ANALYSIS OF VALUATION DETERMINANTS OF COMMERCIAL BANKS WITH DIGITAL SERVICES IN INDONESIA

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ABSTRACT

Purpose: The purpose of the research is to analyze the differences in bank price-to-book value based on the level of digitalization and to explore the influence of digitalization and financial factors on the price-to-book value of banks with digital services.

Theoretical Framework: The theoretical framework likely encompasses theories related to digital transformation, financial performance metrics (such as price-to-book value, fee income, return on equity), and possibly theories related to banking and digital services adoption.

Method: The research methodology involves statistical tests and Panel Data Regressions. Data from 24 banks covering the period from 2019 to 2022 are utilized.

Result and Conclusion: The analysis reveals that higher levels of digitalization are associated with improved contributions of fee income, return on equity, and price to the bank's book value. Additionally, the level of digitalization strengthens return on equity, improves non-performing loans (NPL), and enhances capital utilization, all of which significantly influence price-to-book value.

Originality/Value: The novelty of this study lies in its focus on using the price-to-book value (PBV) of commercial banks with digital services as a metric linked to digital transformation, which is distinct from previous research primarily focused on digital banks' profitability. This shift in focus allows for a deeper understanding of the impact of digitalization on bank value.

Keywords: Bank Transformation, Digital Services, Price to Book Value, Panel Data Regressions.

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Resultado e Conclusão: A análise revela que níveis mais altos de digitalização estão associados a melhores contribuições de receita de tarifas, retorno sobre o patrimônio líquido e preço para o valor contábil do banco. Além disso, o nível de digitalização fortalece o retorno sobre o patrimônio líquido, melhora os empréstimos inadimplentes (NPL) e aprimora a utilização do capital, e tudo isso influencia significativamente o preço em relação ao valor contábil.

Originalidade/Valor: A novidade deste estudo está em seu foco no uso do valor price-to-book (PBV) de bancos comerciais com serviços digitais como uma métrica ligada à transformação digital, o que é diferente de pesquisas anteriores que se concentraram principalmente na lucratividade dos bancos digitais. Essa mudança de foco permite uma compreensão mais profunda do impacto da digitalização no valor do banco.


ANÁLISIS DE LOS FACTORES DETERMINANTES DE LA VALORACIÓN DE LOS BANCOS COMERCIALES CON SERVICIOS DIGITALES EN INDONESIA

RESUMEN

Propósito: El propósito de la investigación es analizar las diferencias en el valor precio-valor contable de los bancos en función del nivel de digitalización y explorar la influencia de la digitalización y los factores financieros en el valor precio-valor contable de los bancos con servicios digitales.

Marco Teórico: El marco teórico probablemente abarque teorías relacionadas con la transformación digital, métricas de rendimiento financiero (como el valor precio-valor contable, los ingresos por comisiones, el rendimiento del capital) y, posiblemente, teorías relacionadas con la banca y la adopción de servicios digitales.

Método: La metodología de investigación incluye pruebas estadísticas y regresiones de datos de panel. Se utilizan datos de 24 bancos que cubren el período de 2019 a 2022.

Resultados y Conclusiones: El análisis revela que los mayores niveles de digitalización se asocian con mejores contribuciones de los ingresos por comisiones, el rendimiento del capital y el precio al valor contable del banco. Además, el nivel de digitalización refuerza la rentabilidad de los fondos propios, mejora la morosidad y mejora la utilización del capital, todo lo cual influye significativamente en la relación precio-valor contable.

Originalidad/Valor: La novedad de este estudio radica en su enfoque en el uso del valor precio-valor en libros (PBV) de los bancos comerciales con servicios digitales como una métrica vinculada a la transformación digital, que es diferente de la investigación anterior centrada principalmente en la rentabilidad de los bancos digitales. Este cambio de enfoque permite una comprensión más profunda del impacto de la digitalización en el valor de los bancos.

Palabras clave: Transformación Bancaria, Servicios Digitales, Precio a Valor Contable, Regresiones de Datos de Panel.

