Digital payment and banking stability in emerging economy with dual banking system

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ABSTRACT

Previous studies provided limited conclusions on the relationship between digital payment and financial stability, particularly in an emerging economy with a dual banking system in which Islamic banking operates in parallel with its conventional counterpart, such as Indonesia. Therefore, this study aims to examine the impact of digitalisation on financial stability, particularly banking stability, in Indonesia. It uses Vector Error Correction Model (VECM) and Vector Autoregressive (VAR) models to investigate the relationship using monthly data during December 2013–July 2021 period. The digital payment transaction is proxied by payment penetration ratio (PPR); meanwhile financial stability is proxied by the value of Z-Score for the Indonesian banking industry. It also conducts a robustness check using Autoregressive Distributed Lag (ARDL) model. The study found a cointegrating relationship between PPR and Z-Score, suggesting that digital payment transactions have an equilibrium and long-run relationship with banking stability in Indonesia. Further examination shows a one-direction causality from digital payment to banking stability and a positive short-run relationship between the variables. Interestingly, despite being the largest Muslim country globally, the estimation result shows no significant causality between digital payment and Islamic banking stability in Indonesia. While this might be due to the small size of Islamic banking in the country, it is expected that the impact will be more significant as Islamic digital banking starts to emerge and gain strong support from society and government in the post-covid period. Overall, our findings support policies promoting a more supportive regulatory ecosystem for a resilient banking and financial system in an emerging economy with a dual banking system.

1. Introduction

Financial digitalisation has been one of the prominent features in the financial scene today, especially since the eruption of the Covid-19 pandemic. According to Forrester Research, there has been a 69% increase in contactless transactions since January 2020 (Rueter, 2020) and there is expectation that the global digital payments market will grow with CAGR of 16.1% in 2021 (Business Wire, 2021). In addition, nearly 50% of global shoppers were using digital payments more than before the pandemic and the majority plan to continue doing so (yStats GmbH & Co. KG, 2020). Meanwhile, in the US market, a report by McKinsey (Goel et al., 2021) explains that 82% of the society use digital payments in 2021, an increase from 78% in 2020 and 72% five years before. However, the increased adoption of financial digitalisation is not confined only to developed countries. For example, in India's case, 33% used digital payments more than before the pandemic (Keelery, 2020). Meanwhile, in Indonesia, there has been a significant jump in digital payment of up to 300% from 2018 to 2019 (Bank Indonesia, 2020), and it still increases in 2021 counted for 150 million transaction, 24% higher from the number in 2020 (Tempo, 2022).

While digitalisation is inevitable and digital transactions are a necessity moving forward (Yao, 2020), less is known about its economic and financial implications. Looking at the literature, limited studies examine the impacts of digitalisation, or in a broader term financial technology, on banking services and the overall economy. The studies generally suggested that digital payment could potentially improve banking services, boost economic activities, and contribute to increasing GDP (Hasan et al., 2012; Beck et al., 2016; Ozili, 2018; Demirguc-Kunt et al., 2018;
Goldstein et al., 2019; Kamal and Souparnika, 2021; Rastogi et al., 2021; Zhang et al., 2019). Even fewer studies assess its implication on financial and banking soundness in both advanced and emerging economies. Most studies suggested that limited conclusions have been reached on the relationship between digital financial transactions and financial stability (Bank of England, 2019; Danisman and Tarazi, 2020; Goldstein et al., 2019).

Building on this line of research, we examine the relationship between digitalisation and financial system stability in Indonesia, an emerging market with a dual banking system in which Islamic banking operating side by side with conventional banking, using a quantitative research method. Vector Autoregressive (VAR) and Vector Error Correction Model (VECM) are employed, with further robustness check using Autoregressive Distributed Lag (ARDL) model. The digital payment transaction is proxied by the payment penetration ratio (PPR). Meanwhile, as the banking system dominates Indonesia’s financial system, financial stability is proxied by the value of Z-Score for the Indonesian banking industry. In addition, several control variables are included in the model. They include inflation, consumer confidence index, money market rate, growth of money supply, dummy variables for Covid-19 and issuance of electronic money regulation, and size of Islamic banks. We use monthly data from January 2013 to July 2021 sourced from publicly available data from the Central Bank of Indonesia, Indonesian Financial Services Authority (OJK), and Datastream.

Our study has several contributions. First, we extend previous studies regarding financial system stability (see for example, Danisman and Tarazi, 2020; Guérineau and Léon, 2019; Hasan et al., 2012; Koong, Law and Ibrahim, 2017) and provide an assessment of aggregate financial stability, which is important in carving macroprudential policies for a financial system with high digital exposure. Thus, our study contributes to the larger literature on financial system stability and macroprudential policies. Second, we bring the emerging countries’ perspectives by studying datasets from Indonesia. According to Oxford Economics (2020), Indonesia ranks as the third-largest emerging market. Amidst the negative impact of the pandemic, it still looks to be a key player in the future, with a growth of 4.4% in 2021 (World Bank, 2020). Moreover, as it had been hit by banking and financial crises with huge economic costs in the past, it is increasingly important that digitalisation as a form of financial innovation does not contribute to future banking and financial crises in the country (Azis et al., 2021). Third, we include Islamic banking indicators in the model, as Indonesia implements a dual-banking system in which both conventional and Islamic banks are operating. Indonesia had adopted the dual-banking system since 1991 when Bank Muamalat Indonesia (BMI), the first Islamic bank in the country, was established. The results obtained from this study could be a lesson learnt for other countries who also adopt dual-banking system in examining the relationship between digital payment and the existence of Islamic banks.

The rest of the paper is structured as follows. After this introductory section, section two and three explains the literature review and methods of the study. Section four explains the findings and analyses of the study. The last section provides conclusions, recommendations, and limitations of the study.

2. Literature review

Innovation in technology, such as in forms of internet banking, electronic payment, electronic money, mobile payment, and e-wallet, has changed the services provided by the banking industry (Berger, 2003; Hollander, 2008). This development can potentially stimulate bank’s efficiency, leading to better performance and, eventually, higher banking stability (Hasan et al., 2012). However, the development of financial technology can also create new risks that can affect financial stability (Bank of England, 2019).

Despite of its importance, the literature on the relationship between technological innovation and financial system are scanty (Goldstein et al., 2019). Among the few, a study by Phan et al. (2019) shows that the growth of fintech companies’ number has caused a decrease in banking performance in Indonesia. In contrast, a study by Guérineau and Léon (2019) employing data from 80 developed countries and 79 developing countries found that credit information sharing can reduce the financial fragility in both countries’ groups. As for studies focused on payment systems, Hasan et al. (2012) examine the effect of retail payment system services heterogeneity on overall bank performance and efficiency. The study used large scale data (consisting of 3,370 commercial banks, savings banks, and cooperative banks from 27 European countries annually for 2000–2007) and found that higher usage of electronic retail payment instruments can support the banking business. Furthermore, effective payment service also has a positive relationship with bank stability.

