an electronic network linking the BOT and BAHTNET members to facilitate high-value fund transfers on Real Time Gross Settlement (RTGS) basis. BAHTNET members include financial institutions and other organizations that are authorized to open deposit accounts with the BOT. BAHTNET is aimed to mitigate risk in payment system which will contribute to a more effective, secure and timely payment system. The system operates daily from 8:30 a.m. to 5:30 p.m., except on bank holidays.

Table 9 Impacts on the effectiveness of monetary policy transmission
Case 1: Wholesale CBDC

Transmission channel	Impacts on monetary policy effectiveness
Interest rate	**No change**
Credit	**No change**
Asset price	**No change**
Exchange rate	**No change**
Expectation	**No change**

Source: assessed by authors

Case 2: Unremunerated retail CBDC

Unremunerated retail CBDC is specifically designed for being means of payment. The characteristics of the unremunerated retail CBDC is similar to cash, which is non-interest bearing and universally accessible.

According to our assessment, the issuance of unremunerated retail CBDC would have no significant impact on monetary policy transmission mechanism because retail CBDC can be regarded as e-Money with DLT, enabling faster and safer settlement of transactions. As unremunerated CBDC is non-interest bearing, any policy rate adjustment will have no net impact on the balance sheets of economic agents, i.e., no net impact on cash, retail CBDC, wealth accumulation, spending, and saving decisions. (Table 10)

Table 10 Changes in balance sheets of economic agents
Case 2: Unremunerated retail CBDC

Central bank	
Asset	Liability & Equity
Bonds	Reserves
International reserves	- CBDC ↑
	- Cash ↓
	Othre liabilities
Other assets	Equity

Commercial bank	
Asset	Liability & Equity
Credit	Loan
Bonds	Deposit ↓
Reserve at Central bank	Equity
- CBDC ↑	
- Cash ↓	
Other assets	

Household and Firms	
Asset	Liability & Equity
Deposit ↓	Loan
Bonds	Other Liabilities
Cash ↓	Equity
CBDC ↑	
Other assets	

Source: assessed by authors

However, under financial stress, the issuance of unremunerated retail CBDC may lead to faster and more severe bank run as depositors could immediately withdraw deposits and transfer into unremunerated retail CBDC. Even though retail CBDC is non-interest bearing, under this circumstance, it might be more attractive than keeping deposits at the banks due to its safer feature and less friction to switch assets. (Table 11)

Table 11 Impacts on the effectiveness of monetary policy transmission
Case 2: Unremunerated retail CBDC

Transmission channel	Impacts on monetary policy effectiveness
Interest rate	**No change**
Credit	**No change in normal times** as people still deposit money for earning interest. However, **effectiveness of transmission mechanism will be lower during crisis time** since people could switch deposits to CBDC. This could reduce bank deposits and credit provisions at financial institutions, and pressure banks to depend more from other sources with higher cost, instead of deposits.
Asset price	**No change**
Exchange rate	**No change**
Expectations	**Indeterminate** While it might lead to lower effective lower bound due to lower cost of holding cash, individuals might switch deposits to unremunerated CBDC in times of negative interest rate.

Source: assessed by authors

Moreover, Rogoff (2016) argued that if retail CBDC is unremunerated, monetary policy transmission through an expectation channel would be hindered since the central bank cannot overcome the zero lower bound issue. If central bank needs to cut policy rate below zero, individuals could immediately switch their deposits to unremunerated CBDC which is risk-free and at zero cost of holding.

Case 3: Remunerated retail CBDC

Remunerated retail CBDC is aimed to use as an alternative monetary policy tool, which has some features quite similar to deposits at financial institutions with interest payment. However, this is a direct claim to the central bank as individuals and businesses can hold the CBDC and earn interest directly from the central bank.

