

DOES DIGITAL PAYMENTS MATTER IN MONETARY POLICY? EVIDENCE FROM MALAYSIA

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ABSTRACT

Over the past few decades, the global adoption of digital payment methods has increased substantially. While the impacts of digital payment on economic performance have been widely examined in the literature, their influence on the traditional money creation process has largely been ignored. This study argues that digital payment influences currency and excess reserve ratios, thereby affecting the money creation process. By employing the ARDL approach and monthly data spanning from 2019 to 2023, this research addresses this important issue in the Malaysian banking system. The findings reveal that digital payment significantly impacts the banks' lending capacity, however, this effect is observed exclusively among domestic banks, including both commercial and Islamic banks. This finding underscores the importance of integrating digital payment activities into the design of monetary policy to enhance its overall effectiveness. Furthermore, the study highlights the need to acknowledge the role of Islamic banks in the money creation process.

Keywords: digital payment, ARDL, bank lending, Islamic banking, monetary policy, money creation.

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1. INTRODUCTION

The Financial Technology (fintech) revolution and the Fourth Industrial Revolution (IR 4.0) are fundamentally altering societal behavior, particularly in the realm of promoting cashless transactions where the use of digital payments has witnessed a significant surge worldwide. Notably, the adult population engaged in digital payments has surged by 77% between 2014 and 2021 (World Bank, n.d.). This trend is further magnified by the growing exploration of central bank digital currencies (CBDCs), with twenty-four CBDCs anticipated to be in circulation by 2030 (Kosse and Mattei, 2023). The prevalence of this phenomenon is projected to be even higher in emerging Asia compared to the global average (Rahman et al., 2020).

Several driving factors contribute to this trend, encompassing technological advancements (Alkhowaiter, 2020; Petralia et al., 2019), evolving policies (Panetta et al., 2023), concerns stemming from the COVID-19 pandemic (Ardizzi et al., 2020), coupled with the widespread accessibility of smartphones and the escalating prevalence of e-commerce activities (Bank for International Settlements, 2021; Ojo et al., 2022).

Despite rapid growth, digital payment adoption continues to face important barriers. Fraud risks undermine user trust (Laxman et al., 2024), while limited financial literacy constrains adoption and effective usage (Sadok and Elouaourti, 2025). These frictions suggest that diffusion is neither automatic nor frictionless, underscoring the need to examine broader economic implications beyond individual adoption.

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The digital payments literature has documented effects on financial inclusion, supply chain efficiency, corruption reduction, and consumer value creation (Aurazo and Vega, 2021; Kilay et al., 2022; Setor et al., 2021; Dzandu et al., 2022). However, most studies rely on behavioral frameworks, such as the Theory of Planned Behavior and the Technology Acceptance Model, and focus on micro-level adoption determinants. Country-specific evidence from Malaysia, Indonesia, and Cambodia similarly highlights risk perception, financial literacy, subjective norms, and perceived ease of use (Balakrishnan and Shuib, 2021; Usman et al., 2025; Ly and Ly, 2024), offering limited insight into macroeconomic effects.

While CBDCs are often viewed as the next phase of monetary digitalization, empirical evidence on their monetary impact remains sparse and largely theoretical. Existing studies suggest that cash-like CBDCs primarily substitute for physical cash, whereas deposit-like designs may influence money demand and policy transmission more directly (Chen and Huang, 2025), without necessarily causing bank disintermediation (Alexandre et al., 2025). Given that most CBDCs remain in pilot stages, this study instead focuses on the realized expansion of existing digital payment systems with observable effects on bank lending and monetary dynamics.

Against this backdrop, the impact of digital payment adoption on the monetary system—particularly money creation—remains underexplored. Under the fractional reserve system, bank lending expands deposits and the money supply, with the money multiplier shaped by the currency–deposit ratio and reserve–deposit ratios (Xiong et al., 2017). As digital payments progressively substitute for physical cash, the currency–deposit ratio declines and the need for excess reserves is reduced, easing liquidity constraints and expanding banks’ lending capacity (Setor et al., 2021; Visconti-Caparrós & Campos-Blázquez, 2022). This process amplifies money creation via an enhanced money multiplier and, if unaccounted for, may weaken the effectiveness of monetary policy—particularly amid the recent shift from accommodative policies in 2020 to global monetary tightening driven by inflationary pressures (International Monetary Fund, 2020, 2023).

With the emergence of this interconnection, policymakers and central banks face the imperative of incorporating the influence of digital payment mechanisms into the design of effective monetary policies. This entails recognizing that expansionary monetary policies could potentially drive the money supply beyond targeted levels due to the catalytic effect of digital payments on lending activities. Conversely, the efficacy of contractionary monetary policies in curbing the money supply might be attenuated for similar reasons. Omitting the consideration of digital payment dynamics in monetary policy formulation consequently curtails the effectiveness of such policies in shaping economic performance.

Malaysia offers an appropriate case for examining the interaction between digital payments and monetary policy. Although Islamic finance accounts for a modest share of global finance, its importance has grown rapidly (International Monetary Fund, 2017; Mensi et al., 2020). In Malaysia, monetary policy applies uniformly to conventional and Islamic banks, yet differences in operational structures—such as profit-sharing contracts—may generate heterogeneity in money creation and lending behavior that is not fully captured by traditional money creation theories focused on conventional banks. Interest in Islamic finance and Islamic fintech has further intensified following the COVID-19 pandemic (Karim et al., 2022). As a global hub for Islamic finance (International Monetary Fund, 2022) and a top-ranked country in the Islamic Finance Development Index (Refinitiv, 2022), Malaysia provides a natural setting to study these dynamics.

Malaysia has also actively promoted digital payments as part of its transition toward a cashless economy (Rahman et al., 2020). Digital payment usage among adults increased by 63% between 2014 and 2021 (World Bank, n.d.), supported by initiatives such as the MYR100 e-cash transfer in 2023 (Prime Minister’s Office, 2023). These efforts are reinforced by fintech-friendly regulation, declining reliance on physical banking infrastructure—Malaysia is the only ASEAN-5 country with fewer ATMs (International Monetary Fund, 2022)—and investments in digital infrastructure, including 5G rollout (Digital Nasional Berhad, n.d.) and cross-border QR payments (Bank Negara Malaysia, 2023).

Policy-led adoption has been complemented by strong consumer demand. Government agencies recorded about 138 million cashless transactions between December 2023 and November 2024 (Ministry of Finance, 2025), while survey evidence shows that nearly two-thirds of Malaysian consumers prefer digital payment methods (Mastercard, 2025). Transaction data further reveal substantial growth in e-money, internet banking, and mobile banking usage between 2019 and 2024, alongside a sharp decline in cheque usage, indicating a sustained shift toward a digitalized payment ecosystem.