On a macro-level, Tee and Ong (2016) studied the relationship between cashless payment and economic growth in the EU from 2000-2012. The study found a short-run causality from cheque payment to telegraphic transfer and card payment. Moreover, there is a significant effect of the adoption of cashless payments in five European countries in the long run. Another study using Statistical Data Warehouse on 1995–2012 for the 27 EU countries found that a higher penetration ratio of e-payment is associated with higher GDP, trade, consumption, and tax revenue. In addition, the 2008 financial crisis and the existence of shadow banking can increase the effect on the relationship between payment methods and the economy (Zhang et al., 2019).

Based on the explanations above, the overall view on the presence of digital payment has been positive to bring notable change in market fundamentals (Visa, 2016) and increasing efficiency in the economy (D’Italia, 1999). For such reasons, emerging economies are exploring the opportunity to exploit the benefits and positive effects of the digital payment system, such as increasing productivity (Berger, 2003), improving bank’s profitability (Hasan et al., 2012), cost-saving (Humphrey et al., 1996; Carbó-Valverde and Rodríguez-Fernández, 2014). Eventually, the promotion of digital payment will allow emerging market economies to facilitate economic transactions, secure capital gain, increase money circulation, and enhance growth (Bech et al., 2018; Genesis Analytics, 2019; Zhang et al., 2019; Ashworth and Goodhart, 2020). Furthermore, Moody’s global report (2013) pointed out that the rise of penetration of electronic payment contributed to a 0.8% increase in GDP within emerging markets; thus, highlighting the impact of digitalisation of payment systems on emerging market development.

On the other hand, the digitalisation of payment systems may also emerge at the expense of the sustenance of the existing system. For example, in examining the relationship between financial innovation and banking growth, financial fragility and country’s economic growth in 32 countries between 1996-2010, Beck et al. (2016) suggest that innovation can increase banks’ fragility and decrease banking performance. Thus, this study represents the mainstream understanding of the nexus between the financial system and innovation, suggesting that the bank, as the financial system’s major player, has relatively low research and development and therefore become less innovative and relatively stable. Nonetheless, the study only captures the vulnerability of the financial and banking sector with no clear explanation of the effect of financial innovation on systemic stability.

Another issue concerning financial stability is the traditional proxy of fragility, sourced from credit growth and its association with NPL (Guérineau and Léon, 2019). The advancement in retail payment through digitalisation could change the relationship, for example, between liquidity and fragility (Diamond & Rajan, 2001), which is part of financial stability. Traditionally, banks turn liquid assets into illiquid assets by providing loans for borrowers. However, banks need to ensure that the lenders (depositors) have the capability to withdraw their savings any time they need. The inability of banks to provide liquidity for depositors could create liquidity risk for banks. The rise of the non-cash payment system suggests that the demand for cash withdrawal is decreasing, which opens a possibility that digital payment affects the bank’s fragility directly instead of buffering from the liquidity issue. In other words, the increase of electronic-based transactions can reduce
financial sector fragility by plummeting a bank’s exposure to liquidity risk as the provision of liquidity becomes abundant.

Since the development of digital innovation within the financial sector can disrupt the business process operating in the banking sector, as discussed earlier, it is also notable that there is a possibility of interaction between lenders and borrowers outside the banking system. In other words, digital innovation disintermediates the surplus side and deficit side (Broby, 2021). As a result, it raises concerns from the central bank and regulators as the transaction occurs outside the system. From the technical aspects, the wider use of digitalization could lead to higher unauthorized transactions, hacking, digital fraud, and other technical issues (Banna et al., 2021). On the other hand, recent study by Banna et al. (2021) found that digital financial inclusion increases Islamic banking stability through the reduction of default risk. This finding strengthens the authority interest in pushing digitalisation further. From the regulatory perspective, the use of digital infrastructure could lead to better regulatory control on the financial activities (Naumenkova et al., 2019).

With the growing digitalisation of payment systems, the financial fragility of a bank may be affected through the shift in liquidity risk level, thus, liquidity requirement. In this manner, banking balances the liquid and illiquid assets to facilitate transactions through digital payment to avoid liquidity risk and ensure strong financial stability. In particular, the increasing number of float funds is an indicator of a new relationship between digital payment and liquidity and financial stability, whereby cash provision for withdrawal potentially decreases with an increase of idle funds within a deposit. Therefore, a strong analytical approach to count for financial stability should consider both the asset side and the liability side of financial institutions.

Aside from the nexus between digital payment and financial stability, in examining the effect of digital payment volume on financial stability, several variables should be included to control for other factors affecting financial stability. Babilhuga (2007) study finds that inflation does not have a significant relationship with capital, asset quality, and profitability. This conclusion is shared by Schou-Zibell et al. (2010), which finds that inflation does not have a significant relationship with capital adequacy and non-performing loans. However, it has a significant negative relationship in developed economies yet a significant positive relationship in emerging Latin America. It is argued that high inflation is claimed to be a form of ‘macroeconomic mismanagement’, thus affecting the banking sector. On the other hand, a low level of inflation can also lower the nominal income and cash flows, affecting the financial institutions. Therefore, it appears that the impact of inflation is inconclusive.

The combination of financial and market indicators was seen as a powerful tool to assess the financial health of Asia-Pacific countries (Osorio et al., 2011). Nevertheless, this approach stresses more on the financial indicator and market-related indicators (Tng et al., 2012) and fall short in capturing financial stability from the point of view of the economy. For instance, Beck et al. (2006), Bussiere and Fratzscher (2006), and Castellano (2013) found out that real interest, growth of money supply, and exchange rate valuation affect the financial health of a country. Therefore, there is a growing importance to balance between financial and market indicators.

While market indicators assist financial stability checks by allowing dynamic measurement on the financial health, credit expansion is considered a relevant measurement for predicting financial shock (see, among others, Bernoth and Pick, 2011; M. Goldstein, 2001; Kraft and Jankov, 2005). This credit measurement is typically revealed by credit growth (Kraft and Jankov, 2005), money supply (Beck et al., 2006), or credit boom (Goldstein, 2001). However, this credit expansion only captures the fragility from the asset standpoint and neglects the increasing influence of digital payment that affects liquidity from the financial institution’s liability side. Previously, the traditional banking institution was required to maintain a certain level of liquidity to meet the depositor’s withdrawal need as part of the fragility architecture of the financial system (de Souza, 2016; Diamond and Kashyap, 2016; Kasri and Kassim, 2009; Diamond & Rajan, 2001).

