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CASHLESS PAYMENTS AND BANKING PERFORMANCES: A STUDY OF LOCAL COMMERCIAL BANKS IN MALAYSIA

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ABSTRACT

The banking industry plays a facilitatory role in moving toward a cashless society. This study investigates the impacts of cashless payments (ATM, internet banking, mobile banking, credit card, debit card, charge card and e-money) on banking performance for eight local commercial banks in Malaysia over the period of 2005 to 2018. The findings show that cashless payments are positively related to the return on assets (ROA) and return on equity (ROE) of banks, except e-money. Furthermore, the study demonstrates cashless payments have improved the cost-to-income ratio of banks, except ATMs. Meanwhile, this study disaggregates the sample into subperiod analysis to further examine the transition effect of cashless payments on banks' performance. The results show that banks' profitability performance is mainly driven by the usage of cashless payments in the first wave of progressive development, while cashless payments do not show progressive impact on banks' efficiency performance. This suggests that cashless payments do not add value to banks' performances in the long run.

Keywords: Cashless payments, ROA, ROE, Cost-to-income ratio, commercial banks, fintech.

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1. INTRODUCTION

The technologies of industrial revolution 4.0 such as big data, Internet of Things, cloud computing and system integration benefit financial services ecosystems, particularly the banking industry. It has transformed traditional banks into multichannel models. Consumers can access banking products and services not only from brick-and-mortar bank branches but also through a variety of electronic channels such as mobile phone applications and websites.

Cashless payments is a form of financial exchange between buyers and sellers, facilitated through electronic channels (Vassiliou, 2004, as cited in Itah & Emmanuel, 2014). Electronic payment, which started off with credit and debit cards has evolved into a higher level of payment services with the adoption of technological devices such as internet banking, mobile banking and e-money. The electronic banking services provide cost savings and efficiency by replacing labour with

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computer networks, diversifying products and providing 24-hour banking services (Yang et al., 2009). The perceived benefits of technology are improvements in customer services (Kurnia et al., 2010). For example, QR codes enable consumers to make payments from anywhere (Lim, 2019). A survey showed that 74% of Malaysians are aware of and interested with virtual banking (Ong et al., 2019). Virtual banking delivers banking services over the electronic channels without requiring the presence of brick-and-mortar branches. In response to the demand, most banks in Malaysia have begun digitizing their financial products and services. On the other hand, the majority of the flourishing fintech companies in Malaysia, also offer payments services. Banks must compete with fintech companies to maintain their position in the market that was once solely owned by them.

Electronic banking has been the interest of many researchers. In Malaysia, a considerable number of studies focused on the adoption of electronic banking (Poon, 2008), the behaviour of internet banking users (Munusamy et al., 2012), the benefits and drawbacks of cashless banking (Kadar et al., 2018) and the issues and challenges of e-banking (Chai, 2006).

Meanwhile, studies that examined the impacts of electronic banking payment services on banks' performance showed mixed results. Some studies documented positive impacts of electronic banking on banks' performances (Aduda & Kingoo, 2012; Kurnia et al., 2010; Yang et al., 2018), while some reported negative impacts (Itah & Emmanuel, 2014; Kamboh & Leghari, 2016; Onay & Ozsoc, 2013). The results were mixed and inconclusive, especially for developing countries (Chen et al., 2020; Dinh et al., 2015; Khrawish & Al-Sa'di, 2011; Malhotra & Singh, 2009).

Additionally, studies on the impact of cashless payments and performances of Malaysia local commercial bank are rare. Examining the impacts of cashless payments on banks' performance is important, as the banking world today is moving toward a cashless future. The findings of this study would provide a roadmap and insights for commercial banks to discover the strengths and efficiency management of cashless banking and could subsequently improve banks' performance. Furthermore, policy makers such as government and regulatory institutions could benefit in designing cashless payment policies.

The findings of this study reveal that cashless payments have improved banks' profitability and efficiency performance over the period of 2005 to 2018. Moreover, findings from the subperiod analysis suggest that the progressive development influenced the relationship of banks' performance and the usage of cashless payments. The results show that banks' profitability performance is mainly driven by the usage of cashless payments in the first wave of progressive development, while cashless payments do not show progressive impact on banks' efficiency performance. This suggests that cashless payments do not add value to banks' performance in the long run.

2. LITERATURE REVIEW

2.1. Cashless Banking in Malaysia

Table 1: Local Commercial Banks in Malaysia and Cashless Payments Offered

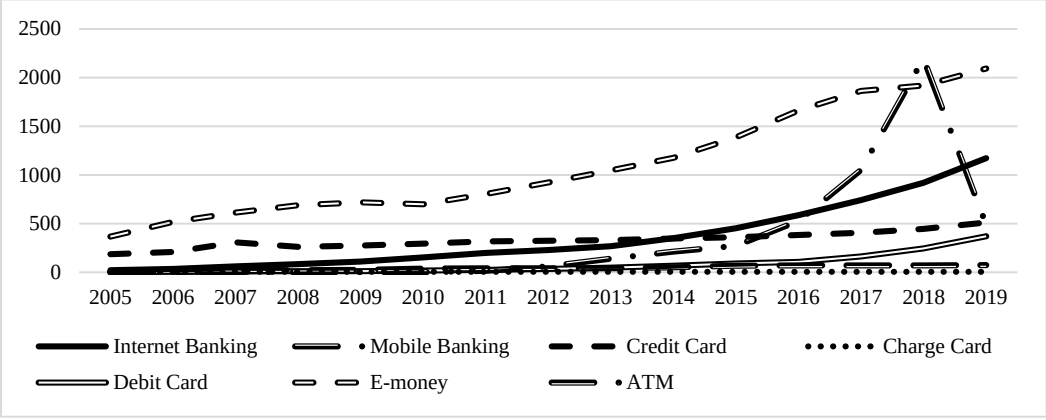
No.	Local Commercial Bank	Cashless Payment						
		ATMs	**CRC**	**DC**	**CC**	**IB**	**MB**	**EM**
1.	Affin Bank Berhad	√	√	√		√	√	
2.	Alliance Bank Berhad	√	√	√		√	√	
3.	AmBank (M) Berhad	√	√	√		√	√	√
4.	CIMB Bank Berhad	√	√	√	√	√	√	√
5.	Hong Leong Bank Berhad	√	√	√		√	√	
6.	Malayan Bank Berhad	√	√	√	√	√	√	√
7.	Public Bank Berhad	√	√	√	√	√	√	
8.	RHB Bank Berhad	√	√	√		√	√	√

Notes: ATMs is automated teller machines, CRC is credit card, DC is debit card, CC is charge card, IB is internet banking, MB is mobile banking and EM is e-money.

Table 1 shows the local commercial banks in Malaysia and cashless payments offered. Services such as ATMs, credit card, debit card, internet banking and mobile banking are offered by all the local commercial banks in Malaysia. However, only CIMB Bank Berhad, Malayan Bank Berhad and Public Bank Berhad offer charge card, only AmBank (M) Berhad, CIMB Bank Berhad, Malayan Bank Berhad and Public Bank Berhad issue e-money. As defined by Bank Negara Malaysia (BNM), ATM is where a cardholder can assess their funds from the automated teller machines. A credit card allows a holder to use it with a given credit line and the amount to be settled in the future. A debit card is a payment card where the transaction amount is tied to the holder's bank account. A charge card functions as a credit card, but the outstanding balance needs to be settled by the due date. Internet banking allows users to perform banking transactions through a web browser while mobile banking allowed users to conduct banking transaction through mobile phones. E-money is an instrument containing monetary value that is paid in advance for the purchase of goods and services.

Figure 1 shows the total transaction volume of cashless payments in Malaysia between 2005 and 2019. There is an increasing trend of cashless payments in Malaysia over time. E-money appears to be the highest transaction volume of cashless payments, followed by internet banking and mobile banking. E-money such as Touch 'n go eWallet, GrabPay, Boost, Lazada Wallet, CIMB pay and ShopeePay has gained popularity in Malaysia.