Given the limited empirical evidence on the interaction between digital payments and monetary policy, this study contributes new evidence from a dual-banking system by empirically examining how digital payment adoption—through e-money, internet banking, and mobile banking—affects bank lending and, by extension, the money creation process. To capture institutional heterogeneity, the analysis distinguishes between commercial and Islamic banks, as well as between domestic and foreign institutions. The central hypothesis is that greater digital payment usage enhances banks' lending capacity by lowering the currency–deposit ratio and easing liquidity constraints, thereby strengthening the money multiplier.

While Malaysia is the focus of the analysis, the findings are relevant for other emerging economies with comparable financial structures, rising fintech adoption, and active monetary policy interventions. As digital payments reduce reliance on cash and expand banks' lending capacity, failing to account for these dynamics may weaken monetary policy effectiveness and increase the risk of excessive credit expansion. Incorporating digital payment considerations is therefore essential for designing more accurate and effective monetary policies in an increasingly cashless economy.

2. LITERATURE REVIEW

Monetary policy stands as a vital tool within the arsenal of central banks, with its transmission mechanisms broadly divided into the "money channel" and the "credit channel," as extensively discussed in existing literature (Carpenter and Demiralp, 2012).

Within the latter, a narrower "bank lending channel" assumes prominence, underscoring the pivotal role of the money multiplier and lending in the propagation of monetary policy. This significance arises from the fact that in modern economies, the creation of a significant portion of circulating money primarily stems from commercial bank lending, rather than central bank printing (Bank of England, 2014).

The process of money creation through lending by commercial banks is characterized by the issuance of deposits. In essence, when banks extend loans, they do not provide borrowers with physical cash. Instead, they credit the borrower's bank account with a deposit equivalent to the loan amount. This borrowing and lending activity is at the core of the money creation process (Xiong et al., 2017).

The foundational money creation model, introduced by Brunner (1961) and further elaborated upon by Brunner and Meltzer (1964), continues to prevail in economics textbooks to this day. This model posits that the aggregate money supply, denoted as M , stems from the monetary base, represented by M_0 , through the money multiplier, symbolized as m , as expressed below:

$$M = M_0 * m \tag{1}$$

The aggregate money supply encompasses both currencies, denoted as C , and bank deposits, represented by D , as shown:

$$M = C + D \tag{2}$$

Post savings and lending activities, the monetary base, M_0 , exists in the form of currency and reserves, encompassing both central bank-mandated required reserves and excess reserves, voluntarily held by commercial banks. This is elaborated as follows:

$$M_0 = C + R \tag{3}$$

Upon converting the components in the aforementioned equations into ratios relative to deposits – that is, the currency-deposit ratio, c , and the reserve-deposit ratio, r – equations (2) and (3) can be restated as follows:

$$M = (c + 1) * D \tag{4}$$

$$M0 = (c + r) * D \tag{5}$$

By combining equations (4) and (5) and inserting the result into equation (1), the money multiplier can be simplified as follows:

$$m = \frac{c+1}{c+r} \tag{6}$$

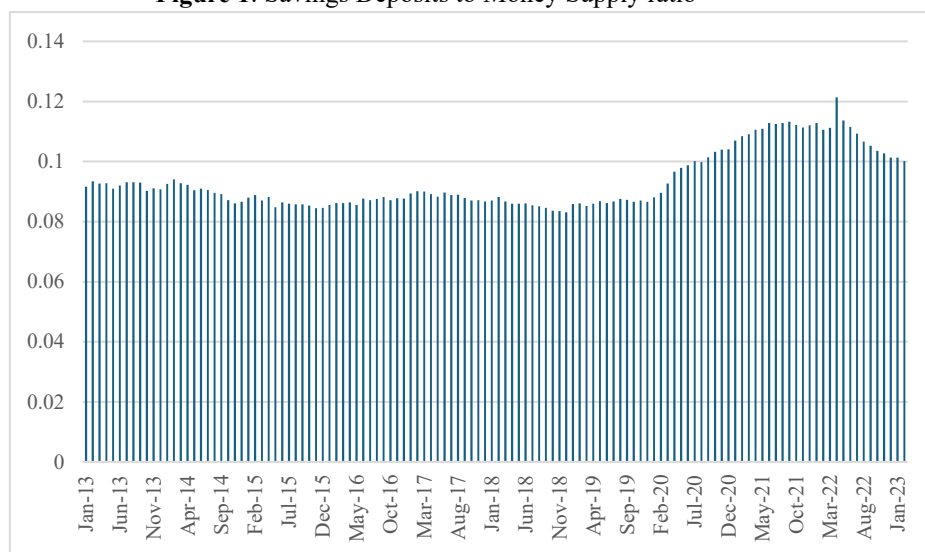
The money multiplier, a key determinant of money creation, is influenced by the currency–deposit and reserve–deposit ratios. While money creation is a long-established concept, its interpretation has evolved: Bhatti and Al-Nassar (2023) support the traditional framework, whereas Carpenter and Demiralp (2012) argue that modern non-traditional monetary tools require an expanded view. Research by the Bank of England (2014) and Xiong et al. (2017) highlights the role of loan repayment in reducing created money.

Since the 1980s, the link between the money multiplier and money supply has weakened due to monetary innovations (Seghezza and Morelli, 2020), suggesting the need to incorporate emerging factors such as digital payment adoption. Digital payments, including mobile wallets, online banking, and cryptocurrencies, have grown rapidly, driven by global internet/mobile penetration, rising online retail sales, smartphone affordability, and the COVID-19 pandemic, which accelerated contactless transactions (Alkhowaiter, 2020; Ardizzi et al., 2020; de Blanes Sebastián et al., 2023; Maurer, 2012).

Digital payments are transforming firm and consumer behavior, gradually replacing cash (Alkhowaiter, 2020; Ardizzi et al., 2020), and have demonstrated positive effects on financial inclusion, customer value, banking stability, profitability, supply chains, tourism revenues, and corruption reduction (Aurazo and Vega, 2021; Dzandu et al., 2022; Kasri et al., 2022; Ramlall, 2023; Kilay et al., 2022; Luan et al., 2023; Setor et al., 2021). As cash usage declines, the currency–deposit and reserve–deposit ratios fall, boosting the money multiplier and facilitating money creation.

Malaysia’s data reveal a clear shift in deposit composition, as shown in Figure 1, with the share of savings deposits rising over the past decade, especially since 2020. This coincides with increased use of deposit-based instruments in a digitalized payment environment, reflecting the global expansion of digital payments—mobile money users worldwide grew from about 121 million in 2011 to 4 billion in 2021 (GSMA, 2017).