This study assesses that remunerated retail CBDC would significantly affect the monetary policy transmission mechanism through several main channels. This is because remunerated retail CBDC is not only a digital form of money that allows individual to use as a means of payment, but it can also be regarded as an alternative choice for investments and savings due to its interest-bearing feature, especially that DLT could help reduce transaction costs and avoid transaction fee charged by intermediaries. (Table 12)

Many studies found that **remunerated retail CBDC can be a tool to enhance central banks' control for domestic financial condition.** In other words, when the central bank adjusts the policy rate, CBDC interest rate will move accordingly. This leads to more direct and faster transmission to individuals' purchasing power. Moreover, the central bank could either choose to set interest rate differently for each group of CBDC holders - known as "targeted measure" or directly inject more money (the CBDC) into wallets of CBDC holders – known as "helicopter money". Therefore, **the remunerated CBDC would be more attractive than Case 2 (unremunerated retail CBDC), in terms of enhancing monetary policy transmission, and even more desirable than deposits at financial institutions to the eyes of individuals**. This is

mainly because the CBDC holders feel more secured from holding money as a direct claim on central bank's liabilities[8] and also earn interest income. Consequently, financial institutions need to adjust their business models in this new environment, particularly when deposits at financial institutions become less attractive.

Table 12 Changes in economic agents' balance sheets
Case 3: Remunerated retail CBDC

Central bank	
Asset	Liability & Equity
Bonds	Reserves
International reserves	- CBDC ↑
	- Cash ↓
	Othre liabilities
Other assets	Equity

Commercial bank	
Asset	Liability & Equity
Credit ↓	Loan ↑
Bonds ↓	Deposit ↓
Reserve at Central bank	Equity
- CBDC ↑	
- Cash ↓	
Other assets	

Household and Firms	
Asset	Liability & Equity
Deposit ↓	Loan
Bonds ↓	Other Liabilities
Cash ↓	Equity
CBDC ↑	
Other assets	

Source: assessed by authors

Table 13 indicates that **remunerated retail CBDC would enhance effectiveness of monetary policy transmission, especially through the expectation channel, when the CDBC completely replace physical cash or printed money.** This would help the central bank eliminate constraints in implementing monetary policy, i.e., the effective lower bound (ELB) or the zero lower bound (ZLB). When the policy interest rate is set below zero, individuals and businesses can no longer avoid transmission of the negative interest rate policy by holding cash anymore. Therefore, the central bank can provide further monetary easing through ultra-negative interest rate which is particularly beneficial during downturns [Stevens (2017)]. This is mainly because, in times of the near-ELB policy interest rate, central bank needs to heavily rely on forward guidance in order to enhance effectiveness of monetary policy transmission. Nonetheless, the effectiveness of forward guidance itself depends on several factors, such as quality and clarity of communication, as well as audiences' literacy and understanding.

Table 13 Impacts on the effectiveness of monetary policy transmission
Case 3: Remunerated retail CBDC

Transmission channel	Impacts on monetary policy effectiveness
Interest rate	**More effective:** Financial institutions need to proactively adjust deposit and loan rates according to the policy rate to maintain their deposit base. [CPMI (2017)] Interest rate paid on CBDC will be regarded as a floor for deposit rates. In case deposit rate is below the policy rate, individuals can switch from deposits to the CBDC instantly for higher return in the latter. Likewise, interest rate paid on the CBDC will be regarded as a ceiling for loan rates. [Meaning et al (2018)]
Credit	**Less effective:** Most people would switch from deposits to the CBDC despite no bank run. Smaller deposit base would reduce

[8] This is different from deposit at financial institutions which is classified as financial institutions' liabilities.

	lending capability of financial institutions (by smaller balance sheet). This might lead to higher cost of funding because financial institutions either need to raise deposit rates to maintain deposit base or need to rely on other source of funds [Stevens (2017), BIS (2018)].
Asset price	**More effective:** Change in policy interest rate might affect financial asset's prices including those of the CBDC. This would directly affect CBDC holders' purchasing power, apart from the traditional transmission channel through financial institutions.
Exchange rate	**No change**
Expectation	**More effective:** Central banks can avoid constraints in implementing monetary policy, i.e., effective lower bound, especially the case where CBDC completely replaces physical cash.