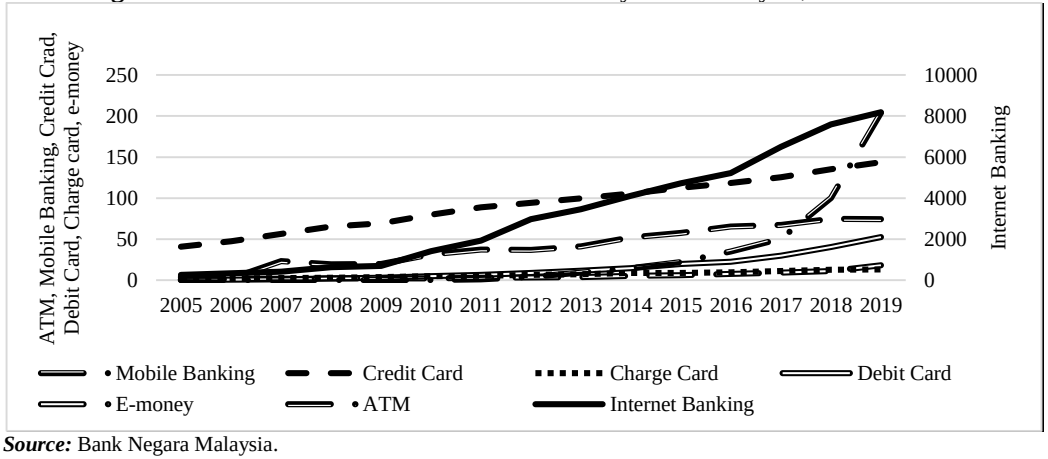
Figure 1: Total Transaction Volume of Cashless Payments Malaysia, 2005 to 2019.



Source: Bank Negara Malaysia.

Figure 2 presents the total transaction value of cashless payments in Malaysia between 2005 and 2019. The figure shows that the highest transaction value of cashless payments is internet banking, followed by mobile banking and credit card. Compared to Figure 1, this could imply that Malaysians use e-money more frequently but for smaller amounts of transactions such as food, groceries, and retail expenses, while the majority of larger transactions such as hire purchase and mortgage instalments, insurance, and bill payments are conducted through internet banking, mobile banking and credit card.

Figure 2: Total Transaction Value of Cashless Payments Malaysia, 2005 to 2019.



Source: Bank Negara Malaysia.

2.2. Empirical Review

The impacts of cashless payments and banks' performances have received great attention in recent years. The advancement of technology has changed the way people make payments, from physical cash to electronic payments.

Although electronic banking system requires huge capital initially, it generates long-term competitive advantage for the banks. Hernando and Nieto (2007) indicate that the profitability of internet banking among Spanish banks has only been realized after three years of implementation. Itah and Emmanuel (2014) report that the introduction of electronic banking required investment in computer technology and telecommunication facilities. However, in the long run, more customers are attracted to the convenience and efficiency of cashless banking, Hence, the net income of banks will rise after the system is established.

The innovation of banking products and services is found to significantly impact banks' performance. The return on asset (ROA) and return on equity (ROE) of banks would improve in the long run with the implementation of electronic banking (Yang et al., 2018). Electronic banking, such as ATMs, internet banking, credit and debit cards, lowers banks' expenditure and generates higher revenue, which has significantly improved banks' profitability (Aduda & Kingoo, 2012; Akara & Asekome, 2018; Gündoğdu & Taşkın, 2017; Itah & Emmanuel, 2014). However, Simpson (2002) demonstrates that electronic banking generated higher revenue for banks in the USA than in emerging markets, due to a strong information technology framework in the USA compared to developing countries.

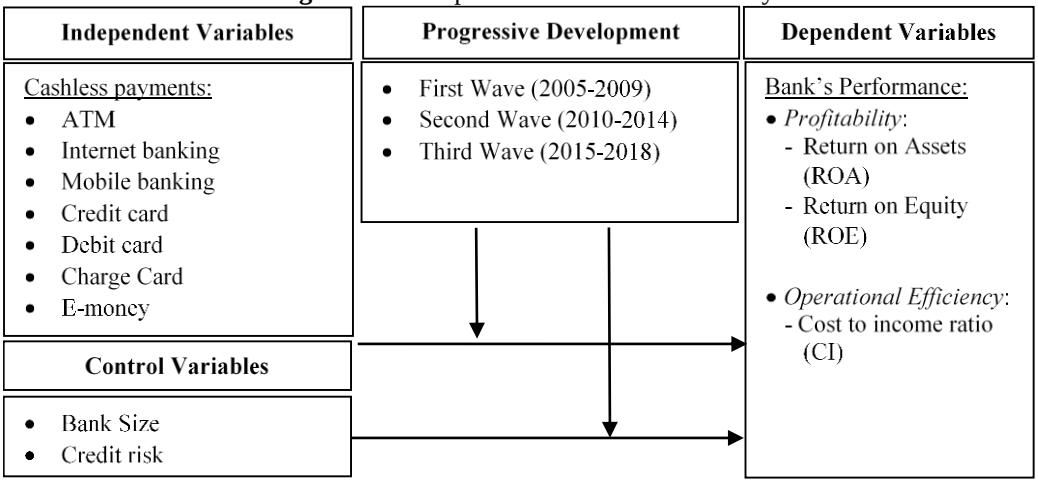
Furthermore, operational efficiency is achieved through electronic banking by minimizing operating costs and maximizing operating revenues (Ardizzi et al., 2019). The application of information and technology decreases the number of employees needed in banks' operations (Dinh et al., 2015). E-banking successfully addresses the rapidly increasing retail banking transaction volumes without significant increases in operating costs (Kurnia et al., 2010). Electronic banking improves banks' asset growth, reduces operating expenses, and enhances the portfolio by providing efficient services to customers (Adewoye, 2013).

However, some studies show contradictory results. For instance, Malhotra and Singh (2009) examine that internet banking has no significant impact on the profitability of Indian banks. Onay and Ozsoz (2013) indicate lower interest income after two years of implementation due to high competition of internet banking in Turkey. Khrawish and Al-Sa'di (2011) show that e-banking does not improve banks' profitability due to the high costs for banks in Jordan. In addition, the development of fintech companies also poses challenges to the profitability of banks. Chen et al. (2020) demonstrate that internet finance giants in China such as Alibaba Ant Financial and Tencent that offer peer-to-peer (P2P) lending and third-party payments have negatively impacted banks' profitability. Banks face a decline in interest revenue of loans, high interest expenses on deposits, and lower growth rates of loan and deposits.

2.3. Research Framework and Hypotheses Development

This study examines the impacts of cashless payments on Malaysia local commercial bank's performances. This study focuses on retail cashless payments, which include ATM, internet banking, mobile banking, credit card, debit card, charge card and e-money.

Figure 3: Conceptual Framework of the Study



Figures 3 shows the research framework for this study. Based on the received literature, profitability and operational efficiency of banks are influenced by the usage of cashless payments. Bank size and credit risk are included as control variables, because they are widely believed to influence banks' performance. Additionally, this study investigates the transition effects of cashless payments' progressive development on banks' performance. As observed in Figure 1 and Figure 2, this study measures the progressive development of cashless payments in three waves. The first wave represents the early progressive development of cashless payments in Malaysia (2005-2009); the second wave represents growing progressive development (2010-2014); and the third wave represents exponential growth progressive development (2015-2018). This investigation is necessary, because changes in global trends and government policies towards cashless payments affect the transactions of cashless payments.

Although, the literature has limited evidence on the effect of progressive development towards banks' performance. This study argues that the progressive development of cashless payments should be more significant in this digital age. Hence, this study hypothesizes that progressive development should have a more positive impact on the relationship between cashless payments and the profitability and operational efficiency of local commercial banks in Malaysia.

In the context of the above discussion, the following hypotheses are designed.

Hypothesis 1: Cashless payments have a significant positive impact on ROA for local commercial banks in Malaysia.

Hypothesis 2: Cashless payments have a significant positive impact on ROE for local commercial banks in Malaysia.

Hypothesis 3: Cashless payments have a significant negative impact on the CI ratio for local commercial banks in Malaysia.

Hypothesis 4: The progressive development (first wave to third wave) positively moderates the relationship between cashless payments and bank performance for local commercial banks in Malaysia.

3. METHODOLOGY

3.1. Data Sources

This study is conducted on eight (8) local commercial banks in Malaysia. The data are collected for the period between 2005 and 2018. The banks' financial data such as income, total assets, total equity, operating costs, operating revenue, provision of loan losses and total loan are obtained from Datastream. In addition, the data for total transaction value of cashless payments are gathered from BNM.