INTRODUCTION

Technological advances that have been taking place since the 21st century are moving increasingly rapidly, changing various aspects of human life and activities. Starting from the way humans interact, communicate, access information, make decisions, and carry out transactions, it is much different compared to what happened in the 19th or even 20th centuries.
Work processes in various economic sectors, which previously reached the level of mechanization and industrialization, have changed dramatically with advances in technology and digitalization.

The work process centered on digitalization, facilitated by information technology, has enabled the birth of new business models that are different from "traditional" business models (Saebah & Asikin, 2022; Fauzi, 2023). The new business model is a digital business model – where the services and services provided have additional-value-proposition which is uniquely digital, namely: it can be accessed anytime and anywhere by people who need it (Syamsu & Endri, 2022). In addition, the delivery time of services and services (delivery-time) in the digital business model is faster and the prices offered are relatively cheaper due to operational process efficiency. Succinctly, additional-value-proposition digital business models are: cheaper access, globalized, easy to use and multiplier effects – which becomes becomes competitive advantage this business model compared to the “traditional” business model (Asikin & Fadilah, 2024). This has meant that various sectors, not only banking but also trade, including MSMEs, have utilized and carried out digital transformation (Fauzi et al., 2023).

Research conducted by Rhys Grossman in 2016 as published in the Harvard Business Review as in Figure 1 shows that the telecommunications industry and financial services (including banks) are at the highest level of disruption with the presence of the following digital business models:

### Figure 1

*Survey digitalization disruption*

<table>
<thead>
<tr>
<th>Business Sector</th>
<th>Disruption Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Media</td>
<td>72%</td>
</tr>
<tr>
<td>Telecom</td>
<td>64%</td>
</tr>
<tr>
<td>Consumer Financial Services</td>
<td>61%</td>
</tr>
<tr>
<td>Retail</td>
<td>57%</td>
</tr>
<tr>
<td>Technology</td>
<td>57%</td>
</tr>
<tr>
<td>Insurance</td>
<td>53%</td>
</tr>
<tr>
<td>Consumer Products</td>
<td>52%</td>
</tr>
<tr>
<td>Non Profit</td>
<td>52%</td>
</tr>
<tr>
<td>Buss &amp; Professional Services</td>
<td>51%</td>
</tr>
<tr>
<td>Education</td>
<td>50%</td>
</tr>
<tr>
<td>Health Care</td>
<td>47%</td>
</tr>
<tr>
<td>Asset WM</td>
<td>43%</td>
</tr>
<tr>
<td>Industrial</td>
<td>39%</td>
</tr>
</tbody>
</table>

The strategy adopted by banks in Indonesia in facing digital technology disruption is to enhance above electronic channel which already exists as in Figure 2. A survey conducted by PwC on the management (C-level) of banks in Indonesia shows this.

**Figure 2**

*Components of a bank’s digitalization strategy*

Mobile banking become a top component of the bank’s transformation strategy and become a marker for banks with digital services. Penetration smartphone which is rapidly making customers more accustomed and familiar with using digital features and menus. In addition, the increasing trend of shopping through e-commerce become a catalyst for development mobile banking so that banking remains relevant to market dynamics and developments and can serve customer transaction needs on various digital shopping channels. Sharia banking also does the same thing, namely by increasing the capabilities mobile banking that is owned by order compatible with various other transaction platforms as well e-commerce. Several commercial banks in Indonesia, both conventional banks and sharia banks, are good private bank nor go public bank, have had mobile banking with capabilities digital on-boarding, biometric and digital analytic. The adoption of digital technology at each bank has different conditions so that there are varying levels of transformation of digital banking services in Indonesia.

Besides mobile banking as the main component of digital banking transformation, banks must at least focus on specific digital factors in several aspects simultaneously. First the bank must optimize data analytic in all aspects, starting from product development, services and operations. Next the bank needs to build customer experience integrated and specific for each segment. In the marketing and communication aspect, banks need to build a strong team so they can compete with digital marketing which is done bye-commerce. Furthermore, banks need to adapt a more concise organizational structure, to accommodate a more effective and efficient
workflow so that they can make savings in terms of costs. Apart from that, banks must also quickly adopt the latest technologies to remain competitive with fintech and e-commerce. Lastly, banks need to build talent management and making adjustments to organizational infrastructure and policies to support digital transformation programs in companies (McKinsey and Company, 2016).