More recently, with the emergence of the Covid-19 pandemic that forces people to work from home, limit their mobility, and restrain their consumption due to the unclear future of the pandemic, it might be necessary to include Consumer Confidence Index as a factor influencing financial stability. Some studies show that consumer confidence can benefit the financial stability in which the consumers can increase their consumption to show their positive attitude (Hussein, 2016; Liu et al., 2019). In Indonesia, such index is developed by the Central Bank of Indonesia and shows the willingness of consumers to spend their income in addition to their basic needs. The behaviour could in turn could affect the banking stability as low spending will result in high savings deposited by consumers but low credit/margining from the banking itself. It can also influence digital payment, as the consumer might increase their digital payment as the confidence index increases.

Another variable that might affect digital payment and banking stability, particularly in Indonesia, is the regulation for electronic money issued by the regulator. In May 2018, the Central Bank of Indonesia issued a regulatory framework for regulating the use of electronic money to protect consumers and boost the confidence of electronic money providers. Prior to this, there was no regulation regarding the issuance of electronic payments. As a result, the number of electronic payment providers was also very limited and mostly included banks’ e-money (card). However, after the issuance of the regulation, more non-bank providers such as ShopeePay and LinkAja were established. As shown in Table 1, which presents the brief milestones of electronic payment in Indonesia, the digital payment providers recorded significant improvement after issuance of the regulation. Thus, regulation is believed to result in higher digital payment. Intuitively, this can also affect banking stability, as it also regulates banking involvement in the payment system.

Furthermore, as Indonesia implements a dual banking system, this study also examines the relationship between digital payment and Islamic banking stability. It has been discussed in previous studies (see: Abedefir et al., 2013; Cihak and Hesse, 2010; Ghassan and Guendouz, 2018; Hasan and Dridi, 2010) that there is a different level of stability between conventional and Islamic banking. The study by Abedefir et al. (2013), employing 553 banks from 24 countries for period 1999–2009, found that Islamic banks with small size are more stable compared to the other sampled banks. The study also found that loan provided by Islamic banks is less influenced by domestic rates. Similar result is also presented by study from Cihak and Hesse (2010) which concluded that small Islamic banks have better financial condition compared to large Islamic banks.

Moreover, comparing the performance and stability of Islamic banks and conventional banks, study by Hasan and Dridi (2010) and Ghassan and Guendouz (2019) found that Islamic banks are more robust and stable, especially during the financial crisis. These studies also suggested that Islamic banks and conventional banks have distinctive characteristics that lead to different stability and robustness during different conditions. However, the studies have not touched upon the issue of digitalization which is one the main characteristics of the current global economic crisis that preceded by the health crisis. As such, their conclusion might not be applied nowadays, and further studies are needed to examine the issue.

Following the discussion on how numerous factors, including financial and economic condition as well as market-related indicators, in constructing and affecting the banking stability index, this study develops hypothesis to be tested that the increase in digital-based retail payment transactions affects the banking system stability.

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1 https://www.bi.go.id/id/statistik/Metadata/Survei/Documents/1-Metadata-a-SK-2016.pdf.
3. Research methods

3.1. Data and variables

In examining the relationship between digital payment and financial system stability in a dual banking system environment, we started by measuring the proxies for digital payment and financial system stability. Afterwards, the empirical model for examining the relationship between the variables is explained. In constructing the model, we added several control variables, including macroeconomic, banking specific factors, and dummy variables of Covid-19 and regulation regarding electronic money in Indonesia.

Data and Measurement of Digital Payment

In measuring digital or electronic-based retail payment, we adopt the variables used by Zhang et al. (2019) which is one of the few studies attempted to analyse digital payment globally. In their study, the payment penetration ratio is not measured based on the absolute value of electronic-based retail payment transactions. Instead, it is a proxy of the penetration rate ratio against GDP. Thus, the payment penetration ratio is obtained by dividing the value of digital payment transactions by the GDPs.

In this study, we use the definition of electronic money determined by the Indonesian Central Bank as the regulator of payment system in Indonesia. According to Bank Indonesia, electronic money is a payment instrument based on the amount of money deposited in advance to the issuer. This amount of money is stored electronically in a media server or chip, which is not treated as a deposit according to the law of Indonesian banking (Bank Indonesia, 2018) Based on this definition, the type of electronic money/payment in Indonesia can be in the form of a card or non-card transactions. Therefore, the payment penetration ratio consists of card transaction ratios and electronic money penetration ratios, in which the data is publicly available in the Central Bank’s online database.

Data and Measurement for Financial System Stability

In recent years, the attempt to develop a financial stability index as a measure of the systemic condition of the financial sector has increased significantly (see among others: Ghosh, 2011; Koong et al., 2017; Tng et al., 2012). There are three approaches commonly adopted to develop a financial stability index: principal-component approach, weighted-sum approach, and dynamic factor modelling approach. Each approach has strengths and weaknesses and has been used mostly based on the availability of data and purpose of study (Wilkinson et al., 2010). Furthermore, when the banking system dominates a financial system, the financial system stability is commonly measured using a z-score that captures the ability of a bank to cover the variability of its return (Chiaramonte et al., 2015).

In practice, financial stability measurement typically contains indicators such as capital-to-asset ratios (CAR), return on assets (ROA), and debt-to-equity ratio (D/E). The capital adequacy ratio can be seen as an indicator of banks’ financial fragility that determines the balance sheets’ ability to absorb the shocks (Schou-Zibell et al., 2010). In addition, non-performing loans (NPL) can be used as an indicator of financial fragility as it shows borrowers’ ability to repay as well as a bank’s susceptibility to generate revenue and maintain its strength. However, as these measurements only provide the current condition of the financial system, real and market indicators should be added as they complement the financial stability by offering measurement of dynamic future state and potential threat to the financial system. This measurement comprises indicators such as spread on credit, stock prices and indexes, interest rate, effective exchange rate, and credit expansion (Osorio et al., 2011).

In this study, we use banking stability as a proxy of financial stability as the banking system dominates Indonesia’s financial system. Indeed, the market share of the banking system in the Indonesian financial system was around 80% (Bisnis Indonesia, 2014). Furthermore, we use the Z-Score as a proxy of banking stability, as it can capture the insolvency risk of banks. It also measures the ability of capital and assets held by banks to cover the volatility of its return. In this respect, a higher Z-Score implies higher stability in the banking industry (Abedefir et al., 2013). We adopt the formula from Phan et al. (2020), in which the Z-Score is estimated as

\[ Z = \frac{ROA - \mu_{ROA}}{\sigma_{ROA}} \]

where ROA is the return on asset ratio and \( \sigma_{ROA} \) is the standard deviation of ROA. Three years rolling windows is used to estimate the standard deviation of ROA on the Z-Score formula. Therefore, a bank with a high Z-Score indicates that the bank has high stability and vice versa.