3.2. Model Specification

This study employs the pooled ordinary least square (Pooled OLS) method to estimate the relationship between the banks' performances and transaction value of the cashless payments in a panel data context.

The dependent variables of this study are banks' profitability performance (measured by ROA and ROE) and banks' operational efficiency (measured by CI ratio). The independent variables of this study are proxied by the total value of cashless payments, with bank size and credit risk as control variables. The progressive development period is used to capture the three transition waves of cashless payment in Malaysia.

ROA is widely used to measure banks' profitability performance. The cashless payment has exposed banks to inter-bank and intra-bank fund transfers; thus, it increases deposits and banks' customer base (Saleem et al., 2019). To meet this need, banks have increase their assets significantly. Hence, this will impact its ROA. Studies such as Aduda and Kingoo (2012), and Yang et al. (2018) also use ROA to examine the profitability performance of bank. The ROA of bank *i* at year *t* is computed as:

$$ROA_{it} = \frac{Net\ income\ after\ taxes_{it}}{Total\ Assets_{it}} \tag{1}$$

ROE measures the accounting profitability from the shareholder's perspective. It evaluates how efficiently a bank generates profits from shareholders' equity. Studies such as Kamboh and Leghari (2016) and Yang et al. (2018) use ROE to determine the profitability performance of bank. The ROE of bank *i* at year *t* is computed as:

$$ROE_{it} = \frac{Net\ income\ after\ taxes_{it}}{Shareholder's\ Equity_{it}} \tag{2}$$

The CI ratio is important in measuring a bank's performance. It evaluates a bank's operational efficiency by measures its operating expenses in relation to operating income. The lower the ratio, the more efficient the bank is. CI is used in studies such as Sarker et al. (2015) and Elouali and Lahsen (2018) to examine banks' operational efficiency. The CI of bank *i* at year *t* is computed as:

$$CI_{it} = \frac{Operating\ expenses_{it}}{Operating\ \text{income}_{it}} \tag{3}$$

The independent variables of this study are the total transaction value of cashless payments, which are ATM, internet banking, mobile banking, credit card, debit card, charge card and e-money. The total transaction value of cashless payments are transformed to its natural logarithm form in the regression analysis as below:

ATM_{it} or $InternetBanking_{it}$ or $MobileBanking_{it}$ or $CreditCard_{it}$ or $DebitCard_{it}$ or $ChargeCard_{it}$ or $Emoney_{it}$ = Log(Transaction Value of ATM_{it} or $InternetBanking_{it}$ or $MobileBanking_{it}$ or $CreditCard_{it}$ or $DebitCard_{it}$ or $ChargeCard_{it}$ or $Emoney_{it}$) (4)

This study controls for bank-specific factors, which are bank size and credit risk. Controlling for these factors reduces the likelihood that the estimated impacts of dependent variables are spurious. Athanasoglou et al. (2005) explained that the effect of the growing size of banks on profitability has been found to be positive to a certain extent. Conversely, Aladwan (2015) found a negative significant relationship between bank size and profitability. It is calculated by transforming total asset of bank *i* at year *t* to natural logarithm in the regression analysis (Aladwan, 2015; Athanasoglou et al., 2005).

$$Size\ of\ bank\ (Size_{it}) = Log(Total\ Assets_{it}) \tag{5}$$

Furthermore, credit risk has a significant impact on a bank's performance. It is a major source of loss for the banks. Credit risk exposure is negatively related to a bank's profitability (Lepetit et al., 2008). The ratio used to measure credit risk in this study is loan losses provision-to-total loan of bank *i* at year *t* (Samad, 2015).

$$Credit\ risk\ (CR_{it}) = \frac{Loan\ losses\ provision_{it}}{Total\ Loan_{it}} \tag{6}$$

This study runs the regression analysis for proxies of the eight local commercial banks' performance (ROA, ROE and CI ratio) on the total transaction value of cashless payments, controlling for bank size and credit risk. In addition, bank dummies are included in this study to control for bank effects. The bank dummies represent the fixed effect, used to capture the influence of the sample banks organizational and managerial characteristics. Therefore, the regression is expressed as below.

$$Y_{it} = \alpha + CP_{it} + Xs_{it} + \varepsilon_{it} \tag{7}$$

Where, Y_{it} is ROA_{it} or ROE_{it} or CI_{it}. CP_{it} are the independent variables of this study, which are transaction value of $ATMs_{it}$ or $InternetBanking_{it}$ or $MobileBanking_{it}$ or $CreditCard_{it}$ or $DebitCard_{it}$ or $ChargeCard_{it}$ or $Emoney_{it}$. Xs_{it} are the control variables including $BankSize_{it}$, $CreditRisk_{it}$ and bank dummies.

Furthermore, to capture the transition effects of cashless payments on banks' performance, this study disaggregates the sample into subperiod analysis. The first wave will take a value of one for the period of 2005 to 2009, and zero otherwise. The second wave will take a value of one for the period of 2010 to 2014, and zero otherwise. Finally, the third wave will take a value of one for the period of 2015 to 2018, and zero otherwise. The interaction term (*CP*ProgDev*) is used to capture

the moderation effects of progressive development of cashless payments on bank performance. Therefore, the regression is expressed as below.

$$Y_{it} = \alpha + CP_{it} + Xs_{it} + ProgDev_{it} + (CP_{it}*ProgDev_{it}) + \varepsilon_{it} \quad (8)$$

Where $ProgDev_{it}$ is added in equation 7. The $ProgDev_{it}$ are the $FirstWave_{it}$ or $SecondWave_{it}$ or $ThirdWave_{it}$. The $CP_{it}*ProgDev_{it}$ is the multiplication of CP_{it} with $ProgDev_{it}$, which are ($ATMs_{it}$ x $ProgDev_{it}$) or ($InternetBanking_{it}$ x $ProgDev_{it}$) or ($MobileBanking_{it}$ x $ProgDev_{it}$) or ($CreditCard_{it}$ x $ProgDev_{it}$) or ($DebitCard_{it}$ x $ProgDev_{it}$) or ($ChargeCard_{it}$ x $ProgDev_{it}$) or ($Emoney_{it}$ x $ProgDev_{it}$)

4. RESULTS AND DISCUSSION

4.1. Descriptive Statistics

Table 2 shows the descriptive statistics of the variables used in this study. There are a total of 112 observations where the study is conducted on 8 commercial banks for the period of 2005 to 2018 (n=8, t=14). Among the dependent variables, ROE shows the highest mean at 11.73%, with a maximum of 27.07% and minimum of -11.58%. Next, the mean of ROA is 0.99% with a maximum of 1.53% and a minimum of -0.86%. The mean of the cost to income ratio is 5.74%, and the maximum and minimum are 312.05 and -5.63, respectively. Meanwhile, for independent variables, internet banking shows the highest mean, which is 7.46%, with a maximum of 8.93% and a minimum of 5.56%. While mobile banking shows the lowest mean, which is 0.07%, with a maximum of 4.61% and a minimum of -5.40%. In addition, the means for credit card and ATMs are 4.42% and 3.31%, respectively, while variables such as debit card, charge card and e-money show values of mean below 2%. For the control variables, the mean of size is 18.73%, with maximum and minimum values of 20.51% and 16.97%, respectively. Credit risk shows a negative mean value of -5.68%.

Table 2: Descriptive statistics of variables

Variables	Obs	Mean	Std. Dev.	Maximum	Minimum
ROE	112	11.7270	5.1437	27.0663	-11.5829
ROA	112	0.9864	0.3412	1.5318	-0.8601
Cost-to-income	112	5.7378	29.2492	312.0451	-5.6250
ATM	112	3.3061	1.0227	4.31149	0.7637
Internet Banking	112	7.4586	1.1362	8.9346	5.5572
Mobile Banking	112	0.0701	3.3160	4.6064	-5.4037
Credit Card	112	4.4236	0.3597	4.9068	3.7111
Debit Card	112	1.7125	1.4622	3.6964	-1.2040
Charge Card	112	1.6840	0.5870	2.5257	0.7885
e-Money	112	1.2012	0.7178	2.3979	0.0000
Size	112	18.7308	0.8885	20.5075	16.9710
Credit Risk	112	-5.6828	1.9471	0.0000	-10.2671

4.2. Correlation Analysis

Table 3 shows a pairwise correlation matrix for the independent variables used in this study. The independent variables are highly correlated with each other. Therefore, the independent variables are tested separately. Hence, this eliminates the concerns of multicollinearity.