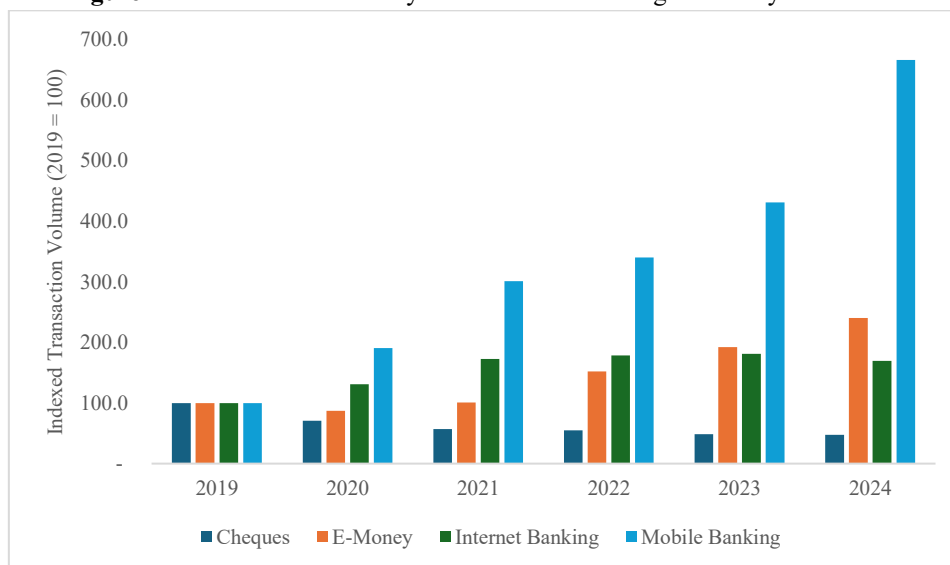
Figure 1: Savings Deposits to Money Supply ratio



Source: Bank Negara Malaysia

Figure 2 highlights trends in selected payment instruments in Malaysia. Cheque usage, linked to traditional demand-deposit transactions, has steadily declined, whereas e-money, internet banking, and mobile banking transactions have expanded rapidly. These patterns indicate a pronounced shift from paper-based to digital payment channels. Although aggregate monetary data do not separate digital payment balances between demand and savings deposits, the rise in savings deposits likely reflects a compositional adjustment accompanying broader digital payment adoption.

Figure 2: Trends in Selected Payment Instruments Usage in Malaysia



Source: Bank Negara Malaysia

The spread of digital payments, initially led by China, has now reached many countries. In Southeast Asia, Malaysia has the highest mobile and internet penetration (Balakrishnan and Shuib, 2021) and the second-highest share of digital payment users, just behind Singapore (VISA, 2022), with minimal urban-rural disparity (World Bank, 2022a). Smartphone prevalence and a growing e-commerce sector further encourage digital payment adoption (Ojo et al., 2022).

While Malaysia's Financial Sector Blueprint (2011–2020) and long-term national plans aimed to promote e-payments (Bank Negara Malaysia, 2011; Public Service Department, 2017; Ministry of Youth and Sport, 2017), progress was slow (Mohd Amin et al., 2022). The COVID-19 pandemic accelerated adoption, as contactless payments were encouraged by the WHO (Daragmeh et al., 2021) and adopted during Malaysia's lockdowns (Aji et al., 2020; Ming and Jais, 2022).

Government initiatives, including e-Tunai (2020), e-Penjaja (2021), eStart (2022), eBelia (2023), and the July 2023 e-cash credit distribution to over 10 million citizens (~30% of the population), further reinforced the shift toward digital payments (Ministry of Finance, 2021, 2022; Prime Minister's Office, 2023).

The standard money multiplier model focuses mainly on commercial banks' lending and borrowing (Carpenter and Demiralp, 2012; Bank of England, 2014; Seghezza and Morelli, 2020; Xiong et al., 2017). The growth of Islamic banking adds complexity to monetary policy design (El Hamiani Khatat, 2016), as profit-and-loss sharing mechanisms differ from conventional banking, though non-profit/loss-sharing transactions are similar (Adalessossi, 2023). Malaysia, a global Islamic finance leader (Refinitiv, 2022; World Bank, 2022b), provides an insightful case study.

Understanding money creation requires incorporating digital payment's influence on lending, yet this factor is often missing in the literature (Birhanu et al., 2021). Accurate assessment of monetary policy is critical, as expansionary measures raise domestic income (Evgenidis and Malliaris, 2023) and contractionary measures curb

inflation (Bergholt et al., 2023). Ignoring such factors may lead to over- or under-adjustments in money supply. This study aims to address this gap to enhance monetary policy design.

3. DATA AND METHODOLOGY

This study employs a dataset comprising monthly time series data spanning from January 2019 to April 2023. The data for dependent and monetary variables, specifically lending rate, deposit size and statutory deposit to asset ratio, are sourced from the Bank Negara Malaysia's Monthly Highlights and Statistics. The macroeconomic indicators, namely inflation rate, unemployment rate, and exchange rate are gathered from Department of Statistics Malaysia. The data pertaining to digital payments are derived from Malaysia's Payment Statistics, a publication issued by the Bank Negara Malaysia.

In an effort to dissect the role of digital payment within the framework of monetary policy, this research zeroes in on its effects on banking loans and advances. This focus is particularly salient due to its integral role in the fundamental process of money creation, as expounded by Xiong et al. (2017). The foundational model utilized in this study is adapted and refined from the work of Birhanu et al. (2021), as presented below:

$$LOAN_t = f(DP_t, LR_t, DS_t, SRR_t, INF_t, UNEM_t, EXR_t) \quad (7)$$

The variable notations utilized in this study are as follows: *LOAN* signifies loan and advance payments for banks, *LR* represents lending rate, *DS* stands for deposit size, *SRR* indicates statutory deposit to asset ratio, *INF* denotes inflation rate, *UNEM* is the unemployment rate, *EXR* refers to exchange rate, and *DP* encompasses the digital payment channels. Specifically, the digital payment channels considered are the transaction value of e-money, internet banking, and mobile banking, each analyzed separately. All variables are transformed into natural logarithm form, except for *LR*, *SRR*, *INF*, and *UNEM*, which are expressed as ratios.