Source: assessed by authors

3.2.2 Other considerations for issuing retail CBDC

From the assessment above, for both unremunerated and remunerated retail CBDC, **issuing retail CBDC might be an appropriate option for central bank to handle the rising trend of using cryptocurrency as a means of payment**. In addition to allow individuals direct access to central bank's money and maintaining central bank's capability in controlling domestic financial condition, issuing retail CBDC will enhance monetary policy transmission which depends on the design of retail CBDC. **However, issuing retail CBDC needs to thoroughly consider some other important issues as follows.**

(1) Financial landscape: Issuing retail CBDC would affect financial institution's business model whereby individuals might switch from deposits at financial institutions to retail CBDC. Financial institutions, hence, need to adjust themselves to accommodate a smaller deposit base. Meanwhile, the central bank will act as the "narrow bank" with only lending and borrowing functions. Moreover, issuing retail CBDC would enlarge central bank's balance sheet due to larger liabilities that subsequently required larger foreign reserves to back up larger amount of digital currency in circulation.

(2) Financial stability: BIS (2018) indicated that Issuing retail CBDC would increase financial stability risk. Financial institutions are under pressures to lend and take more risks to obtain higher interest income to compensate higher wholesale funding cost, e.g., raising funds from short-term interbank market to compensate less funding from retail depositors.[9] This creates additional roll-over risk and interest rate risk. Last but not least, as mentioned earlier, retail CBDC accommodates abrupt digital bank run which could cause the financial institutions lack of liquidity and fall into liquidity problem.

(3) Increasing policy space from lowering ELB this way could pose risk on central bank's reputation and credibility. Rogoff (2016) and Engert (2017) viewed that the negative

[9] In general, raising funds from wholesale has higher cost and volatility than raising funds from retail.

interest rate policy might not be widely accepted for public and could stimulate consumption as much, especially in downturns. In the meantime, central bank could consider other policy options to expand policy space, e.g. abolish high-denomination banknotes to increase cost of holding cash, which could also lower the ELB.

(4) **Preserving monetary policy effectiveness should not be the only reason to issue retail CBDC.** Issuing retail CBDC might prevent central bank from losing seignorage income when public have more incentive to use cryptocurrency over central bank's money. This could pressure the central bank's balance sheet running on deficit and require bailout from government which could be harmful for central bank independence. However, Engert (2017) indicated that this might not be an issue if there is a legal framework to accommodate central bank suffering from consecutive losses in financial statement. In addition, He (2018) viewed that even though cryptocurrency gains more popularity among some groups and becomes more money-alike, it hardly substitutes central's bank money as long as there is trust in the central bank. Therefore, the central bank should focus on how to adopt new technology for promoting effectiveness of monetary policy in order to preserve the public trust.

4. Summary

This study analyzes impacts from digitalization in financial services on monetary policy in Thailand for 2 perspectives: the current landscape, i.e., e-Payment, and the future landscape, i.e., cryptocurrency and central bank digital currency.

Our empirical study shows that e-Payment usage in Thailand has replaced cash in a lesser degree due to its early stage. Demand for cash among Thai people depends mostly on economic activities and opportunity cost of holding cash. This finding explains the reason why cash in Thailand is still growing despite mild economic growth and inflation, resulting in a constant cash-to-GDP ratio overtime. Moreover, Thailand's monetary variables have not significantly been affected, unlike other countries in transition to a cashless society, which commonly observed a significant decline in the cash-to-GDP ratio and rising velocity of money. Therefore, there is no obvious impact on Thailand's monetary policy transmission along the road towards "less-cash" society under inflation targeting monetary policy framework that controls policy interest rate instead of money supply. **Moreover, our quantitative analysis indicates that e-Payment usage enhances monetary policy transmission, particularly through the credit and asset price channels. Meanwhile, the exchange rate channel also improves** due to more convenient cross-border capital flows movement from lower transaction costs.

Our scenario analysis for digital currency shows that, given growing usage of cryptocurrency, i.e., private digital currency, in Thailand, monetary policy transmission might be negatively affected, especially through more volatile asset price channel. The degree of impact depends on popularity of cryptocurrency among public. Consequently, many central banks have been preparing to cope with the new technology of digital currencies, alongside considering the need to issue its own digital currency.

Even though Thailand is still on the beginning phase towards cashless society which has not yet affected the monetary policy transmission, the BOT needs to closely monitor and assess the impacts from the fast-changing technology and more interconnected world. Similar to other central banks, the BOT needs to stand ready and continually develop its electronic payment system as a backbone infrastructure of the country to lower cost of cash usage and reap the most benefits from moving towards cashless society in the coming future.