Table 3: Correlation matrix between variables

Variables	ATM	Internet Banking	Mobile Banking	Credit Card	Debit Card	Charge Card	e-Money	Size	Credit Risk	ROA	ROE	Cost-to-income
ATM	1											
Internet Banking	0.8799	1										
Mobile Banking	0.8652	0.9896	1									
Credit Card	0.9199	0.9886	0.9807	1								
Debit Card	0.9151	0.9878	0.9815	0.9995	1							
Charge Card	0.8639	0.9945	0.9902	0.9838	0.9847	1						
e-Money	0.8553	0.9637	0.9775	0.9686	0.9714	0.9749	1					
Size	0.3727	0.4200	0.4208	0.4176	0.4177	0.4184	0.4112	1				
Credit Risk	-0.1837	-0.2048	-0.1925	-0.2050	-0.2019	-0.2020	-0.1876	-0.2127	1			
ROA	0.3066	0.2647	0.2355	0.2674	0.2613	0.2465	0.1849	0.3368	-0.1797	1		
ROE	0.0696	-0.0125	-0.0388	0.0007	-0.0059	-0.0348	-0.0866	0.3509	-0.1936	0.8521	1	
Cost-to-income	-0.0256	-0.1323	-0.1243	-0.1180	-0.1187	-0.1435	-0.1071	-0.0664	0.0926	-0.3612	-0.3061	1

4.3. Impacts of Cashless Payment on ROA

Table 4 reports the results for the impacts of cashless payments on banks' ROA for local commercial banks in Malaysia.

Table 4: The Impacts of Cashless Payments on Bank's ROA

ROA		CP	Bank Size	Credit Risk	ProgDev	CP* ProgDev	Intercept	R-square	F-stat
2005 – 2018[1]	ATM	**0.1910*** **	**-0.2815** **	-0.0071			**5.5880** **	0.3304	**4.9837*** **
		(3.6462)	(-2.0313)	(-0.4567)			(2.2856)		
	Internet Banking	**0.3869** **	**-0.9410*** **	-0.0046			**15.6993** **	0.3619	**5.7271*** **
		(4.3506)	(-3.6165)	(-0.3013)			(3.7021)		
	Mobile Banking	**0.0957*** **	**-0.6415** **	-0.0084			**12.9477** **	0.3017	**4.3636*** **
		(2.9319)	(-2.297)	(-0.5234)			(3.7021)		
	Credit Card	**1.1086*** **	-0.8338	-0.0047			**11.6733*** **	0.3550	**5.5591*** **
		(4.2017)	(-3.4124)	(-0.3061)			(3.3562)		
	Debit Card	**0.2571*** **	**-0.7785*** **	-0.0057			**15.0965*** **	0.3419	**5.2477*** **
		(3.9109)	(-3.1438)	(-0.3681)			(3.3315)		
	Charge Card	**0.5552*** **	**-0.6568** **	-0.0062			**12.3186*** **	0.3143	**4.6292*** **
		(3.2571)	(-2.5478)	(-0.3921)			(2.7046)		
	e-Money	0.0742	0.0178	-0.0091			0.5130	0.2450	**3.2769*** **
		(0.6014)	(0.0075)	(-0.5460)			(0.1237)		
First Wave (2005-2009)[2]	ATM	0.0141	**-0.4451** **	-0.0029	-0.8110	0.1374	**9.4393** **	0.4009	**5.5200*** **
		(0.0773)	(-2.0006)	(-0.1915)	(-1.4105)	(0.8105)	(2.5637)		
	Internet Banking	0.1908	**-0.8416*** **	-0.0020	**-2.6853*** **	**0.3778*** **	**15.4549*** **	0.4234	**6.0591*** **
		(1.6483)	(-3.2642)	(-0.1354)	(-3.0667)	(2.8649)	(3.7485)		
	Mobile Banking	**0.05968***	**-0.9113*** **	-0.0025	-0.0706	**0.1159*** **	**18.2149*** **	0.4261	**6.1255*** **
		(1.9641)	(-2.9793)	(-0.1716)	(-0.6784)	(3.5681)	(3.1841)		
	Credit Card	0.4113	**-0.7194*** **	-0.0022	**-2.7177***	**0.5673***	**12.7884*** **	0.4112	**5.7614*** **
		(1.1247)	(-2.8313)	(-0.1484)	(-1.9478)	(1.7492)	(3.6191)		
	Debit Card	0.0928	**-0.7041*** **	-0.0025	**-0.4624*** **	**0.1379***	**14.1665*** **	0.4071	**5.6665*** **
		(1.0671)	(-2.7616)	(-0.1680)	(-3.2863)	(1.7764)	(3.0477)		
	Charge Card	0.1853	**-0.6523*** **	-0.0020	**-1.1284*** **	**0.6637*** **	**13.0476*** **	0.4072	**5.6677*** **
		(0.9913)	(-2.6937)	(-0.1362)	(-3.6386)	(2.8038)	(3.0459)		
	e-Money	0.0912	**-0.6424** **	-0.0024	**-0.7904*** **	**0.5170*** **	**13.1143*** **	0.4070	**5.6622*** **
		(0.8175)	(-2.6199)	(-0.1579)	(-5.1176)	(3.1483)	(2.9048)		
Second Wave (2010-2014)[2]	ATM	**0.1586*** **	**-0.2508** **	-0.0025	0.3148	-0.0325	**5.0759** **	0.4005	**5.5122*** **
		(3.0538)	(-1.7988)	(-0.1645)	(0.3033)	(-0.1151)	(2.0644)		
	Internet Banking	**0.3177*** **	**-0.7868*** **	-0.0013	0.1286	0.0059	**13.2836*** **	0.4157	**5.8704*** **
		(3.5464)	(-3.0124)	(-0.0869)	(0.1403)	(0.0504)	(3.1207)		
	Mobile Banking	**0.1172*** **	**-0.8487*** **	-0.0006	**0.2725*** **	-0.0365	**16.7859*** **	0.4238	**6.0681*** **
		(3.7623)	(-3.2280)	(-0.0378)	(4.5677)	(-1.3348)	(3.4115)		
	Credit Card	**1.0420*** **	**-0.8335*** **	-0.0013	-1.2577	0.3216	**11.9105*** **	0.4322	**6.2795 *** **
		(3.9634)	(-3.3667)	(-0.0901)	(-0.5717)	(0.6629)	(3.3661)		
	Debit Card	**0.2457*** **	**-0.7950*** **	-0.0016	0.0961	0.0542	**15.3724*** **	0.4271	**6.1499*** **
		(3.8317)	(-3.2342)	(-0.1099)	(0.3890)	(0.4780)	(3.4182)		
	Charge Card	**0.5237*** **	**-0.6557*** **	-0.0007	0.3251	-0.0574	**12.3036*** **	0.4059	**5.6361*** **
		(3.2565)	(-2.6753)	(-0.0433)	(0.8101)	(-0.2655)	(2.8405)		
	e-Money	**0.4153*** **	**-0.6424** **	0.0007	**0.4490** **	-0.0927	**12.4038*** **	0.4049	**5.6140*** **
		(3.2162)	(-2.6280)	(0.0445)	(2.1864)	(-0.5757)	(2.8070)		

[1] $ROA_{it} = \alpha + CP_{it} + Xs_{it} + \varepsilon_{it}$

[2] $ROA_{it} = \alpha + CP_{it} + Xs_{it} + ProgDev_{it} + (CP_{it}{*}ProgDev_{it}) + \varepsilon_{it}$