In computing the Z-Score, many previous studies using the country level Z-Score that published by the World Bank (see, for example, Phan et al., 2020). However, this study does not use the World Bank database because the frequency of Z-Score in the database is a yearly score, while the study needs a monthly score. Therefore, we calculate the Z-Score estimation in two stages. First, we estimate Z-Score at the bank level each month. Second, we estimate country or aggregate level Z-Score each month using the value-weighted approach in which the banks’ total asset is used as the basis for weighting. For this purpose, the data is obtained from the Indonesia Financial Services Authority (OJK) and DataStream.

Data and Measurement for Other Variables

In addition to the previously explained main variables, several control variables are included in the equation. The variables include Consumer Confidence Index (CCI), inflation (INF), growth of money supply (MS G), money market rate (MMR), size of Islamic banks (SIZE IB) dummy variables. According to OECD, CCI provide an indication of future developments of households’ consumption and saving. An increase in CCI can be a signal of improving household’s spending. Therefore, our studies can expect CCI can explain household’s spending behaviour, especially when using digital payment. Next, Following Fazio et al. (2015), this study includes Inflation (INF) as control variable because it represents price stability in the economy. Indeed, in Indonesia, the Central Bank also use Inflation Targeting Framework (ITF) as its monetary framework. Money supply growth (MS G) and money market rate (MMR) are also included as control variables since the Central Bank of Indonesia use both indicators as monetary tools.

To represent the dual banking system economy, this study includes Islamic banking size in the empirical model. The total asset of Islamic banking industry is included as control variable to examine the effect of Islamic banking’s presence on the banking stability, considering that Indonesia had adopted a dual banking system since 1991. In addition, this study includes two dummy variables in the empirical model, namely dummy variable to represent issuance of relevant banking regulation and covid-19 pandemic. The regulation dummy variable is incorporated to capture the regulation on digitalization on the financial industry, which can have direct and indirect influence on the digital payment usage. Meanwhile, the Covid-19 pandemic dummy is added as it has been known that there are several regulations issued by Indonesia Financial Authority to strengthen banking sector since March 2020, after the first case of Covid-19 in Indonesia. Therefore, our study uses dummy banking regulation and covid-19 pandemic. Table 2 summarizes the definition and sources for each variable.

3.1.1. Empirical model

To examine the relationship between digital payment and financial system stability, the two variables are the main variables of interest in this study. As explained earlier, the digital payment transaction is

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1 https://www.bi.go.id/en/fungsi-utama/moneter/inflasi/default.aspx.
2 https://data.oecd.org/leadind/consumer-confidence-index-cci.htm.
3 https://www.bis.go.id/en/fungsi-utama/moneter/inflasi/default.aspx.
4 https://www.bis.go.id/en/fungsi-utama/moneter/default.aspx.
proxied by payment penetration ratio (PPR), meanwhile financial stability is proxied by the value of Z-Score for the Indonesian banking industry.

In determining the most appropriate model, it is notable that banking stability and penetration of digital payments in Indonesia might have endogeneity problems. This is primarily due to the regulation issued by the authority, in which all-digital payment transactions (i.e., through bank or non-banks financial institutions) should go through the banking system. As such, this study uses Vector Autoregressive (VAR) as its empirical model. As suggested in various literature, the use of VAR model is expected to solve such an endogeneity problem (Brooks, 2008). Furthermore, there is a possibility that banking stability has a long-term equilibrium with digital payment penetration ratio due to the above-mentioned regulation. Therefore, this study employs the Johansen Cointegration Test to identify the existence of a long-term equilibrium between banking stability and digital payment penetration ratio. If the long-term equilibrium occurs, the Vector Error Correction Model (VECM) will be used. On the other hand, if no cointegration relationship is found, Vector Autoregression (VAR) will be used (Brooks, 2008). Additionally, furthermore, this study also employs the Granger Causality test to identify the direction of the relationship between banking stability and digital payment penetration ratio. Several standard procedures in the time series model, such as the stationarity test and another test, are also used in this study (Brooks, 2008).

Based on the literature and considerations above, the VAR equation used in this study is as follows:

\[ Z - \text{Score}_t = \beta_0 + \sum_{k=1}^{p} \beta_k Z - \text{Score}_{t-k} + \sum_{k=1}^{q} \alpha_k \Delta \text{PPR}_{t-k} + M_{Ct} + \text{SIZE}_{IB} + \text{d}_{\text{reg}} + \text{d}_{\text{covid}} + u_t \]

### Table 1. The development of digital payment providers in Indonesia.

| Launch year | Pre-2000 | 2006 | 2008 | 2010 | 2012 | 2014 | 2016 | 2018 | 2020 |
|-------------|----------|------|------|------|------|------|------|------|------|
| Cash on delivery | Kaskus Internet forum – meet & pay to sellers | COD supported by 3PL | | | | | | | |
| Bank | Klik BCA E-banking (desktop access) | Internet Banking BRI Mobile App BCA Mobile | RCA KlikPay Mandiri ClickPay By OTP/PIN token | Direct debit OneClick BCA JeniusPay | | | | | |
| Payment gateway | AINO DOKU midtrans xendit | | | | | | | | |
| BNPL | | | | | | | | | |
| Ewallet | uangku Gopay t-cash Ovo Dana | | Ceria, PayLater, Shopee Pay | | | | | | |
| Regulations | Regulation about electronic money Bibili Bukalapak Lazada Shopee | Regulation about digital lending platforms National Payment Gateway (GPN) | Universal QR Code | | | | | | |
| Ecommerce | Tokopedia | | | | | | | | |

Source: Blooming Ecommerce in Indonesia Part 2.1: Ecosystem – Payment (2021); Notes: BNPL = Buy Now Pay Later