If you look at digital transformation with 4 (four) levels which include individuals, organizations, ecosystems and socio-cultural contexts, then the most common determinant of digital transformation is at the organizational level (Fauzi et al., 2023). At the organizational level, specific digital factors that often appear in publications in the 2015-2023 time period are related to the level of digitalization, the relationship between shares and the digital ecosystem, user growth, the amount of technology investment, the role of technology management and cyber security.

**Table 1**

*List of Public Banks with Digital Services (Mobile Banking) in Indonesia in 2019*

<table>
<thead>
<tr>
<th>No</th>
<th>Ticker</th>
<th>Bank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AGRO</td>
<td>Bank Rakyat Indonesia Agroniaga Tbk.</td>
</tr>
<tr>
<td>2</td>
<td>AMAR</td>
<td>Bank Amar Indonesia Tbk.</td>
</tr>
<tr>
<td>3</td>
<td>BABP</td>
<td>Bank MNC Internasional Tbk.</td>
</tr>
<tr>
<td>4</td>
<td>BANK</td>
<td>Bank Aladin Syariah Tbk. [S]</td>
</tr>
<tr>
<td>5</td>
<td>BBHI</td>
<td>Ato Bank Indonesia Tbk.</td>
</tr>
<tr>
<td>6</td>
<td>BBYB</td>
<td>Bank Neo Commerce Tbk.</td>
</tr>
<tr>
<td>7</td>
<td>INPC</td>
<td>Bank Artha Graha Internasional Tbk.</td>
</tr>
<tr>
<td>8</td>
<td>NOBU</td>
<td>Bank Nationalnobu Tbk.</td>
</tr>
<tr>
<td>9</td>
<td>ARTO</td>
<td>Bank Jago Tbk.</td>
</tr>
<tr>
<td>10</td>
<td>BBKP</td>
<td>Bank KB Bukopin Tbk.</td>
</tr>
<tr>
<td>11</td>
<td>BSIM</td>
<td>Bank Sinarmas Tbk.</td>
</tr>
<tr>
<td>12</td>
<td>BDMN</td>
<td>Bank Danamon Indonesia Tbk.</td>
</tr>
<tr>
<td>13</td>
<td>BJBR</td>
<td>Bank Pembangunan Daerah Jawa Barat dan Banten Tbk.</td>
</tr>
<tr>
<td>14</td>
<td>BNGA</td>
<td>Bank CIMB Niaga Tbk.</td>
</tr>
<tr>
<td>15</td>
<td>BNI1</td>
<td>Bank Maybank Indonesia Tbk.</td>
</tr>
<tr>
<td>16</td>
<td>BNLJ</td>
<td>Bank Permata Tbk.</td>
</tr>
<tr>
<td>17</td>
<td>BRIS</td>
<td>Bank Syariah Indonesia Tbk. [S]</td>
</tr>
<tr>
<td>18</td>
<td>BTPN</td>
<td>Bank BTPN Tbk.</td>
</tr>
<tr>
<td>19</td>
<td>MEGA</td>
<td>Bank Mega Tbk</td>
</tr>
<tr>
<td>20</td>
<td>NISP</td>
<td>Bank OCBC NISP Tbk.</td>
</tr>
<tr>
<td>21</td>
<td>BBCA</td>
<td>Bank Central Asia Tbk.</td>
</tr>
<tr>
<td>22</td>
<td>BBNI</td>
<td>Bank Negara Indonesia (Persero) Tbk.</td>
</tr>
<tr>
<td>23</td>
<td>BBRI</td>
<td>Bank Rakyat Indonesia (Persero) Tbk.</td>
</tr>
<tr>
<td>24</td>
<td>BMRI</td>
<td>Bank Mandiri (Persero) Tbk.</td>
</tr>
</tbody>
</table>

Source: Company Release

Among the public banks that have digital banking services, several banks have public communication strategies with positioning as banks with a high level of digitalization, for
example BRI Agroniaga (Bank Raya), Bank Jago, Allo Bank Indonesia, Bank Neo Commerce, Bank Aladin Syariah and Bank BTPN. Interestingly, in certain periods these banks had much higher valuations than the valuations of banks in general, as shown in the data in Figure 3. The valuations of these banks reached a record high in 2021, with Allo Bank (BBHI) recording price to book value amounting to 63.42 times, followed by Bank Aladin (BANK) at 28.98 times, and Bank Jago (ARTO) with a PBV of 26.87 times. Meanwhile, the three largest banks, namely Bank BRI (BBRI), Bank Mandiri (BMRI), and Bank BCA (BBCA), respectively only recorded PBV of 2.15 times, 1.6 times, and 4.43 times. However, if you look closely at the share price movements of these digital banks in 2023, they are likely to fall and be at normal levels like other public banks.