Third Wave (2015-2018)[2]	ATM	**0.1798*** **	-0.1063	-0.0056	0.2112	-0.0944	2.4035	0.3618	**4.6774*** **
		(3.4637)	(-0.6719)	(-0.3500)	(0.0887)	(3.6488)	(0.85516)		
	Internet Banking	**0.4357*** **	**-0.8610*** **	-0.0034	**1.6769***	**-0.2238** **	**13.9206*** **	0.4295	**6.2099*** **
		(4.2141)	(-2.923)	(-0.2094)	(1.7696)	(-0.1659)	(2.9433)		
	Mobile Banking	**0.1325*** **	**-0.6929** **	-0.0072	-0.0176	-0.0772	**14.0031*** **	0.3860	**5.1874*** **
		(4.0489)	(-2.5804)	(-0.4596)	(-0.0483)	(-0.8116)	(2.7882)		
	Credit Card	**1.2659*** **	**-0.7569*** **	-0.0042	3.3238	-0.7462	**9.6155*** **	0.4234	**6.0570*** **
		(4.8849)	(-3.1558)	(-0.2807)	(0.9216)	(-0.9942)	(2.7809)		
	Debit Card	**0.3032*** **	**-0.7200*** **	-0.0048	0.2987	-0.1742	**14.0036*** **	0.4141	**5.8299*** **
		(4.6811)	(-2.9787)	(-0.3170)	(0.4818)	(-0.9276)	(3.1690)		
	Charge Card	**0.8027*** **	**-0.7456*** **	-0.0054	0.9289	-0.5373	**13.6648*** **	0.4116	**5.7720*** **
		(4.6277)	(-2.9913)	(-0.3545)	(0.9762)	(-1.3165)	(3.1081)		
	e-Money	**0.6521*** **	**-0.5624*** **	-0.0101	0.6545	**-0.5597** **	**10.8296** **	0.3708	**4.8629*** **
		(3.6876)	(-2.1722)	(-0.6426)	(1.2004)	(-2.0324)	(2.3244)		

Notes: Asterisk (*), (**) and (***) indicate significant that the observed mean is significantly different from zero at 10%, 5% and 1% level, respectively. The figure in parentheses is t-statistic.

This study shows that cashless payments in Malaysia significantly and positively influence banks' ROA, except e-money, for the examined period. The electronic banking decreases the operational cost and increases revenue (Aduda & Kangoo, 2012). This enhances banks' profitability (DeYoung et al., 2007; Itah & Emmanuel, 2014; Kamboh & Leghari, 2016; Yang et al., 2018).

To further investigate the transition effects of cashless payments on ROA, the coefficient of the interaction term (*CP*ProgDev*) is used. The empirical results show that only the first wave of progressive development is statistically significant and positively moderates the impact of most of the cashless payments on ROA. Interestingly, the second and third waves of progressive development do not statistically significantly moderate the relationship between cashless payments and ROA, except for internet banking and e-money in the third wave.

This may be possible due to the high competition and changes in government policies during the examined period. The flourish of fintech companies in the financial services ecosystem has threatened banks' profitability. Fintech companies emerged after the 2007-2008 financial crisis. They use digital platforms to offer financial products. The non-bank e-money providers offer incentives such as cash back and rebates to attract more consumers. This has driven banks to lower payment charges to mitigate the threat which in turn has decreased the profit of banks. Additionally, in line with BNM's policy for moving toward a cashless society, banks removed service charges for instant interbank fund transfers. Meanwhile, internet banking is vulnerable to frauds such as identity theft, account takeover, cyber-attack and scams. This reduces banks' income in the second and third waves of cashless payment.

The insignificant impact in the second and third waves could imply that cashless payments do not enhance banks' profitability in the long run. Hence, this study rejects Hypothesis 4, as there is no progressive impact found. The statistically significant positive impact is only found in the first wave. This could be due to the active role of BNM in promoting cashless payments and low competition in the early progressive development.

Furthermore, the results show a statistically significant and negative relationship between banks' profitability and bank size for the examined period. This suggests that small banks showed greater

performance in comparison to larger banks. Small banks can achieve economies of scale when increasing their asset size (Aladwan, 2015).

However, this study finds no significant relationship for banks' profitability and credit risk for the examined period, although the coefficient sign is negative. An increase in credit risk increases the cost of funds and leads to lower profit (Felix & Claudine, 2008). The credit risk is statistically insignificant, which could mean that it does not affect the profitability of bank directly. However, this is not within the scope of this study.

4.4. Impacts of Cashless Payment on ROE

Table 5 shows the results for the impacts of cashless payments on banks' ROE for local commercial banks in Malaysia.

Table 5: The Impacts of Cashless Payments on Bank's ROE

ROE		CP	ProgDev	CP* ProgDev	Intercept	R-square	F-stat
2005 – 2018[3]	ATM	**2.3186*** ** (-3.4661)			**118.5554*** ** (3.7964)	0.5194	**10.9140*** **
	Internet Banking	**3.0682** ** (2.5731)			**167.5123** ** (2.9462)	0.4953	**9.9115*** **
	Mobile Banking	0.5186 (1.2107)			108.6750 (1.5831)	0.4699	**8.9523*** **
	Credit Card	**10.6722*** ** (3.0724)			**158.4880*** ** (3.4613)	0.5082	**10.4356*** **
	Debit Card	**2.3615*** ** (2.7319)			**183.9990*** ** (3.0875)	0.4992	**10.0681*** **
	Charge Card	2.9273 (1.2970)			**103.1221*** (1.7098)	0.4710	**8.9931*** **
	e-Money	-1.6930 (-1.0843)			-24.7895 (-0.4726)	0.4684	**8.8990*** **
First Wave (2005-2009)[4]	ATM	**-4.6445** ** (-2.0417)	**-25.0460*** ** (-3.4984)	**6.3672*** ** (3.0162)	**94.9787*** (2.0716)	0.5913	**11.9354*** **
	Internet Banking	-0.6307 (-0.4290)	**-50.3009*** ** (-4.5227)	**7.0687*** ** (4.2206)	**162.6940*** ** (3.1067)	0.5908	**11.9098*** **
	Mobile Banking	0.0104 (0.0263)	0.6590 (0.3589)	**2.0076*** ** (4.0782)	**180.2813*** ** (2.8567)	0.5864	**11.6956*** **
	Credit Card	-4.0415 (-0.8806)	**-69.4827*** ** (-3.9679)	**15.3940*** ** (3.7818)	**155.0682*** ** (3.4965)	0.5920	**11.9688*** **
	Debit Card	-1.0919 (-1.0011)	**-7.9112*** ** (-4.4857)	**3.7314*** ** (3.8351)	**132.2914** ** (2.2705)	0.5902	**11.8811*** **
	Charge Card	-2.9800 (-1.2575)	**-19.1249*** ** (-4.8656)	**11.8113*** ** (3.9365)	**114.2242** ** (2.1034)	0.5810	**11.4404*** **
	e-Money	-1.7247 (-1.2417)	**-10.7012*** ** (-5.5643)	**8.8871*** ** (4.3457)	**124.1358** ** (2.2081)	0.5954	**12.1424*** **

[3] $ROE_{it} = \alpha + CP_{it} + Xs_{it} + \varepsilon_{it}$

[4] $ROE_{it} = \alpha + CP_{it} + Xs_{it} + ProgDev_{it} + (CP_{it}*ProgDev_{it}) + \varepsilon_{it}$