### Table 2. Variable definitions and data sources.

| Variable | Definition | Source |
|----------|------------|--------|
| Payment Penetration Ratio | Digital payment transaction to GDP | Bank Indonesia |
| Z-Score | Banking stability | Author calculation |
| Consumer Confident Index | Index that measures how optimistic or pessimistic consumers are regarding their expected financial situation | Bank Indonesia |
| Money Supply Growth | Change in the quantity of money supply | Bank Indonesia |
| Inflation | The increase of an average price level in the economy (Yoy) | Bank Indonesia |
| Money Market Rate | Market interest rate of money market instrument that reflect the condition of short-term financial market in Indonesia | Bank Indonesia |
| IB Asset Size | Size of the Islamic banking asset in Indonesia | Otoritas Jasa Keuangan |
| Dummy Covid | Dummy for period that experienced Covid-19 pandemic | Author calculation |
| Dummy Regulation | Dummy for period after the regulator issued regulation related to digital payment | Author calculation |

### Table 3. Descriptive statistics.

| Variable | N | Mean | Median | St. Dev | Min | Max |
|----------|---|------|--------|--------|-----|-----|
| Z-Score | 92 | 214.18 | 132.70 | 29.02 | 5.275 | 214.32 |
| Payment Penetration Ratio (PPR) | 92 | 0.16% | 0.03% | 0.01% | 0.053 | 0.58% |
| Payment Penetration Ratio Float (PPR_Float) | 92 | 0.08% | 0.04% | 0.01% | 0.005 | 0.25% |
| Money Supply Growth (MS_G) | 92 | 0.009 | 0.012 | 0.029 | 0.000 | 0.056 |
| Money market rate (MMR) | 92 | 0.053 | 0.054 | 0.009 | 0.000 | 0.069 |
| Inflation (INF) | 92 | 0.293 | 0.220 | 0.399 | 0.000 | 2.460 |
| Consumer Confidence Index (CCI) | 92 | 113.685 | 116.882 | 12.740 | 77.803 | 128.166 |
| Dummy Covid-19 (d_covid) | 90 | 0.156 | 0.000 | 0.364 | 0.000 | 1.000 |
| Dummy Regulation (d_reg) | 90 | 0.411 | 0.000 | 0.495 | 0.000 | 1.000 |
| Total Asset Islamic Bank (size_IB) | 90 | 5.431 | 5.436 | 0.099 | 5.275 | 5.607 |
| Z-Score Islamic banks (zscore_IB) | 90 | 44.472 | 34.283 | 41.501 | 2.718 | 214.326 |

Notes: Z-Score = banking stability.
ΔPPRt = β10 + \sum_{k=1}^{T} β2k ΔPPRt-k + \sum_{k=1}^{T} \alpha2k Z - Scoret-k + MCt + SIZE_IBt + d_regt + d_covidt + ut

where Z-Score is banking stability, ΔPPRt is the difference of the Payment Penetration Ratio, SIZE_IB is the size of Indonesian Islamic banks, MCt is macro-economic factors, D_REG is dummy regulation (1 starting from May 2018 onwards, 0 otherwise) and D_COV is dummy covid-19 pandemic (1 starting from March 2020 onwards, 0 otherwise). Furthermore, MC includes Consumer Confidence Index (CCI), inflation (INF), growth of money supply (MS_G), and money market rate (MMR).

### 4. Findings and analysis

#### 4.1. Descriptive statistics

Table 3 presents the descriptive statistics for all variables used in this study. From December 2013 to July 2021, it is shown that the banking stability in Indonesia is relatively good, with average and median values of 214.18 and 132.70, respectively. However, during the Covid-19 pandemic, the banking stability in Indonesia experienced a significant
decrease (see also: Figure 1). However, it is also shown that Indonesia’s payment penetration ratio (PPR) is relatively low at 0.16%. This result implies that cash transaction still dominated the economic activities in the country during the period. Nevertheless, if we look at a longer trend (see: Figure 2), the payment penetration ratio in Indonesia experienced a significant increase since 2018. This trend is presumably related to the issuance of Bank Indonesia regulation regarding electronic money in May 2018, resulting in various providers offering digital payment services for the customers.

Figure 2 also shows that an increase in digital payment transactions also increases the float fund kept in the banking system. Float fund (dana float) is a reserve fund required by the Central Bank of Indonesia from all-digital payment service providers as reserve funds for their electronic transactions in the five biggest banks in Indonesia (Bank Indonesia, 2018). However, the pandemic has made the digital payment penetration faced a decrease for two months, i.e., from April to May 2020. Nevertheless, it has been experiencing a significant increase afterwards.

Further examination on the correlation between the digital payment penetration and the Indonesian Consumer Confidence Index result in a positive correlation of 0.82, suggesting that Indonesian consumers have a high dependency on digital payment. Figure 4 also depicts a shift in Indonesian consumer behaviour in shopping, from using cash transactions into electronic money.

4.2. Stationarity and cointegration test

Figures 1 and 2 presented earlier indicate that the Z-Score and PPR variables are not stationary. Hence, this study conducts stationarity and cointegration tests before estimating the VAR model. Table 4 shows the results of the unit root test by using Augmented Dickey-Fuller (ADF) test.
It shows that Z-Score and PPR are not stationary in the level, but stationary at the first difference or I(1).

Figures 2 and 3 above also indicate the possibility of a structural break in the payment penetration ratio in Indonesia. Meanwhile, Figure 4 indicates that PPR experienced a structural break in February 2019 due to a significant change compared to the previous period. Therefore, this study also conducts a breakpoint unit root test for the PPR variable to check the existence of structure break on the digital payment in Indonesia using Dickey-Fuller t-statistics. The result shows that the massive use of digital payment in Indonesia had started even before the pandemic emerged in early 2020. However, the pandemic has created momentum for the acceleration of digital payment as travel and mobility restrictions have forced consumers to do their transactions digitally rather than paying their shopping directly in cash.

The result for the stationarity test in Table 4 and Figure 4 presents that both main variables are stationary at the first difference or I(1).

### Table 5. Johansen cointegration test.

| Ho | λmax Statistics | 5% Critical Value |
|----|----------------|-------------------|
|    | Without Control Variable | With Control Variable |
| r = 0 | 31.441 | 28.364 | 15.495 |
| r ≤ 1 | 0.845 | 0.404 | 3.841 |

It indicates that PPR experienced a structural break in February 2019 due to a significant change compared to the previous period. Therefore, this study also conducts a breakpoint unit root test for the PPR variable to check the existence of structure break on the digital payment in Indonesia using Dickey-Fuller t-statistics. The result shows that the massive use of digital payment in Indonesia had started even before the pandemic emerged in early 2020. However, the pandemic has created momentum for the acceleration of digital payment as travel and mobility restrictions have forced consumers to do their transactions digitally rather than paying their shopping directly in cash.

The result for the stationarity test in Table 4 and Figure 4 presents that both main variables are stationary at the first difference or I(1).