**Figure 3**

*Digital Bank Issuer Valuation (selected)*

![Graphs showing valuations of various banks](image)

Source: Bloomberg 2023

The difference in valuation of banks with digital services in this period raised questions from market players regarding specific digital factors that caused differences in the valuation of these banks, considering that several banks with digital services were relatively new in operation and had not yet demonstrated profitable and stable financial performance. Valuations that far exceed the industry average and are anomalous will have a high investment risk, especially for ordinary investors who do not have sufficient experience in assessing company fundamentals.
By paying attention to the phenomenon of digital banking transformation and the valuation of digital banks, this research aims to: (1) analyze differences in valuation of public commercial banks based on groups of levels of diversity in the transformation of digital banking services, and (2) analyze specific digital factors as determinants that influence valuation public commercial bank with digital banking services.

2 STUDY LITERATURE

2.1 BEHAVIORAL ECONOMICS

Thaler combines the study of rational economic decision-making with the study of a person's psychology in making sometimes irrational decisions. Someone can make a decision that should be certain, but it turns out to be different from the decision made, so the causes and consequences are studied. Thaler also provides views related to the problem of preventing individual self-control conflict of interest between his role as a company administrator to optimize company value, and his interests as an individual investor (Thaler & Shefrin, 1981). In models planner-doer From Thaler and Shefrin, an individual is not only considered as a short-sighted actor who evaluates options only for their current interests but also as a planner who has a long-term orientation. Another contribution by Thaler was to show how social preferences are crucial for economic decision-making.

Next in behavioral economics, Donnelly said that although there is no consensus which states that there is a positive relationship between company value as reflected in Book to Market (BTM) with the prospect of stock gains, but deep behavioral economics There is an explanation that with a low BTM there are optimistic expectations for share prices, while for a high BTM there are actually less optimistic expectations (Donnelly, 2014). Ratio Book to Market (BTM) has the same role as price to Book Value (PBV) However, with the numerator and denominator being in opposite positions, Donelly's view regarding BTM can be interpreted as meaning that a high PBV has optimistic expectations for share prices, while a low PBV has less optimistic expectations.

2.2 DIGITAL MATURITY AND CYBER SECURITY OF INDONESIAN BANKING INDUSTRY

Law no. 10 of 1998, which is an amendment to Law no. 7 of 1992. In these legal regulations, it is stated that banking is everything that concerns banks, including institutions,
business activities, as well as methods and processes for carrying out business activities. The definition of a bank is a business entity that collects funds from the public in the form of savings and distributes them to the public in the form of credit and/or other forms in order to improve the standard of living of many people. The definition of a Commercial Bank is further explained as a bank that carries out business activities conventionally and/or based on Sharia Principles and in its activities provides services in payment traffic.

To measure the condition of banks, the Financial Services Authority through POJK Number 4/POJK.03/2016 concerning Assessment of the Soundness Level of Commercial Banks assesses the Health Level of Banks individually using a risk approach (Risk-based Bank Rating) with the scope of assessment of risk profile factors (risk profile), Good Corporate Governance, profitability (earnings), capital (capital).

Meanwhile, technology-based disruption occurs very quickly and brings fundamental changes in various business lines that encourage new consumer behavior in accessing financial and banking services. Banking services that are closely linked to customers real-time becomes an important and basic need, even something that banks focus on in terms of products (product) and distribution channels (delivery channel) becomes irrelevant because it is replaced by experience (experience) (King, 2019).

In fact, banking regulators in Indonesia, both Bank Indonesia and OJK, have anticipated the development of information technology through the stages of Commercial Banks, Banking Services Via Electronic Media, Digital Banking Services and Banks Operating Digitally as in Figure 4.