Second Wave (2010-2014)[4]	ATM	**1.7937*** **	6.2718	**-0.8671***	**109.5161*** **	0.5967	**12.2039*** **
		(2.7932)	(0.4887)	(-0.2482)	(3.6017)		
	Internet Banking	1.7693	6.5279	-0.4292	**120.0872** **	0.5732	**11.0788*** **
		(1.5328)	(0.5527)	(-0.2859)	(2.1894)		
	Mobile Banking	**0.7640***	**3.8007*** **	-0.3022	**156.9043** **	0.5781	**11.3027*** **
		(1.9004)	(4.9379)	(-0.8576)	(2.4717)		
	Credit Card	**9.0744*** **	-4.6331	-4.6331	**153.2689*** **	0.5932	**12.0324*** **
		(2.7049)	(-0.1650)	(0.2797)	(3.3946)		
	Debit Card	**2.0683** **	3.2586	0.0268	**178.1102*** **	0.5902	**11.8829*** **
		(2.5296)	(1.0350)	(0.0186)	(3.1062)		
	Charge Card	2.3999	6.3672	-1.6035	**100.7618***	0.5699	**10.9315*** **
		(1.1634)	(1.2370)	(-0.5777)	(1.8135)		
	e-Money	2.4668	**5.9510** **	-1.5234	**119.3462** **	0.5741	**11.1225*** **
		(1.4978)	(2.2722)	(-0.7421)	(2.1176)		
Third Wave (2015-2018)[4]	ATM	**2.0817*** **	14.6883	-4.4471	50.5406	0.5836	**11.5621*** **
		(3.2937)	(0.5064)	(-0.6419)	(1.4766)		
	Internet Banking	**3.9229*** **	27.2881	-3.6899	**135.1384** **	0.5891	**11.8300*** **
		(3.5311)	(-1.0692)	(-1.0692)	(2.5478)		
	Mobile Banking	**1.1205*** **	-0.4917	-1.2125	**125.5155***	0.5695	**10.9123*** **
		(2.7121)	(-0.1069)	(-1.0099)	(1.9796)		
	Credit Card	**13.4615*** **	55.2427	-12.4889	**120.2115*** **	0.6066	**12.7223*** **
		(4.1717)	(1.2301)	(-1.3363)	(2.7920)		
	Debit Card	**3.1728*** **	4.6922	-2.9617	**163.6560*** **	0.5997	**12.3616*** **
		(3.9312)	(0.6074)	(-1.2462)	(2.9722)		
	Charge Card	**6.6829*** **	10.9516	-6.9089	**120.1925** **	0.5763	**11.2197*** **
		(3.0113)	(0.8995)	(-1.3232)	(2.1367)		
	e-Money	**5.9561*** **	6.8159	**-6.6116***	**109.3654***	0.5696	**10.9183*** **
		(2.7011)	(1.0026)	(-1.9253)	(1.8825)		

Notes: Asterisk (*), (**) and (***) indicate significant that the observed mean is significantly different from zero at 10%, 5% and 1% level, respectively. The figure in parentheses is t-statistic. The signs and significance of the control variables are consistent with Table 4, hence it is not reported due to limited length.

The empirical results in Table 5 show that the majority of the cashless payments are statistically significant and positively related to ROE over the examined period, except for mobile banking and e-money. Although mobile banking is statistically insignificant, it shows a positive coefficient. These results are similar for ROA. Studies such as DeYoung et al. (2007), Itah and Emmanuel (2014), Kamboh and Leghari (2016), Gündoğdu and Taşkın (2017) and Akara and Asekome (2018) also found consistent findings.

The coefficient of the interaction term (*CP*ProgDev*) on ROE also shows that only the first wave of progressive development is positively and significantly moderates the impacts of cashless payments on ROE.

4.5. Impacts of Cashless Payment on Cost-to-Income Ratio

Table 6 shows the results of the impacts of cashless payments on banks' cost-to-income ratio for local commercial banks in Malaysia.

Table 6: The Impacts of Cashless Payments on Bank's CI Ratio

Cost-to-income		CP	ProgDev	CP* ProgDev	Intercept	R-square	F-stat
2005 - 2018[5]	ATM	4.5875			295.4412	0.2144	**2.7566*** **
		(0.8718)			(1.2026)		
	Internet Banking	**-19.6113****			**-770.9278***	0.1878	**2.3353****
		(-2.1844)			(-1.8008)		
	Mobile Banking	**-5.9958***			-809.0909	0.1893	**2.3580****
		(-1.8945)			(-1.5952)		
	Credit Card	-40.3778			-374.2966	0.1819	**2.2458****
		(-1.5059)			(-1.0589)		
	Debit Card	-10.1583			-551.3764	0.1825	**2.2552****
		(-1.5368)			(-1.2100)		
	Charge Card	**-41.8634****			**-949.2070****	0.1978	**2.4898****
		(-2.5420)			(-2.1569)		
	e-Money	-11.5330			-245.9605	0.1863	**2.3119****
		(-0.9886)			(-0.6275)		
First Wave (2005-2009)[6]	ATM	0.9276	3.5772	-0.6302	-158.0712	0.2232	**2.3700*** **
		(1.2815)	(1.5956)	(-0.8030)	(-0.4107)		
	Internet Banking	-17.9247	28.7491	-4.1689	**-772.2246***	0.1906	**1.9423****
		(-1.4586)	(0.3093)	(-0.2978)	(-1.7643)		
	Mobile Banking	-5.0055	6.9708	-2.0552	**-962.1738****	0.1900	**1.9358****
		(-1.5260)	(0.4573)	(-0.5024)	(-1.8363)		
	Credit Card	-42.7943	-67.8130	18.4343	-500.1258	0.1899	**1.9338****
		(-1.1067)	(-0.4596)	(0.5375)	(-1.3385)		
	Debit Card	-10.5011	7.0806	3.9776	-695.9801	0.1898	**1.9321****
		(-1.1459)	(0.4779)	(0.4866)	(-1.4217)		
	Charge Card	**-33.7159****	32.5264	-23.0452	**-961.4877****	0.1991	**2.0510****
		(-1.7443)	(1.0145)	(-0.9416)	(-2.1711)		
	e-Money	-13.1954	20.5081	-4.5890	-674.4054	0.1898	**1.9324****
		(-1.1234)	(1.2610)	(-0.2654)	(-1.4186)		
Second Wave (2010-2014)[6]	ATM	5.9063	-49.8546	12.0955	339.7086	0.2160	**2.2726****
		(1.0764)	(-0.4546)	(0.4052)	(1.3075)		
	Internet Banking	**-19.1851****	1.7933	-0.3748	**-757.3701***	0.1908	**1.9447****
		(-2.0303)	(0.0186)	(-0.0305)	(-1.6867)		
	Mobile Banking	**-6.8935****	-7.0228	2.1883	-940.0861	0.1907	**1.9438****
		(-2.0849)	(-1.1093)	(0.7550)	(-1.8006)		
	Credit Card	-40.1149	45.2780	-10.7145	-392.4537	0.1832	**1.8502***
		(-1.4111)	(0.1903)	(-0.2043)	(-1.0258)		
	Debit Card	-10.1107	0.6047	-2.0149	-569.4826	0.1838	**1.8575****
		(-1.4659)	(0.0228)	(-0.1653)	(-1.1773)		
	Charge Card	**-45.0648****	-6.2064	-6.2371	**-939.7352****	0.1991	**2.0511****
		(-2.5010)	(-0.8252)	(-0.5245)	(-2.1184)		
	e-Money	-21.7306	-14.2341	3.4411	-599.9630	0.1863	**1.8887****
		(-1.5977)	(-0.6581)	(0.2030)	(-1.2890)		
	ATM	4.5906	-4.2382	1.0282	296.6034	0.2179	**2.2981****
		(0.8594)	(-0.0173)	(0.0176)	(1.0253)		

[5] $Cost\text{-}to\text{-}income_{it} = \alpha + CP_{it} + Xs_{it} + \varepsilon_{it}$

[6] $Cost\text{-}to\text{-}income_{it} = \alpha + CP_{it} + Xs_{it} + ProgDev_{it} + (CP_{it*}ProgDev_{it}) + \varepsilon_{it}$

Third Wave (2015-2018)[6]	Internet Banking	**-20.4192**** (-2.2044)	-91.2184 (-0.3655)	10.7214 (-0.3655)	**-778.8989*** (-1.7613)	0.1908	**1.9451****
	Mobile Banking	**-6.6692*** (-1.9727)	-10.5941 (-0.2816)	3.9180 (0.3988)	-848.7474 (-1.6358)	0.1911	**1.9497****
	Credit Card	-42.5262 (-1.5277)	-122.9070 (-0.3172)	25.7853 (0.3172)	-383.2945 (-1.0320)	0.1860	**1.8853****
	Debit Card	-10.7965 (-1.5651)	-20.2561 (-0.3068)	6.6276 (0.3313)	-568.9030 (-1.2088)	0.1863	**1.8892****
	Charge Card	**-49.1606**** (-2.4102)	-70.8343 (-0.7175)	33.0191 (0.7798)	**-1035.366**** (-2.2696)	0.1990	**2.0496****
	e-Money	-26.5894 (-1.4607)	-34.8031 (-0.6201)	22.2478 (0.7848)	-537.8822 (-1.1215)	0.1871	**1.8983****

Notes: Asterisk (*), (**) and (***) indicate significant that the observed mean is significantly different from zero at 10%, 5% and 1% level, respectively. The figure in parentheses is t-statistic. The signs and significance of the control variables are consistent with Table 4, hence it is not reported due to limited length.