To assess the above model, the study employs the ARDL model proposed by Pesaran and Shin (1999) and Pesaran et al. (2001). This model offers the advantage of simultaneously evaluating the short-term and long-term effects of independent variables on the dependent variable. Moreover, it provides enhanced flexibility when dealing with variables integrated at order zero or one, and mitigates concerns of endogeneity, while being conducive to small sample sizes (Peng et al., 2022; Tee et al., 2021).

With respect to the variables integrated into the model, the standard formulation depicted in equation (7) is presented in ARDL format as follows:

$$LOAN_t = \delta_0 + \sum_{i=1}^p \delta_1 LOAN_{t-i} + \sum_{i=0}^p \delta_2 DP_{t-i} + \sum_{i=0}^p \delta_3 LR_{t-i} + \sum_{i=0}^p \delta_4 DS_{t-i} + \sum_{i=0}^p \delta_5 SRR_{t-i} + \sum_{i=0}^p \delta_6 INF_{t-i} + \sum_{i=0}^p \delta_7 UNEM_{t-i} + \sum_{i=0}^p \delta_8 EXR_{t-i} + \varepsilon_t \quad (8)$$

The cointegration relationship can be confirmed using the bound test based on the unrestricted error-correction model (ECM) below.

$$\Delta LOAN_t = \gamma_0 + \gamma_1 LOAN_{t-1} + \gamma_2 DP_{t-1} + \gamma_3 LR_{t-1} + \gamma_4 DS_{t-1} + \gamma_5 SRR_{t-1} + \gamma_6 INF_{t-1} + \gamma_7 UNEM_{t-1} + \gamma_8 EXR_{t-1} + \sum_{i=1}^p \theta_1 \Delta LOAN_{t-i} + \sum_{i=0}^p \theta_2 \Delta DP_{t-i} + \sum_{i=0}^p \theta_3 \Delta LR_{t-i} + \sum_{i=0}^p \theta_4 \Delta DS_{t-i} + \sum_{i=0}^p \theta_5 \Delta SRR_{t-i} + \sum_{i=0}^p \theta_6 \Delta INF_{t-i} + \sum_{i=0}^p \theta_7 \Delta UNEM_{t-i} + \sum_{i=0}^p \theta_8 \Delta EXR_{t-i} + \varepsilon_t \quad (9)$$

Specifically, the bound test is conducted by testing the F-statistic on the null hypothesis of $\gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = \gamma_6 = \gamma_7 = \gamma_8 = 0$. Rejecting the null hypothesis indicates the existence of a cointegrating relationship in the loan equation.

Subsequently, a long-run equation and a short-run ECM model can be derived, as shown in equations (10) and (11) below, respectively.

$$LOAN_t = \beta_0 + \beta_1 DP_t + \beta_2 LR_t + \beta_3 DS_t + \beta_4 SRR_t + \beta_5 INF_t + \beta_6 UNEM_t + \beta_7 EXR_t + \varepsilon_t \quad (10)$$

where $\beta_0 = \frac{\delta_0}{1-\sum \delta_1}$, $\beta_1 = \frac{\delta_2}{1-\sum \delta_1}$, $\beta_2 = \frac{\delta_3}{1-\sum \delta_1}$, $\beta_3 = \frac{\delta_4}{1-\sum \delta_1}$, $\beta_4 = \frac{\delta_5}{1-\sum \delta_1}$, $\beta_5 = \frac{\delta_6}{1-\sum \delta_1}$, $\beta_6 = \frac{\delta_7}{1-\sum \delta_1}$, $\beta_7 = \frac{\delta_8}{1-\sum \delta_1}$. The parameter used to compute the long-run coefficient is obtained from equation (8).

$$\Delta LOAN_t = \varphi_0 + \lambda ECT_{t-1} + \sum_{i=1}^p \varphi_1 \Delta LOAN_{t-i} + \sum_{i=0}^p \varphi_2 \Delta LR_{t-i} + \sum_{i=0}^p \varphi_3 \Delta INF_{t-i} + \sum_{i=0}^p \varphi_4 \Delta DS_{t-i} + \sum_{i=0}^p \varphi_5 \Delta SRR_{t-i} + \sum_{i=0}^p \varphi_6 \Delta DP_{t-i} + \sum_{i=0}^p \varphi_7 \Delta UNEM_{t-i} + \sum_{i=0}^p \varphi_8 \Delta EXR_{t-i} + \varepsilon_t \quad (11)$$

where ECT_{t-1} represents the lagged residual from the long-run model. λ is the error-correction coefficient, measuring the speed at which deviations from the long-run equilibrium are corrected. A statistically significant negative λ indicates the presence of cointegration (Safuan et al., 2022).

The analysis examines the impact of digital payment on lending through several steps. First, an aggregate model uses system-wide banking data. Next, separate models are estimated for commercial and Islamic banks, which are further disaggregated into domestic and foreign banks for each type. This study acknowledges that Islamic banks operate under profit-and-loss sharing but are affected by the same factors, such as digital payment adoption, which can enhance financing capacity. Modeling them alongside conventional banks captures system-wide effects, while disaggregation identifies differential responses. Due to differences in lending rates (LR), the average lending rate is used for commercial banks, the Islamic financing rate for Islamic banks, and the average of both for the aggregate model.

4. RESULTS AND DISCUSSION

Table 1 reports the descriptive statistics for all variables. The dependent variable is loans and advances ($LOAN$), while the independent variables include lending rates (LR)—the average lending rate (ALR) for commercial banks and the Islamic financing rate (IFR) for Islamic banks—deposit size (DS), the statutory deposit-to-asset ratio (SRR), inflation (INF), unemployment ($UNEM$), exchange rate (EXR), and digital payment channels comprising e-money (EM), internet banking (IB), and mobile banking (MB). The analysis covers seven models: aggregate banking, commercial banking, Islamic banking, domestic commercial banking, foreign commercial banking, domestic Islamic banking, and foreign Islamic banking.

The descriptive statistics indicate that commercial banks dominate loans and advances, with lower variability than Islamic banks. Domestic banks—both commercial and Islamic—account for the bulk of lending and deposits relative to foreign banks. Islamic banks consistently exhibit higher statutory deposit-to-asset ratios than commercial banks, across both domestic and foreign institutions. Among digital payment channels, mobile banking is the most widely used, while internet banking shows the lowest adoption.

Although the ARDL approach offers several advantages, it is not applicable when variables are integrated of order $I(2)$ (Peng et al., 2022). Accordingly, Augmented Dickey–Fuller (ADF) and Phillips–Perron unit root tests were conducted (Table 2), confirming that all variables satisfy the required integration properties.

Following the unit root tests, bounds F-tests were employed to assess cointegration. The results are presented in Tables 3 to 5, corresponding to e-money, internet banking, and mobile banking, respectively. Each table reports results for seven models covering the aggregate banking system and its disaggregated components.