### Table 6. Short-run and long-run relationships between PPR and Z-score.

| Without Control Variable | D (PPR) (I) | D (ZSCORE) (II) | With Control Variables | D (PPR) (III) | D (ZSCORE) (IV) |
|--------------------------|-------------|-----------------|------------------------|--------------|----------------|
| **Error Component**      | 0.035       | **-370.781***   | 0.002                  | -249.937***  |
|                          | (2.291)     | (-5.127)        | (0.194)                | (-4.467)     |
| **D(PPR(-1))**           | -0.029      | 507.463         | -0.359                 | 45.263       |
|                          | (-2.183)    | (0.826)         | (-2.864)               | (0.074)      |
| **D(PPR(-2))**           | -0.141      | 1371.368        | -0.226                 | 630.963      |
|                          | (-1.097)    | (2.217)         | (-1.769)               | (1.01)       |
| **D(PPR(-3))**           | -0.106      | 2886.666        | -0.123                 | 2222.263***  |
|                          | (-0.794)    | (4.502)         | (-0.922)               | (3.406)      |
| **D(PPR(-4))**           | -0.016      | 3633.758        | -0.077                 | 3282.155***  |
|                          | (-0.109)    | (5.03)          | (-0.522)               | (4.521)      |
| **D(PPR(-5))**           | -0.078      | 3795.386        | -0.124                 | 3620.92***   |
|                          | (-0.47)     | (4.784)         | (-0.755)               | (4.51)       |
| **D(PPR(-6))**           | 0.01        | 1010.045        | 0.037                  | 907.986      |
|                          | (0.062)     | (1.249)         | (0.218)                | (1.102)      |
| **D(ZSCORE1(-1))**       | 6.44E-06    | 9.66E-02        | 2.03E-05               | 1.34E-01     |
|                          | (0.327)     | (1.02)          | (0.932)                | (1.255)      |
| **D(ZSCORE1(-2))**       | 2.36E-05    | **-307E-01***   | 4.27E-05               | 2.51E-01**   |
|                          | (1.217)     | (-3.292)        | (2.082)                | (2.503)      |
| **D(ZSCORE1(-3))**       | 4.46E-07    | 1.10E-01        | 1.68E-05               | 1.09E-01     |
|                          | (0.022)     | (1.122)         | (0.766)                | (1.021)      |
| **D(ZSCORE1(-4))**       | 7.37E-07    | **-938E-02***   | 8.72E-06               | 3.40E-02**   |
|                          | (0.041)     | (-1.084)        | (0.444)                | (0.354)      |
| **D(ZSCORE1(-5))**       | 6.05E-06    | **-172E-01**    | 9.42E-06               | 1.98E-01**   |
|                          | (0.365)     | (-2.161)        | (0.519)                | (2.227)      |
| **D(ZSCORE1(-6))**       | -1.38E-05   | **-140E-01**    | **-4.11E-06**          | **-1.38E-01**|
|                          | (-0.807)    | (-1.698)        | (0.224)                | (1.536)      |
| **D_COV**                | 4.00E-02    | 4.29E-01        | (1.598)                | (0.35)       |
| **CCI**                  | 1.04E-03    | * 2.45E-09      | (2.005)                | (0.963)      |
| **INF**                  | 4.21E-03    | -1.50E-01       | (0.591)                | (0.431)      |
| **MS_G**                 | 1.43E-02    | **-9.01E-02**   | (0.154)                | (1.99)       |
| **MMR**                  | 1.38E-01    | 3.95E-03        | (0.314)                | (1.838)      |
| **D_REG**                | 1.69E-02    | * -7.96E-01     | (1.745)                | (1.68)       |
| **Size_IB**              | -2.94E-02   | 5.61E-02***     | (-0.875)               | (3.41)       |

Notes: ***, **, * denote significant at 1%, 5%, and 10% respectively; t-statistics are in parentheses.
Hence, the cointegration test should be conducted to identify the existence of a long-term relationship between both variables.

Table 5 shows the result for the cointegration test using the Johansen test, in which one cointegrating vector was found. Hence, this study will have a maximum of one cointegrating vector between Z-Score and PPR, whether including control variables (dummy Covid-19 and PPR) or not. The result shows a consistent long-term relationship between banking stability and payment penetration ratio in Indonesia.

4.3. Estimation results

Following the previous results, this section explains the estimation results for the relationship between banking stability and payment penetration ratio in Indonesia. Table 6 presents the results for Vector Error Cointegrating Model (VECM) showing the short-run and long-run relationships between PPR and Z-Score, by including control variables and without it. The control variables included in the model are Confidence Index (CCI), inflation (INF), growth of money supply (MS_G), money market rate (MMR), the dummy variable for the establishment of electronic money regulation (dummy regulation), dummy variable for Covid (dummy covid), consumer and size of Islamic banks in Indonesia (Size IB). It should also be noted that both models include six lags for the Z-Score and PPR variables, as suggested by the results of the lag order selection tests.

The result shows a one-way direction between Z-score and payment penetration ratio, as shown by the chi-squared value of the Granger Causality test. Thus, the relationship goes from the payment penetration ratio affecting Z-score, consistent for both models without and with control variables. This result is confirmed by the coefficients of the error component for the relationship when Z-score is the dependent variable, showing negative and significant coefficients as expected from a cointegrating equation. This result implies that the coefficient will be the correction factor for the payment penetration ratio and Z-score in achieving a long-run equilibrium.

In identifying the short-run relationship between the dependent and the control variables, Table 6 depicts that when payment penetration ratio (PPR) acts as the dependent variable, it is only affected by its own lag in the first period for the model without control variable. When the control variables are included, PPR is affected by its own lag for two periods, second lag of Z-score, Consumer Confidence Index (CCI), and Dummy Regulation. On the other hand, when Z-score acts as the dependent variable, it is affected by its lags and lag value of PPR. The results imply a short-run relationship between PPR and Z-score. The coefficient has a positive sign, indicating that an increase in PPR can increase Z-score. However, the effect occurs at least in the next two months for models without control variables and three months for those with control variables (see: columns II and IV, respectively). As for the control variables, column IV in Table 6 shows that the growth of money supply (MS_G) negatively correlates with Z-score. In contrast, the money market rate (MMR) and total asset of Islamic bank (Size IB) has a positive relationship with Z-score.