As presented in Table 6, only internet banking and charge card are statistically significant and negatively related to the CI of bank over the examined period. Internet banking decreases the average operational costs on banks with more efficient and effective business processes (DeYoung et al., 2007). Furthermore, charge card is only offered to customers with good credit rating and the outstanding balance must be settled by the due date. This reduces credit risk and improves the operational efficiency of bank. Although mobile banking, credit card, debit card and e-money show statistically insignificant impact on CI, it should be noted that the coefficient is negative. The inverse relationship of CI and cashless payments shows that higher usage of cashless payment lowers the cost of operations for a bank. This suggests that the adoption of these financial innovations in cashless payment enhances the operational efficiency of bank. This is corroborated by Kurnia et al. (2010), Adewoye (2013), Dinh et al. (2015), and Ardizzi et al. (2019).

In contrast, only ATM is statistically insignificant and positively related to CI ratio of bank. ATM breakdowns, cash shortages, ATM fraud and theft increase operating costs, which ultimately decreases the profitability of banks (Itah & Emmanuel, 2014).

Meanwhile, the results show that none of the progressive development waves significantly moderates cashless payments on the CI of banks. This suggests that cashless payments have no progressive impact on banks' efficiency performance. In moving toward cashless banking, banks have made significant investment in information technology systems, research and innovation, new operating models and at the same time has exposed them to the risks associated with these changes. This is also found in the studies by Malhotra and Singh (2009), Khrawish and Al-Sa'di (2011) and Onay and Ozsoz (2013).

4.6. Robustness Analysis

Table 7 and Table 8 below show the robustness analysis for the impacts of cashless payments on banks' profitability and operational efficiency performance, using operating profit margin (OPM) and efficiency ratio, respectively.

Table 7: The Impacts of Cashless Payments on Bank's OPM

OPM		CP	ProgDev	CP* ProgDev	Intercept	R-square	F-stat
2005 - 2018[7]	ATM	**0.2090***** (3.7225)			**4.7928***** (4.1715)	0.1167	**4.7551*****
	Internet Banking	**0.2046***** (3.9856)			**4.3291***** (3.8734)	0.1311	**5.4335*****
	Mobile Banking	**0.0644***** (3.6256)			**5.6950***** (4.6138)	0.1115	**4.5171*****
	Credit Card	**0.6476***** (3.9991)			**2.9821***** (2.6367)	0.1319	**5.4694*****
	Debit Card	**0.1573***** (3.9415)			**5.5535***** (4.6499)	0.1287	**5.3166*****
	Charge Card	**0.3937***** (3.9629)			**5.1734***** (4.4542)	0.0836	**3.2836****
	e-Money	**0.2550***** (3.0752)			**5.0910***** (4.2034)	0.1685	**4.2967*****
First Wave (2005-2009)[8]	ATM	**-0.6425**** (-1.8919)	**-2.5980**** (-2.4309)	**0.6771**** (2.1487)	-4.8029 (-0.7018)	0.1955	**5.1518*****
	Internet Banking	-0.0914 (-0.7344)	**-4.5560***** (-2.6595)	**0.6335**** (2.4538)	**6.7258***** (4.7315)	0.1952	**5.1409*****
	Mobile Banking	-0.0230 (-0.7053)	0.0382 (0.1364)	**0.1851**** (2.4620)	**6.0303***** (5.0630)	0.1842	**4.7853*****
	Credit Card	-0.3150 (-0.7817)	-5.4881 (-2.1557)	**1.1928**** (2.0216)	**7.3924***** (3.6393)	0.1837	**4.7715*****
	Debit Card	-0.0761 (-0.7952)	**-0.7125**** (-2.6229)	0.2871 (2.0238)	**6.1238***** (5.1512)	0.2190	**5.9462*****
	Charge Card	-0.1582 (-0.7627)	**-2.0355***** (-3.4508)	**1.3650***** (3.0313)	**6.3368***** (5.3744)	0.1853	**4.8226*****
	e-Money	-0.1030 (-0.8120)	**-0.9393***** (-3.5549)	**0.6915**** (2.1970)	**6.0902***** (5.1291)	0.1651	**4.1922*****
Second Wave (2010-2014)[8]	ATM	**0.1783***** (3.1298)	1.3343 (0.6891)	-0.2900 (-0.5498)	**4.7070***** (4.1568)	0.1814	**4.6983*****
	Internet Banking	**0.1840***** (3.4847)	1.8436 (1.0451)	-0.2015 (-0.8964)	**4.2854***** (3.8954)	0.1844	**4.7929*****
	Mobile Banking	**0.0646***** (3.5471)	**0.3545***** (3.0676)	-0.0676 (-1.2791)	**5.6706***** (4.7484)	0.1852	**4.8193*****
	Credit Card	**0.5820***** (3.5619)	3.3315 (0.8129)	-0.6741 (-0.7454)	**3.0982***** (2.7626)	0.1851	**4.8140*****
	Debit Card	**0.1427***** (3.5576)	0.6395 (1.3766)	-0.1677 (-0.7878)	**5.4226***** (4.6427)	0.1851	**4.8140*****
	Charge Card	**0.3688***** (3.6726)	1.0591 (1.3792)	-0.4204 (-1.0156)	**5.0882***** (4.4942)	0.1908	**4.9974*****
	e-Money	**0.2817***** (3.4658)	**0.7702*** (1.9401)	-0.3307 (-1.0605)	**5.2515***** (4.5346)	0.1807	**4.6758*****
	ATM	**0.2475***** (3.8236)	-0.7597 (-0.1653)	0.1407 (0.1281)	**4.5327***** (3.8691)	0.1289	**3.1372****

[7] $OPM_{it} = \alpha + CP_{it} + Xs_{it} + \varepsilon_{it}$

[8] $OPM_{it} = \alpha + CP_{it} + Xs_{it} + ProgDev_{it} + (CP_{it} * ProgDev_{it}) + \varepsilon_{it}$

Third Wave (2015-2018)[8]	Internet Banking	**0.3085*** ** (4.6355)	0.1917 (0.0417)	-0.0655 (-0.1234)	**3.6128*** ** (3.1739)	0.1761	**4.5300*** **
	Mobile Banking	**0.1030*** ** (4.2925)	-0.2786 (-0.4000)	-0.0291 (-0.1603)	**5.8105*** ** (4.7787)	0.1557	**3.9085*** **
	Credit Card	**0.9739*** ** (4.6461)	1.1962 (0.1705)	-0.3268 (-0.2236)	1.589388 (1.2672)	0.1766	**4.5476*** **
	Debit Card	**0.2397*** ** (4.6032)	-0.1241 (-0.1038)	-0.0781 (-0.2150)	**5.4761*** ** (4.6625)	0.1741	**4.4689*** **
	Charge Card	**0.6473*** ** (4.8220)	0.2648 (0.1477)	-0.3032 (-0.3944)	**4.8900*** ** (4.2961)	0.1873	**4.8846*** **
	e-Money	**0.5657*** ** (4.1898)	0.2598 (0.2709)	-0.3949 (-0.8480)	**5.1464*** ** (4.3645)	0.1497	**3.7323*** **

Notes: Asterisk (*), (**) and (***) indicate significant that the observed mean is significantly different from zero at 10%, 5% and 1% level, respectively. The figure in parentheses is t-statistic. The signs and significance of the control variables are consistent with Table 4, hence it is not reported due to limited length.

Table 7 presents consistent results with the previous regression model in Table 4 and Table 5. All of the cashless payments are statistically significant and positively related to banks' OPM over the examined period. Besides that, the results also show that only the first wave of progressive development is statistically significant and positively moderates the impacts of most of the cashless payments on the profitability performance of banks.