Consistent with Safuan et al. (2022), each table is organized into three panels. Panel A reports summary statistics, including optimal lag length—selected using the Akaike Information Criterion (AIC), which is suitable for samples of 60 observations or fewer (Liew, 2004)—adjusted R^2 , and the LM test for serial correlation. Panel B presents long-run estimates, while Panel C reports short-run dynamics. The analysis begins with the aggregate banking system and is progressively disaggregated into commercial versus Islamic banks, and further into domestic and foreign institutions.

All models pass the serial correlation test. The bounds F-test results reject the null hypothesis of no cointegration at least at the 5% significance level for all specifications, except for foreign Islamic banks under the mobile banking channel. The ARDL estimates show that digital payment adoption exerts a positive and statistically significant long-run effect on lending in the aggregate banking system. This result remains robust for commercial banks, domestic commercial banks, Islamic banks, and domestic Islamic banks, with digital payment variables also significant in the short run in some specifications. Overall, the findings support the study's hypothesis that greater digital payment usage facilitates increased bank lending.

In contrast, the effects are weaker for foreign banks. For foreign commercial banks, digital payment channels are significant only in the short run, while no significant effects are observed for foreign Islamic banks. This likely reflects their relatively small market share—less than 20% of total deposits and loans—and constraints on branch expansion and market penetration (Bank Negara Malaysia, 2011). Foreign banks also tend to focus on trade- and investment-related activities rather than retail lending (Ahmad, 2013).

The positive relationship between digital payments and lending suggests that increased digital payment usage enhances banks' lending capacity, including among domestic Islamic banks, thereby amplifying the money creation process. Monetary policy must therefore account for this channel, as neglecting it may weaken

effectiveness: contractionary policies may insufficiently restrain money supply, while expansionary policies may unintentionally accelerate inflation.

Finally, the estimated coefficients of the control variables align with existing literature. Larger deposit bases are associated with higher lending (Birhanu et al., 2021), while higher lending rates, statutory reserve ratios, and inflation rates are linked to lower loan growth (Hsing, 2014; Kapounek et al., 2017; Le et al., 2022; Modugu and Dempere, 2022; Yu et al., 2014). In contrast, exchange rate depreciation is found to stimulate bank lending (Beck et al., 2025).

Table 1: Descriptive Statistics

Variables	Mean	Std. dev	Min	Max
<i>ALR</i>	4.16	0.67	3.40	5.26
<i>IFR</i>	4.57	0.51	3.97	5.41
<i>EM</i>	146.29	34.84	79.30	198.74
<i>IB</i>	98.38	40.31	29.90	157.34
<i>MB</i>	200.27	60.57	45.99	323.46
<i>INF</i>	1.52	2.08	-2.89	4.68
<i>UNEM</i>	4.01	0.62	3.20	5.30
<i>EXR</i>	4.24	0.15	4.01	4.73
Aggregate				
<i>LOAN</i>	1803825.54	87723.72	1667260.77	1955752.76
<i>DS</i>	2084030.27	118254.94	1906218.99	2294124.24
<i>SRR</i>	0.66	0.74	0.07	1.89
Commercial				
<i>LOAN</i>	1138289.29	25063.93	1100003.34	1179679.51
<i>DS</i>	1442145.95	79790.09	1341068.50	1597717.70
<i>SRR</i>	0.60	0.67	0.06	1.73
Islamic				
<i>LOAN</i>	658382.56	62543.08	558091.06	767820.10
<i>DS</i>	662384.08	61952.91	560634.30	777600.21
<i>SRR</i>	0.80	0.93	0.07	2.45
Commercial: Local				
<i>LOAN</i>	860939.00	27217.45	822479.25	909152.63
<i>DS</i>	1072835.87	58977.51	997999.87	1193113.94
<i>SRR</i>	0.64	0.73	0.06	1.87
Commercial: Foreign				
<i>LOAN</i>	277350.29	4367.51	269889.24	288861.48
<i>DS</i>	369310.08	21751.54	339874.11	415883.89
<i>SRR</i>	0.45	0.49	0.05	1.31
Islamic: Local				
<i>LOAN</i>	617416.46	61630.80	516391.72	723068.83
<i>DS</i>	619439.24	60179.28	521034.65	732584.86
<i>SRR</i>	0.81	0.94	0.07	2.49
Islamic: Foreign				
<i>LOAN</i>	40966.10	1839.99	38401.05	45368.96
<i>DS</i>	42944.84	1968.26	39599.65	46944.00
<i>SRR</i>	0.68	0.81	0.02	2.07

Notes: *LOAN* denotes loan and advance payments, *ALR* denotes average lending rate, *IFR* denotes Islamic financing rate, *DS* denotes deposit size, *SRR* denotes statutory deposit to asset ratio, *EM* denotes e-money, *IB* denotes internet banking, *MB* denotes mobile banking, *INF* denotes inflation rate, *UNEM* denotes unemployment rate, *EXR* denotes exchange rate.

Table 2: Stationary test results

Level Variables	ADF		PP	
	Level	First Difference	Level	First Difference
<i>ALR</i>	-2.2214	-2.9389**	-0.9747	-2.9879**
<i>IFR</i>	-2.1313	-2.9701**	-1.4474	-4.4654***
<i>EM</i>	-2.2874	-6.8729***	-2.1567	-9.2807***
<i>IB</i>	-1.2754	-11.3015***	-2.4934	-11.3906***
<i>MB</i>	-2.5046	-10.3853***	-2.0093	-10.3388***
<i>INFL</i>	-1.5312	-5.1999***	-1.7073	-4.0659***
<i>UNEM</i>	-2.0617	-5.2561***	-1.6160	-4.1441***
<i>EXR</i>	-1.7535	-7.7785***	-1.6726	-8.2193***
Aggregate				
<i>LOAN</i>	-0.1012	-8.3398***	-0.1012	-8.3398***
<i>DS</i>	1.9006	-9.5599***	0.8875	-9.5599***
<i>SRR</i>	-1.6115	-6.5116***	-1.6531	-6.5505***
Commercial				
<i>LOAN</i>	-0.0618	-8.7827***	0.0459	-8.8362***
<i>DS</i>	0.5821	-6.4858***	0.5821	-8.4214***
<i>SRR</i>	-1.6355	-6.5258***	-1.6713	-6.5635***
Islamic				
<i>LOAN</i>	-0.4154	-7.2638***	-0.4142	-7.2638***
<i>DS</i>	-0.3863	-9.1710***	-0.6221	-8.9523***
<i>SRR</i>	-1.5594	-6.7047***	-1.6098	-6.7764***
Commercial: Local				
<i>LOAN</i>	0.4637	-8.0364***	0.6508	-8.1093***
<i>DS</i>	0.7251	-8.0858***	1.0999	-8.1002***
<i>SRR</i>	-1.5355	-6.6606***	-1.5874	-6.7543***
Commercial: Foreign				
<i>LOAN</i>	-1.3811	-6.8507***	-1.6988	-6.8723***
<i>DS</i>	-0.8273	-8.6856***	-0.6662	-8.7264***
<i>SRR</i>	-1.7854	-6.5975***	-1.7969	-6.5974***
Islamic: Local				
<i>LOAN</i>	-0.7446	-6.8406***	-0.7456	-6.8406***
<i>DS</i>	-0.4323	-8.7264***	-0.6461	-8.5820***
<i>SRR</i>	-1.5112	-6.4767***	-1.5754	-6.5102***
Islamic: Foreign				
<i>LOAN</i>	0.2030	-7.4784***	0.3045	-7.4663***
<i>DS</i>	-0.7404	-10.1605***	-0.9559	-10.1967***
<i>SRR</i>	-1.6409	-7.1078***	-1.6611	-7.1218***