To further examine the effect of digital payment on banking stability, this study also employs Z-Score specific for the Islamic banking industry in Indonesia. Table 7 presents the results, showing the cointegrating equation for one lag of PPR and Z-Score. However, both variables do not Granger Cause each other, whether it is a one-way or two-way causal relationship for both models without and with control variables (see: Granger Causality test at the bottom of Table 7). It is further confirmed by the sign and significance of error correction coefficients for all models, showing that they are not significant, except for Column IV in Table 7. However, the result also shows that there is no other variable affecting Z-Score in Column IV. This result might be influenced by the relatively low proportion of Islamic banks in the Indonesia banking industry, which is currently at around 6% (Otoritas Jasa Keuangan, 2022). Thus, the

| Table 7. Short-run and long-run relationship for islamic banking stability. |

| Without Control Variable | With Control Variable |
|--------------------------|-----------------------|
|                          | D (PPR) (I) D (ZSCORE) (II) | D (PPR) (III) D (ZSCORE) (IV) |
| **Error Component**      |                      |                          |
| D (PPR(-1))              | -0.178               | -0.231 **               |
| (1.637)                  | (0.936)              | (2.142 (1.1)           |
| D (ZSCORE, IB(-1))      | -0.000006            | 0.00004                 |
| (-0.062)                 | (-0.766)             | (0.444)                 |
| D_COV                    | 0.046 **             | 0.046 **                |
| (2.097)                  | (0.537)              | (0.927)                 |
| CCI                      | 0.001 **             | 0.001 **                |
| (2.371)                  | (0.953)              | (0.953)                 |
| INF                      | 0.00002              | 0.00002                 |
| (0.002)                  | (0.193)              | (0.193)                 |
| MS_G                     | 0.041                | 0.041                   |
| (0.483)                  | (0.032)              | (0.032)                 |
| MMR                      | 0.392                | 0.392                   |
| (6.093)                  | (1.11)               | (1.11)                  |
| D_REG                    | 0.008                | 0.008                   |
| (1.165)                  | (0.719)              | (0.719)                 |
| Size IB                  | -0.025 **            | 0.913 **                |
| (-2.125)                 | (0.067)              | (0.067)                 |
| R-Squared                | 0.048                | 0.023                   |
| (0.164)                  | 0.133                |
| Adj. R-Squared           | 0.026                | 0.00047                 |
| 0.067                    | 0.032                |
| F-statistic              | 2.164                | 1.02                    |
| 1.696                    | 1.325                |
| Granger Causality Test (chi-sq) | 0.004 | 0.876 | 0.197 | 1.209 |

Notes: ***, **, * denote significant at 1%, 5%, and 10% respectively; t-statistics are in parentheses.
increased usage of digital payment does not have a direct relationship with the Islamic banking industry separately. In other words, the effect has already accounted in the Z-Score for the entire banking industry.

As for the control variables, Table 7 shows that only the model in Column III presents that the Consumer Confidence Index (CCI) and dummy variable of electronic money regulation introduced in 2018 positively correlate with payment penetration ratio (PPR).

The results of this study are aligned with the study conducted by Berger (2003) and Zhang et al. (2019). The studies found that the advancement of technology in the financial sector can increase productivity, especially in the retail sector, as it was empirically proved that higher payment penetration is related to higher GDP, trade, consumption, and tax revenue. The study’s findings are also consistent with Hasan et al. (2012) suggesting that advanced retail payment contributes positively to banking performance; thus, increasing the number of electronic payment support banking businesses in terms of profitability and efficiency leading to strengthening the stability.

Moreover, Neanidis (2019) explains that policy issued by banking regulators is expected to maintain financial stability and long-run economic growth. It supports the study’s empirical results suggested that digital payment and banking stability has a long-run relationship. Further, the positive short-run relationship coefficient between PPR and Z-Score indicates that the banking sector is actually being advantaged by digital payment. This is presumably due to the increase of fee-based income generated from the digital transactions. However, the effect on banking stability would not be as high as in the short run, considering the infrastructure investment that banking sector needs to provide for further developing the digitalization in its business. Hence, there is a need for the regulators to provide incentives for banking sector for them to develop the digital infrastructure.

4.4. Robustness check

To ensure robustness of the findings, this study conducts a robustness check for the estimation results by employing an Autoregressive Distributed Lag (ARDL) model. Table 8 presents the results for ARDL estimation, in which Columns I and II employ Z-Score from the whole banking industry. At the same time, Columns III and IV use Z-Score from the Islamic banking industry. Looking at the model fit, the model using Z-Score for the Islamic banking industry does not provide a fit estimation. This result is aligned with the results in Table 6, in which there is no Granger Causality between PPR and Z-Score for Islamic banks. On the other hand, the results are better when employing Z-Score of the whole banking industry, although Column I show that the first lag of D (PPR) is the only significant variable affecting the D (PPR). Column II presents that lag of D (PPR) do have a relationship with D (SCORE), that is aligned with the results in Table 6.

| Table 8. ARDL results. |
|-------------------------|
| **Z-Score Banking**     |
| D (PPR) | D (ZSCORE) |
| **(I)** | **(II)** |
| D(PPR) | 332.785  |
| (0.520) |          |
| D(PPR(-1)) | -0.155 ** |
| (-1.430) |          |
| D(PPR(-2)) | 86.402 |
| (0.132) |          |
| D(PPR(-3)) | 1570.752 ** |
| (2.384) |          |
| D(PPR(-4)) | 1514.206 ** |
| (2.242) |          |
| D(PPR(-5)) | 1405.108 * |
| (1.982) |          |
| D(PPR(-6)) | -1672.029 ** |
| (-2.184) |          |
| D(PPR(-7)) | -1916.071 ** |
| (-2.491) |          |
| D(ZSCORE1) | 4.68E-06 |
| (0.772) |          |
| D(ZSCORE1(-1)) | 1.40E-05 *** |
| (0.349) |          |
| D(ZSCORE1(-2)) | 2.67E-05 |
| (0.091) |          |
| D(ZSCORE1(-3)) | -0.065 |
| (-1.084) |          |
| D(ZSCORE1(-4)) | -1.72E-01 ** |
| (-2.161) |          |
| D(ZSCORE1(-5)) | -1.40E-01 * |
| (-1.698) |          |
| Constant | 0.0074 *** |
| (2.961) |          |
| R-Squared | 0.067 |
| (0.384) |          |
| Adj R-Squared | 0.021 |
| (0.266) |          |
| F-Stat | 1.47 |
| (3.261) |          |

| **Z-Score Islamic Banking** |
| D (PPR) | D (ZSCORE) |
| **(III)** | **(IV)** |
| D(PPR) | -48.810 |
| (-0.401) |          |
| D(PPR(-1)) | -0.133 |
| (-1.230) |          |
| D(PPR(-2)) | 86.402 |
| (0.132) |          |
| D(PPR(-3)) | 1570.752 ** |
| (2.384) |          |
| D(PPR(-4)) | 1514.206 ** |
| (2.242) |          |
| D(PPR(-5)) | 1405.108 * |
| (1.982) |          |
| D(PPR(-6)) | -1672.029 ** |
| (-2.184) |          |
| D(PPR(-7)) | -1916.071 ** |
| (-2.491) |          |
| D(ZSCORE1) | -3.29E-05 |
| (0.846) |          |
| D(ZSCORE1(-1)) | -0.320 *** |
| (-2.922) |          |
| D(ZSCORE1(-2)) | 0.160 |
| (0.091) |          |
| D(ZSCORE1(-3)) | -0.065 |
| (-1.084) |          |
| D(ZSCORE1(-4)) | -1.72E-01 ** |
| (-2.161) |          |
| D(ZSCORE1(-5)) | -1.40E-01 * |
| (-1.698) |          |
| Constant | 0.0077 *** |
| (2.837) |          |
| R-Squared | 0.067 |
| (0.384) |          |
| Adj R-Squared | 0.021 |
| (0.266) |          |
| F-Stat | 1.47 |
| (3.261) |          |