Table 8: The Impacts of Cashless Payments on Bank's Efficiency Ratio

Efficiency Ratio		CP	ProgDev	CP* ProgDev	Intercept	R-square	F-stat
2005 - 2018[9]	ATM	**0.1349*** ** (3.1752)			**6.3518*** ** (7.3044)	0.2261	**10.5157*** **
	Internet Banking	**0.0988** ** (2.4799)			**5.9730*** ** (6.8855)	0.1994	**8.9666*** **
	Mobile Banking	**0.0305** ** (2.2226)			**6.6143*** ** (6.9446)	0.1908	**8.4901*** **
	Credit Card	**0.3362*** ** (2.6862)			**5.2914*** ** (6.0531)	0.2068	**9.3865*** **
	Debit Card	**0.0803** ** (2.6044)			**6.6119*** ** (7.1625)	0.2038	**9.2161*** **
	Charge Card	**0.1739** ** (2.2474)			**6.3261*** ** (6.9888)	0.1916	**8.5337*** **
	e-Money	**0.1151*** (1.8142)			**6.3017*** ** (6.7978)	0.1788	**7.8406*** **
First Wave (2005-2009)[10]	ATM	-0.2422 (-1.4245)	**-1.5508**** (-2.2857)	**0.4029**** (2.2158)	**7.6082*** ** (7.3505)	0.2625	**7.5471*** **
	Internet Banking	-0.1070 (-1.1086)	**-3.8024*** ** (-2.8619)	**0.5466*** ** (2.7296)	**7.6449*** ** (6.9342)	0.2598	**7.4408*** **
	Mobile Banking	-0.0261 (-1.0306)	0.1581 (0.7250)	**0.1524**** (2.6061)	**6.8248*** ** (7.3670)	0.2553	**7.2673*** **
	Credit Card	-0.3713 (-1.1968)	**-5.2871*** (-2.6970)	**1.1976*** ** (2.6358)	**8.4820*** ** (5.4226)	0.2600	**7.4503*** **

[9] $EfficiencyRatio_{it} = \alpha + CP_{it} + Xs_{it} + \varepsilon_{it}$

[10] $EfficiencyRatio_{it} = \alpha + CP_{it} + Xs_{it} + ProgDev_{it} + (CP_{it} * ProgDev_{it}) + \varepsilon_{it}$

	Debit Card	-0.0924 (-1.2525)	**-0.4979**** (-2.3785)	**0.2868*** (2.6238)	**6.9826***** (7.6218)	0.2585	**7.3917*****
	Charge Card	-0.1972 (-1.2010)	**-1.3377***** (-2.8641)	**0.8844**** (2.4803)	**7.1098***** (7.6155)	0.2511	**7.1079*****
	e-Money	-0.1259 (-1.2903)	**-0.7024***** (-3.4553)	**0.6777***** (2.7986)	**6.9448***** (7.6022)	0.2624	**7.5424*****
Second Wave (2010-2014)[10]	ATM	**0.1153*** (2.6611	1.2690 (0.8617)	-0.2968 (-0.7397)	**6.2741***** (7.2854)	0.2614	**7.5024*****
	Internet Banking	**0.0815*** (1.9776)	0.9852 (0.7161)	-0.1008 (-0.5749)	**5.9629***** (6.9501)	0.2385	**6.6392*****
	Mobile Banking	**0.0289**** (2.0331)	**0.2356**** (2.6119)	-0.0310 (-0.7509)	**6.5887***** (7.0680)	0.2399	**6.6908*****
	Credit Card	**0.2880**** (2.2680)	2.0894 (0.6560)	-0.4177 (-0.5943)	**5.3847***** (6.1777)	0.2472	**6.9609*****
	Debit Card	**0.0700**** (2.2458)	0.4525 (1.2532)	-0.1187 (-0.7172)	**6.5192***** (7.1814)	0.2470	**6.9536*****
	Charge Card	**0.1531*** (1.9430)	0.6592 (1.0943)	-0.2458 (-0.7570)	**6.2729***** (7.0624)	0.2382	**6.6290*****
	e-Money	**0.1326**** (2.0995)	0.5048 (1.6359)	-0.2163 (-0.8923)	**6.4073***** (7.1180)	0.2429	**6.8015*****
Third Wave (2015-2018)[10]	ATM	**0.1858***** (3.8502)	-1.2540 (-0.3659)	0.2455 (0.2999)	**6.0074***** (6.8769)	0.2592	**7.4170*****
	Internet Banking	**0.1821***** (3.5362)	-0.8282 (-0.2327)	0.0603 (0.1467)	**5.3929***** (6.1214)	0.2451	**6.8825*****
	Mobile Banking	**0.0614***** (3.3278)	-0.3904 (-0.7285)	0.0199 (0.1421)	**6.7006***** (7.1643)	0.2359	**6.54486*****
	Credit Card	**0.6138***** (3.8145)	-0.6605 (-0.1226)	0.0702 (0.0626)	**4.0988***** (4.2572)	0.2579	**7.3683*****
	Debit Card	**0.1495***** (3.7354)	-0.4054 (-0.4414)	0.0249 (0.0891)	**6.5390***** (7.2468)	0.2544	**7.2325*****
	Charge Card	**0.3550***** (3.3778)	-0.3087 (-0.2199)	-0.0061 (-0.0102)	**6.1132***** (6.8602)	0.2381	**6.6237*****
	e-Money	**0.3499***** (3.3861)	-0.0688 (-0.0937)	-0.1759 -0.4933	**6.3279***** (7.0113)	0.2381	**6.6241*****

Notes: Asterisk (*), (**) and (***) indicate significant that the observed mean is significantly different from zero at 10%, 5% and 1% level, respectively. The figure in parentheses is t-statistic. The signs and significance of the control variables are consistent with Table 4, hence it is not reported due to limited length.

The results in Table 8 are also found consistent with the regression model in Table 6. The results shows that all cashless payments are statistically significant and positively related to the efficiency ratio over the examined period. However, the results indicate that only the first wave of progressive development is statistically significant and positively moderates the relationship between cashless payments and the efficiency performance of banks.

5. CONCLUSION

In response to the Industrial Revolution 4.0, Malaysia is moving toward a cashless society. The banking system plays a facilitatory role in achieving this objective. This study examines the impacts of cashless payments (ATM, internet banking, mobile banking, credit card, debit card, charge card and e-money) on banking performance for eight local commercial banks in Malaysia

over the period of 2005 to 2018. Banking performance is measured by return on assets (ROA), return on equity (ROE) and cost-to-income ratio (CI).

The results of this study show that cashless payment has positively influenced banks' performance. The cashless payments are statistically significant and positively related to the banks' ROA and ROE, except e-money. A possible reason could be the fact that Malaysia has authorized non-bank provider to issue e-money. This exposes commercial banks to greater competition.

On the other hand, the study demonstrates a statistically significant and negative relationship between cashless payments and CI. Cashless payments have improved the operational efficiency of banks except for ATMs. This reflects cost optimisation by banks with applications of cashless payments, which in turn has strengthened banks' profits.

Moreover, this study highlights that the significant effects of cashless payments on ROA and ROE are mainly driven by the usage of cashless payments in the first wave (2005-2009) of the transition. A possible reason behind this could be the active role of BNM during the early progressive development of cashless payment. For example, the efforts to incorporate the bankcard as a payment option at the credit card terminals in 2003 to increase the usage of cashless, introduced online payment services for the public, and enhance public confidence in 2007 (BNM, 2007). Conversely, cashless payments do not show significant impacts on banks' profitability in the second wave (2010-2014) and third wave (2015-2018) of progressive development. This result could be explained by the fact that, in the growing and exponential growth of the cashless payment transition, the entry of fintech companies has caused fierce competition to the banks. This forced banks to lower payment services fees, which lowered their profits. In addition, the study also reveals that all three waves of progressive development do not significantly moderate the relationship between cashless payments and efficiency of banks. Banks need to develop a more competitive business strategy in this digital age.

In summary, BNM has successfully increased cashless payment transactions. However, the concern about banks' health and profitability might be neglected with the flourish of fintech companies in Malaysia. Due to the intensifying competition, the demarcation between the banking industry and fintech companies is becoming blurred. This could threaten banks' performance in the long run. Banks and fintech companies should complement each other to achieve competitive advantage by integrating their infrastructures. Traditional banks have the advantages of a larger client pool and the ability to set up virtual banks compared to fintech companies. Fintech companies offer more personalized customer experiences and convenient services. The collaboration of these two players in a cashless society could present a win-win situation.

This study suggests that future studies could investigate the impact of cashless payments on banks' performance in the long run. This can be measured by using Tobin's *q* model which examines the banks' market financial performance, to provide better insight into banks' long-term performance.

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