Notes: *** and ** indicate that rejection of the null hypothesis at 1% and 5% significance levels, respectively. *LOAN* denotes loan and advance payments, *ALR* denotes average lending rate, *IFR* denotes Islamic financing rate, *DS* denotes deposit size, *SRR* denotes statutory deposit to asset ratio, *EM* denotes e-money, *IB* denotes internet banking, *MB* denotes mobile banking, *INF* denotes inflation rate, *UNEM* denotes unemployment rate, *EXR* denotes exchange rate.

Table 3: Estimates based on ARDL model: E-Money channel

	Aggregate	Commercial	Domestic Commercial	Foreign Commercial	Islamic	Domestic Islamic	Foreign Islamic
<i>Panel A. ARDL</i>							
Lag	1, 0, 1, 1, 1,	1, 0, 0, 2, 1,	3, 0, 0, 0, 1,	1, 3, 3, 2, 0,	1, 1, 1, 0, 0,	1, 1, 1, 0, 0,	1, 3, 0, 0, 0,
Structure	2, 2, 0	3, 3, 0	4, 3, 0	3, 1, 3	0, 0, 1	0, 0, 1	2, 0, 2
R^2_{adj}	0.97	0.92	0.95	0.91	0.97	0.97	0.95
LM test	[0.6593]	[0.2959]	[0.2946]	[0.1086]	[0.4253]	[0.3682]	[0.9841]
<i>Panel B. Long-run model</i>							
Constant	3.2095*** (6.2945)	5.1660*** (19.4501)	3.9776*** (13.1532)	8.3621*** (8.0041)	1.2055 (1.6278)	1.3849 (1.9977)	3.3500*** (3.0143)
<i>EM</i>	0.0340*** (3.2236)	0.0252*** (4.6994)	0.0202*** (2.8068)	0.01632 (0.8290)	0.0493** (2.0461)	0.0569** (2.3661)	0.0454 (1.4474)
<i>LR</i>	-0.0032 (-1.1603)	-0.0017 (-1.3641)	0.0021 (1.4742)	0.0022 (0.4563)	-0.0122 (-1.2992)	-0.0127 (-1.4376)	0.0036 (0.2220)
<i>DS</i>	0.4655*** (5.2865)	0.1273** (2.7219)	0.3181*** (5.7810)	0.5785** (27364)	0.7763*** (5.2114)	0.7424*** (5.2521)	0.1040 (0.3898)
<i>SRR</i>	-0.0041 (-1.1559)	-0.0029 (-1.4929)	-0.0066*** (-3.5048)	-0.0153 (-1.7668)	-0.0021 (-0.0392)	-0.0027 (-0.5873)	0.0129 (1.1835)
<i>INF</i>	-0.0012*** (-2.9036)	-0.0009*** (-3.2136)	-0.0006 (-1.7076)	0.0006 (0.5264)	-0.0032*** (-4.1989)	-0.0032*** (-4.1609)	-0.0025 (-1.6611)
<i>UNEM</i>	-0.0082*** (-3.4789)	-0.0063*** (-5.5519)	-0.0066*** (-4.7676)	-0.0094** (-2.6410)	-0.0131*** (-2.8019)	-0.0136*** (-2.8309)	-0.0033 (-0.5482)
<i>EXR</i>	0.023539 (0.97822)	0.0363** (2.4419)	-0.0053 (-0.3137)	0.1929** (2.1806)	0.0274 (0.5101)	0.0210 (0.3926)	0.4275*** (2.9749)
F-bound test	7.1619***	6.6103***	11.9616***	4.4119**	9.3010***	10.0451***	4.4481**
<i>Panel C. Short-run model</i>							
$\Delta LOAN_{t-1}$							
ΔEM_t				0.0219 (1.1659)	0.0071 (0.9626)	0.0091 (1.2178)	0.0007 (0.0479)
ΔLR_t	-0.0095*** (-5.2989)			-0.0038 (-0.8284)	-0.0169*** (-4.2353)	-0.0178*** (-4.4099)	
ΔDS_t	0.2846*** (6.9237)	0.1843*** (5.7716)		0.0479 (0.1841)			
ΔSRR_t	0.001138 (1.3321)	-0.0001 (-0.2119)	-0.0001 (-0.1423)				
ΔINF_t	-0.0001 (-0.5939)	0.0001 (0.4586)	0.0002 (1.0907)	0.0003 (0.6822)			-0.0001 (-0.1953)
$\Delta UNEM_t$	-0.0002 (-0.2917)	0.0009 (1.4386)	-0.0013* (-1.7451)	0.0027 (1.4909)			
ΔEXR_t				0.0891*** (5.8469)	-0.02349 (-1.4751)	-0.0256 (-1.5787)	0.0501 (1.6511)
ECM_{t-1}	-0.4287*** (-8.9232)	-0.6813*** (-8.6513)	-0.6168*** (-11.719)	-0.4929*** (-7.2398)	-0.4042*** (-10.0439)	-0.4079*** (-10.438)	-0.4461*** (-7.0525)
R^2_{adj}	0.60	0.70	0.67	0.69	0.41	0.44	0.50

Notes: *** and ** indicate that rejection of the null hypothesis at 1% and 5% significance levels, respectively. Figures in round (. . .) and square brackets [. . .] are t-statistics and p-values, respectively. *LOAN* denotes loan and advance payments, *EM* denotes digital payment channel of e-money, *LR* denotes lending rate, *DS* denotes deposit size, *SRR* denotes statutory deposit to asset ratio, *INF* denotes inflation rate, *UNEM* denotes unemployment rate, *EXR* denotes exchange rate.