Notes: ***, **, * denote significant at 1%, 5%, and 10% respectively; t-statistics are in parentheses.
5. Conclusions, recommendations and limitations of study

Previous studies generally suggested that digital payment systems could improve banking services and boost economic activities. However, limited conclusions have been reached on the relationship between digital payment and financial stability, particularly in an emerging economy with a dual banking system like Indonesia. Therefore, this study aims to examine the impact of digital payment transactions on financial stability in Indonesia which is the third largest emerging market globally and at the same time implementing a unique dual banking system in its economy. In particular, it aims to determine how the increase in digital-based retail payment transactions affects banking system stability in the country.

This study uses a quantitative research method with Vector Error Correction Model (VECM) and Vector Autoregressive (VAR) models to achieve the research objectives. It also conducts a robustness check using Autoregressive Distributed Lag (ARDL) model. The digital payment transaction is proxied by the payment penetration ratio. Meanwhile, financial stability is proxied by the value of Z-Score for the Indonesian banking industry. In addition, several control variables are included, including inflation, consumer confidence index, money market rate, growth of money supply, dummy variable of Covid-19, dummy variable of electronic money regulation, and size of Islamic banks. In terms of data, this study employs publicly available data from the Central Bank of Indonesia, Financial Services Authority (OJK), and Datostream. The data utilised are monthly data from January 2013 to July 2021.

The study found a cointegrating relationship between payment penetration ratio and Z-Score, suggesting that the digital payment transactions have a long-run relationship or equilibrium with financial stability. Further examination using the Granger Causality test shows one-direction causality from D (PPR) to D (Z-Score), implying that digital payment transactions affect banking stability, but not the other way around. The short-run relationship also shows a positive relationship between digital payment and banking stability with negative value of coefficient for the error component. These results suggest that the banking sector can benefit, both in terms of revenue and stability of the revenue, from the increase of digital payment in the short run, particularly due to the regulation of float funds which enable banks to have a higher fee-based income from the digital payment transactions. However, this positive effect on banking stability might not stay in the long run, as banks need to invest in infrastructure for accommodating the digital transactions, spending higher cost, to compete with the digital transactions that are also provided by fintech companies.

In relation to Islamic banking, the finding shows that there is no Granger Causality between digital payment and Islamic banking stability. This result implies that currently there is no causality between digitalisation and Islamic banking stability. It is argued that this result is primarily due to the relatively small size of Islamic banking in the whole banking industry in Indonesia now. Nevertheless, it is expected that the impact will be bigger in the future as Islamic banks start to have digital banking operations very soon and gain strong supports from government, particularly post-Covid period.

Overall, the finding of this paper is in line with the academic literature view that digital payment adds value to economic system. In contrast to the view of Beck et al. (2016), which point out the negative impact of innovation to bank performance and fragility, the main contribution of this paper enhances the literature by confirming that the development in digital payment penetration improve financial stability both in the short-run and in the long-run. This result supports the finding of Hasan and Dridi (2010) suggested that better retail payment leads to improved banking performance, even in the stage of development. Nevertheless, the result from VECM also suggest that the coefficient of error component would correct the short-run relationship gradually in the long-run. We translate this result as an effect of early investment stage, where the noise can distort the positive contribution that the increasing digital payment penetration have on financial stability. In the long run, a developed digital payment system is still forecasted to have positive contribution to financial stability as long as the barriers could be removed.

The study’s findings also offer practical insights for policymakers and authorities overseeing payment system in an emerging market economy, particularly those adopting a dual banking system, that the current development of digital (retail) payment does not harm banking stability. The ‘noise’ to financial stability, as a result of digital penetration, was higher in the short-run than in the long-run. Hence, there are need to be a protective measure in the short run, on top of accommodative policy measure adopted, to maintain and support development. This can be done in the form of incentive, such as tax deduction, for financial institution to invest in digital payment penetration to compensate for decreasing financial stability as result of lower marginal income in the short-run compared to long-run. In addition to short-term incentive, pro-payment digitalisation policy must be set in place to ensure that infrastructure investment is encouraged and accommodated, unequal opportunity is shedded, and channel development is pushed forward beyond volume and scale.

In more practical sense, the result of this study also pointed out the importance of lean and efficient business model with given its low marginal income level in the early stage compared to the previous stage. This is especially crucial for low capitalised initiative; hence, regulator can be stricter to the assessment for licensing. Furthermore, barrier to entry for digital payment penetration has to be eliminated to ensure that the development process can take place in enabling environment. This covers costs of admission to other potential hindering condition to place and to manage fund for payment.

This study is limited by several conditions attached to the research construct. Firstly, the time frame of the analysis is only conducted for seven years over monthly data due to the recent use of the electronic payment, resulting in the data availability. It will be interesting to observe the result over a longer time frame. Secondly, the banking competition issue was not explored in great detail. As Indonesia has a high banking concentration landscape, the competition issue will also determine the outcome of the analysis of digital penetration and financial stability. Thirdly, this study is conducted in Indonesia, which currently still has a low Islamic banking penetration. A similar analysis for countries with higher Islamic banking penetration, or perhaps a comparison of countries with different levels of Islamic banking share, can shed some light on how Islamic banking differs from the conventional bank in terms of its contribution to financial stability within the issue of digital payment penetration and development.

Declarations

Author contribution statement

Rahmatina Awallah Kasri; Banjaran Surya Indrastomo: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.
Nur Dhami Hendranastiti; Muhammad Budi Prasetyo: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data associated with this study has been deposited at Bank Indonesia (www.bi.go.id); OJK (https://www.ojk.go.id/en/default.aspx); DataStream.
Declaration of interest’s statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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