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Appendix

Factor-augmented vector autoregression (FAVAR) model

The Factor-augmented vector autoregression (FAVAR) model used in this study is a combination of Principal Component Analysis (PCA) and the estimation of relationships between economic variables using the Vector autoregression (VAR) model. The model was introduced by Bernanke et al (2005) studying the effectiveness of monetary policy transmission in the United States that applied by Ahuja et al (2008) in the case of Thailand. Using this method, researchers can use other economic variables apart from observed variables to help explain the results of economic shocks.

The FAVAR model consists of two groups of variables, namely observed variables (Y) and factor (F) derived from an analysis of the common factors of unobserved variables. The joint dynamics of (Ft, Yt) can be written as follows:

$$\begin{bmatrix} F_t \\ Y_t \end{bmatrix} = \phi(L) \begin{bmatrix} F_{t-i} \\ Y_{t-i} \end{bmatrix} + \nu_t,$$

where F_t is unobserved factor (k x 1),
Y_t is observed variables (m x 1),
$\phi(L)$ is lag polynomial of finite order d, and
ν_t is error term with zero mean and constant covariance (Q)

Our study determined 3 main observed variables in the base model, namely inflation, economic growth used coincident economic index (CEI) as a proxy variable and the policy interest rate[10]. **In the alternative model, the case of using e-Payment, we will include the value of e-Payment usage as an observed variable.** In addition, 113 other variables (details in the table below) are included to analyze common factors. In this study, our model employs 5 factors. The model is set and ordered observed variables and factors by Cholesky decomposition. The one-lag length is chosen by the Schwartz information criterion (SIC).

The model employed monthly data from January 2006 to June 2018. The table below indicates unit and methods of data conversion (transformation code: TCODE) of each unobserved variable in the model. TCODE consists of 1-no transformation, 2-first difference, 3-seasonal adjustment, 4-logarithm, 5-first difference of logarithm, and * refer to fast-moving variables (see more details in Bernanke et al (2005)).

	Consumption and investment		
1	Private consumer index (PCI)	Index	5
2	Private investment index (PII)	Index	5
3	Private investment index: Imports of Capital Goods	Index	5
4	Private investment index: Domestic Machinery Sales	Index	5
5	Retail sales index	Index	5
6	Retail sales index: Non-durable Goods	Index	5
7	Retail sales index: Durable Goods	Index	5

[10] The variable used will be adjusted to the growth rate compared to the previous period. Except for the interest rate which was made as compared to the previous period To solve the problem Non-stationary

8	Wholesale index	Index	5
9	Wholesale index: Non-durable Goods	Index	5
10	Wholesale index: Durable Goods	Index	5
11	Wholesale index: Intermediate Goods	Index	5
	Production		
12	Manufacturing production index (MPI)	Index	5
13	Manufacturing production index: export <30%	Index	5
14	Manufacturing production index: 30%< export <60%	Index	5
15	Manufacturing production index: export >60%	Index	5
16	Capacity utilization rate	%	2
17	Capacity utilization rate: export <30%	%	2
18	Capacity utilization rate: 30%< export <60%	%	2
19	Capacity utilization rate: export >60%	%	2
	Expectation		
20	Business sentiment index (BSI)*	Index	5
21	Business sentiment index: Performance*	Index	5
22	Business sentiment index: Total order book*	Index	5
23	Business sentiment index: Investment*	Index	5
24	Business sentiment index: Employment*	Index	5
25	Business sentiment index: Production costs*	Index	5
26	Expected business sentiment index*	Index	5
27	Consumer Confidence Index (CCI)*	Index	5
28	Consumer Confidence Index: Current*	Index	5
29	Consumer Confidence Index: Future*	Index	5
	Labor Indicators		
30	Registered Applicants	Thousands	5
31	Job vacancies	Thousands	5
32	Employment	Thousands	5
33	Unemployment rate	%	2
	Real estate sector		
34	Land and building transactions nationwide	Million Baht	5
35	Construction areas permitted in municipal zone	Thousands of m^2	5
36	Condominium registration nationwide	unit	5
37	Property credit outstanding	Billon baht	5
38	Real estate development credit	Billon baht	5
39	Personal housing credit	Billon baht	5
	Price indices		
40	Production price index (PCI)	Index	5
41	Production price index: Agriculture	Index	5
42	Production price index: Mining	Index	5
43	Production price index: Manufacturing	Index	5
44	Consumer price index (CPI)	Index	5
45	Consumer price index: Food and non-alcoholic beverages	Index	5
46	Consumer price index: Apparel and footware	Index	5
47	Consumer price index: Housing and furnishing	Index	5
48	Consumer price index: Medical and personal care	Index	5
49	Consumer price index: Transportation and communication	Index	5
50	Consumer price index: Recreation and education	Index	5
51	Consumer price index: Tobaco and alcoholic beverages	Index	5
	Interest rates		
52	1-month T-BILL yield*	%	2
53	3-month T-BILL yield*	%	2
54	6-month T-BILL yield*	%	2
55	Government bond yield 1 year*	%	2
56	Government bond yield 2 year*	%	2
57	Government bond yield 3 year*	%	2
58	Government bond yield 5 year*	%	2
59	Government bond yield 10 year*	%	2
60	Overnight rate*	%	2
61	Minimum loan rate (MLR)*	%	2