Table 4: Estimates based on ARDL model: Internet-banking channel

	Aggregate	Commercial	Domestic Commercial	Foreign Commercial	Islamic	Domestic Islamic	Foreign Islamic
<i>Panel A. ARDL</i>							
Lag	3, 3, 0, 2, 3,	4, 4, 4, 3, 4,	1, 2, 1, 0, 0,	1, 2, 0, 2, 3,	1, 2, 0, 2, 0,	1, 2, 0, 2, 0,	3, 3, 3, 0, 3,
Structure	2, 0, 3	3, 4, 4	2, 0, 0	3, 1, 3	1, 0, 1	3, 0, 0	2, 3, 2
R_{adj}^2	0.98	0.93	0.96	0.93	0.97	0.97	0.95
LM test	[0.1622]	[0.1993]	[0.1744]	[0.1821]	[0.6490]	[0.2908]	[0.2927]
<i>Panel B. Long-run model</i>							
Constant	2.3254*** (13.4874)	4.0701*** (20.8852)	3.6664*** (23.089)	7.6603*** (9.0734)	0.5485 (1.7879)	0.5074 (1.9964)	2.0948** (2.2424)
<i>IB</i>	0.1379*** (7.3380)	0.1128*** (7.7624)	0.0741*** (5.4127)	0.0988 (1.2524)	0.2318*** (3.4621)	0.2415*** (3.9783)	0.2764 (1.7117)
<i>LR</i>	-0.0079*** (-3.7664)	-0.0108*** (-3.7498)	0.0016 (1.1401)	-0.0041 (-0.7399)	-0.0142 (-1.7611)	-0.0118 (-1.9964)	-0.0322 (-0.9645)
<i>DS</i>	0.4740*** (11.451)	0.1738*** (7.8297)	0.2954*** (8.5380)	0.5738*** (3.1291)	0.6555*** (5.4995)	0.6589*** (6.4919)	0.0301 (0.1186)
<i>SRR</i>	0.0076*** (2.8728)	0.0180*** (3.2082)	-0.0012 (-0.6565)	0.0061 (0.5174)	0.0033 (0.6067)	0.0003 (0.0813)	0.0653** (2.1826)
<i>INF</i>	-0.0007*** (-3.4366)	-0.0003 (-2.0146)	-0.0001 (-0.1008)	-0.0001 (-0.0276)	-0.0030*** (-4.0874)	-0.0029*** (-3.7056)	-0.0050*** (-3.8206)
<i>UNEM</i>	0.0017 (1.5181)	-0.0065** (-2.6888)	0.0014 (1.2663)	0.0016 (0.3832)	-0.0033 (-0.7530)	-0.0033 (-0.7840)	-0.0335** (-2.4101)
<i>EXR</i>	0.0991*** (4.2240)	0.1800*** (5.1765)	0.0267 (1.6247)	0.2770*** (3.7176)	0.1184 (2.0268)	0.0809 (1.7743)	0.6924*** (2.9724)
F-bound test	7.2502***	16.2689***	12.9707***	4.0312**	8.0266***	9.3252***	3.8663**
<i>Panel C. Short-run model</i>							
$\Delta LOAN_{t-1}$	-0.1797** (-2.0675)	-0.4319*** (-7.1182)					0.1606 (1.4326)
ΔIB_t	0.0327*** (8.8317)	0.0241*** (12.534)	0.0146*** (6.2421)	0.0329*** (6.0417)	0.0515*** (6.7765)	0.0542*** (7.1826)	0.0459 (1.6545)
ΔLR_t		-0.0118*** (-8.3140)	0.0070*** (6.3015)				-0.0004 (-0.0422)
ΔDS_t	0.1436*** (3.3258)	0.0446 (1.9041)		0.0887** (2.0101)	0.0959 (1.5721)	0.0722 (1.2952)	
ΔSRR_t	0.0001 (0.1254)	-0.0009 (-1.8194)		-0.0075*** (-3.3654)			0.0128*** (3.1131)
ΔINF_t	0.0002 (1.3929)	0.0009*** (10.538)	0.0003** (2.3411)	0.0001 (0.0821)	-0.0002 (-0.6583)	-0.0006 (-1.7186)	-0.0021** (-2.3195)
$\Delta UNEM_t$		-0.0011** (-2.4017)		-0.0447** (-2.4025)			-0.0009 (-0.2521)
ΔEXR_t	0.026899 (3.947210)	0.0568*** (13.417)		0.1173 (7.9183)	0.0228 (1.5003)		0.1632*** (4.1673)
ECM_{t-1}	-0.6544*** (-9.2807)	-1.1628*** (-16.2344)	-0.5549*** (-11.945)	-0.4788*** (-6.8913)	-0.3856*** (-9.4208)	-0.4279*** (-10.211)	-0.5402*** (-6.8884)
R_{adj}^2	0.7812	0.95	0.68	0.72	0.54	0.58	0.60

Notes: *** and ** indicate that rejection of the null hypothesis at 1% and 5% significance levels, respectively. Figures in round (. . .) and square brackets [. . .] are t-statistics and p-values, respectively. *LOAN* denotes loan and advance payments, *IB* denotes digital payment channel of e-money, *LR* denotes lending rate, *DS* denotes deposit size, *SRR* denotes statutory deposit to asset ratio, *INF* denotes inflation rate, *UNEM* denotes unemployment rate, *EXR* denotes exchange rate.

Table 5: Estimates based on ARDL model: Mobile-banking channel

	Aggregate	Commercial	Domestic Commercial	Foreign Commercial	Islamic	Domestic Islamic	Foreign Islamic
<i>Panel A. ARDL</i>							
Lag	4, 4, 3, 2, 4,	1, 0, 3, 0, 1,	1, 2, 0, 0, 1,	2, 1, 3, 2, 3,	1, 0, 1, 2,	1, 0, 1, 0, 0,	2, 2, 3, 0,
Structure	2, 3, 4	1, 3, 0	1, 2, 0	3, 1, 2	0, 0, 0, 1	0, 0, 1	3, 2, 0, 2
R^2_{adj}	0.98	0.92	0.96	0.93	0.96	0.97	0.95
LM test	[0.4727]	[0.3273]	[0.3690]	[0.5805]	[0.5033]	[0.4456]	[0.9098]
<i>Panel B. Long-run model</i>							
Constant	3.7045*** (11.8919)	5.1214*** (29.0699)	4.4668*** (27.388)	8.7803*** (7.6576)	1.6064 (1.3801)	1.1622 (0.9365)	2.5376 (0.9431)
<i>MB</i>	0.0425*** (7.0199)	0.0185*** (5.9090)	0.0231*** (7.3157)	0.0059 (0.3881)	0.0537** (2.5773)	0.0416** (2.5919)	0.0474 (1.1195)
<i>LR</i>	-0.0059*** (-3.4740)	0.0011 (1.2819)	0.0030*** (3.5646)	0.0109 (1.7748)	-0.0135 (-1.3739)	-0.0180 (-1.5806)	-0.1168 (-0.9988)
<i>DS</i>	0.3587*** (6.5855)	0.1375*** (4.4082)	0.2262*** (7.6989)	0.6290*** (2.8272)	0.6851*** (2.8405)	0.7825*** (3.0126)	0.1441 (0.2354)
<i>SRR</i>	0.0058*** (2.5070)	-0.0057*** (-3.5229)	-0.0041*** (-3.2339)	-0.0356** (-2.4469)	0.0045 (0.2148)	-0.0003 (-0.0484)	0.1041 (1.2119)
<i>INF</i>	-0.0001 (-0.4548)	0.0002 (1.8025)	0.0001 (0.8304)	0.0016 (1.8507)	-0.0024** (-2.4255)	-0.0029** (-2.4783)	-0.0045 (-1.3390)
<i>UNEM</i>	-0.0042*** (-3.0156)	-0.0069*** (-7.5566)	-0.0043*** (-5.5239)	-0.0146*** (-2.9949)	-0.0137** (-2.6882)	-0.0170*** (-2.7517)	0.0128 (0.6068)
<i>EXR</i>	0.0849*** (4.7957)	0.0189 (1.8443)	0.0023 (0.2348)	0.1104 (1.5604)	0.0670 (1.0066)	0.0429 (0.5831)	1.1145 (1.5298)
F-bound test	5.7211***	12.5192***	10.7518***	5.9039***	4.7988***	11.8584***	3.0679
<i>Panel C. Short-run model</i>							
$\Delta LOAN_{t-1}$	0.2367** (2.2674)			0.2357** (2.4147)			-0.2100* (-1.8678)
ΔMB_t	0.0127** (2.9358)		0.0076*** (2.8473)	0.0447 (0.9835)			0.0117 (0.7267)
ΔLR_t	-0.0126*** (-4.8859)	0.0005 (0.2707)		0.0079 (1.8399)	-0.0158*** (-4.3479)	-0.0169*** (-4.6363)	-0.0122 (-1.1405)
ΔDS_t	0.1634*** (3.4534)			0.0468 (1.1011)	0.2319*** (3.6863)		
ΔSRR_t	0.0032*** (3.5802)	-0.0020*** (-2.8026)	-0.0002 (-0.4088)	-0.0092*** (-3.8480)			0.0112*** (2.7909)
ΔINF_t	0.0004 (2.0790)	0.0006*** (3.435613)	0.0004** (2.2670)	0.0004 (1.2561)			-0.0004 (-0.4942)
$\Delta UNEM_t$	0.0011 (1.2268)	-0.0004 (-0.5480)	-0.0013 (-1.8656)	0.0035 (1.8155)			
ΔEXR_t	0.0191*** (2.9882)			0.0935*** (6.9465)	-0.0173 (-1.0728)	-0.0232 (-1.4582)	0.0595 (1.7844)
ECM_{t-1}	-1.2425*** (-8.9979)	-0.8947*** (-11.8677)	-0.8492*** (-10.903)	-0.5024*** (-8.4170)	-0.3860*** (-7.2476)	-0.3209*** (-11.317)	-0.2275*** (-5.9827)
R^2_{adj}	0.81	0.71	0.69	0.77	0.40	0.41	0.53

Notes: *** and ** indicate that rejection of the null hypothesis at 1% and 5% significance levels, respectively. Figures in round (. . .) and square brackets [. . .] are t-statistics and p-values, respectively. *LOAN* denotes loan and advance payments, *MB* denotes digital payment channel of mobile banking, *LR* denotes lending rate, *DS* denotes deposit size, *SRR* denotes statutory deposit to asset ratio, *INF* denotes inflation rate, *UNEM* denotes unemployment rate, *EXR* denotes exchange rate.

5. CONCLUSION AND POLICY IMPLICATIONS

The fintech evolution is transforming society, most visibly through the global rise of digital payments. This shift was accelerated by the COVID-19 pandemic, which heightened concerns over infection risks associated with cash handling. Governments, including Malaysia, have actively promoted cashless transactions in public agencies through initiatives such as the Malaysia Digital Economy Blueprint and the *Cashless Boleh* campaign (Ministry of Finance, 2025). Despite growing research interest, important macroeconomic implications remain underexplored.

This study addresses this gap by showing that digital payment adoption reduces reliance on physical cash and excess reserves, thereby enhancing banks' lending capacity and amplifying the money creation process. These

findings underscore the importance of incorporating digital payment dynamics into the design and assessment of monetary policy.

Using ARDL analysis on Malaysian data from January 2019 to April 2023, this study examines e-money, internet banking, and mobile banking. The results reveal a positive relationship between digital payment adoption and bank lending, indicating that digital payments expand lending capacity and influence the broader money supply.

The positive effect of digital payments on lending is observed mainly among domestic banks, including both commercial and Islamic banks. The relatively small market share of foreign banks may explain the absence of significant effects for that segment. Importantly, while traditional money creation theories focus primarily on commercial banks, this study shows that digital payment adoption also stimulates lending among domestic Islamic banks, highlighting their role in digital-driven credit expansion.

This study emphasizes system-wide effects rather than differences in the underlying mechanisms of conventional and Islamic banking. Although the impacts are broadly similar across domestic bank types, future research could explore potential heterogeneity in transmission channels in greater depth.

From a policy perspective, central bank interventions should account for Islamic banks alongside conventional banks. Ignoring their lending activities may underestimate overall credit expansion and weaken policy effectiveness. Traditional monetary tools—such as interest rate adjustments or reserve requirements—may be insufficient if the catalytic role of digital payments is overlooked. Expansionary policies could generate excessive lending and inflation, while contractionary measures may underperform.

Beyond monetary policy, digital payment adoption also promotes financial inclusion (Aurazo and Vega, 2021), particularly among underserved groups, supporting Sustainable Development Goal 10 on Reduced Inequalities (Bank for International Settlements, 2023). Recognizing the role of digital payments in policy design is therefore essential for both effective monetary management and broader socio-economic outcomes.

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