62	Minimum overdraft rate (MOR)*	%	2
63	Minimum retail rate (MRR)*	%	2
64	Saving rate*	%	2
65	Saving rate 3 month*	%	2
66	Saving rate 6 month*	%	2
67	Saving rate 12 month*	%	2
68	New loan rate (NLR)*	%	2
69	New loan rate: 20 mb <contract amount< 50 mb*	%	2
70	New loan rate: 50 mb <contract amount< 100 mb*	%	2
71	New loan rate: 100 mb <contract amount< 500 mb*	%	2
72	New loan rate: 500 mb <contract amount< 1000 mb*	%	2
73	New loan rate: contract amount > 1000 mb*	%	2
	Exchange rate		
74	Exchange rate: THB/JPY*	THB/JPY	5
75	Exchange rate: THB/KRW*	THB/KRW	5
76	Exchange rate: THB/USD*	THB/USD	5
77	Exchange rate: THB/GBP*	THB/GBP	5
78	Exchange rate: THB/EURO*	THB/EURO	5
79	Nominal Effective Exchange Rate (NEER)*	index	5
80	Real Effective Exchange Rate (REER)*	index	5
	Money and credit quantity aggregates		
81	Deposit at commercial banks	Billon baht	5
82	New private credit	Billon baht	5
83	Non-performing loans (NPLs)	%	1
84	Non-performing loans : Corporate loans	%	1
85	Non-performing loans : Consumer loans	%	1
86	Broad money	Billon baht	5
87	Narrow money	Billon baht	5
88	Cash in circulation (CIC)	Billon baht	5
89	Cash in circulation: Banknote	Billon baht	5
90	Cash in circulation: Coins	Billon baht	5
	External sector and capital flow		
91	Exports of goods (f.o.b.)	Billon baht	5
92	Imports of goods (f.o.b.)	Billon baht	5
93	Number of tourist	Thousands	5
94	Occupation rate	%	2
95	Direct investment (net)	Billon baht	1
96	Portfolio investment: equities (net)	Billon baht	1
97	Portfolio investment: debt securities (net)	Billon baht	1
	Government sector		
98	Government expenditure (current)	Billon baht	5
99	Government expenditure (capital)	Billon baht	5
100	Government expenditure (total)	Billon baht	5
101	Government revenue	Billon baht	5
102	Government revenue: VAT: import	Billon baht	5
103	Government revenue: VAT: domestic	Billon baht	5
104	Public debt	%	1
	Stock price		
105	SET Index*	Index	5
106	SET50 Index*	Index	5
107	MAI Index*	Index	5
	Oil Price		
108	Crude oil price: WTI*	USD per Barrel	5
109	Crude oil price: Brent*	USD per Barrel	5
110	Crude oil price: Dubai*	USD per Barrel	5
	Global policy rate		
111	Policy rate: USA (Fed fund rate)*	%	2
112	Policy rate: United kingdom*	%	2
113	Policy rate: Japan*	%	2