**Figure 4**

*Development of banking technology*

Source: PBI and POJK
Bank Indonesia before the OJK was formed had anticipated developments in banking information technology by issuing PBI Number 9/15/PBI/2007 concerning the Implementation of Risk Management in the Use of Information Technology by Commercial Banks. The PBI regulates banking services via electronic media (Electronic Banking) is a service that enables Bank customers to obtain information, communicate and carry out banking transactions via electronic media, among others ATM, phone banking, electronic fund transfer, internet banking, mobile phone.

These provisions were further developed in POJK No.12/POJK.03/2018 in the form of Digital Banking Services. Digital Banking Services are Electronic Banking Services developed by optimizing the use of customer data in order to serve customers more quickly, easily and according to their needs (customer experience), and can be carried out completely independently by the customer, taking into account security aspects. These Digital Banking Services can be in the form of:

a) account administration (e.g. onboarding namely opening a new account from smartphone customer);

b) transaction authorization (e.g. verification biometric, fingerprint, Face Recognition etc);

c) financial management (e.g. customer analytic and pay later);

d) other financial product services based on approval from the Financial Services Authority.

Based on Financial Services Authority (OJK) Regulation Number 12 of 2018 concerning the implementation of digital banking services by commercial banks, one of the activities included in digital banking services is account administration, where customers can open and close accounts via the Bank application on the customer's smartphone. equipped with customer data updating facilities and can be verified online (online) by the Bank (digital on-boarding).

Furthermore, based on POJK No.12/POJK.03/2021 concerning Commercial Bank Consolidation, it is explained that an Indonesian Legal Entity Bank, hereinafter referred to as Bank BHI, is a Bank that carries out banking business activities in the form of an Indonesian legal entity in accordance with the provisions of statutory regulations, including banks. intermediary. The POJK further explains that Bank BHI can operate as a Digital Bank and is required to have 1 (one) physical office as a Head Office (KP). Meanwhile, Digital Bank business activities are carried out through electronic channels without physical offices or can use limited physical offices.

Apart from institutional matters, POJK 12/2021 also regulates changes in bank groupings, from previously commercial banks with business activities (BUKU) to KBMI (Bank
Groups based on Core Capital). In the BUKU grouping, commercial banks are divided into four categories based on core capital, namely commercial banks with business activities (BUKU) I, II, III, and IV. BUKU I banks have core capital of under IDR 1 trillion, BUKU II IDR 1 trillion to IDR 5 trillion, BUKU III more than IDR 5 trillion to IDR 30 trillion, and BUKU IV with core capital of more than IDR 30 trillion. The BUKU classification limits business activities based on the capital group. For example, BUKU 1 banks cannot carry out the business activities of BUKU IV banks. Meanwhile, in the KBMI regulations, the capital grouping is readjusted and is not linked to business activities and office networks as is the grouping based on BUKU. KMBI 1 is for banks that have core capital of less than IDR 6 trillion. KMBI 2 is for banks that have core capital of IDR 6 to IDR 14 trillion. Then, KMBI 3 is for banks that have core capital of IDR 14 trillion to IDR 70 trillion. Meanwhile, KMBI 4 is for banks that have core capital of more than IDR 70 trillion. The change in these provisions will certainly have an impact on the bank's business activities and business strategies to become more dynamic, especially those related to the development of digital services.

Not only that, the Financial Services Authority has again issued provisions regarding the implementation of digital banking services through POJK 21 of 2023 which regulates in more detail the scope of services, requirements for banks that will provide digital services, payment systems, partnerships, customer protection and licensing.

Meanwhile, McKinsey defines Digital Bank as not just an additional feature, but as a fully integrated mobile experience where customers use their mobile phones to do everything from opening accounts and making payment transactions to resolving credit card bill disputes without coming to the Branch Office at all (McKinsey, 2016).

From the McKinsey model, the Financial Services Authority (2020) developed the fundamental factors that need to be carried out by banks in carrying out digital transformation which includes 5 (five) things, namely Talent & Agility, Clear Value Proposition, customer-centric product, Delightful Experience and Scalable Model. The Banking Digital Transformation Blueprint also explains 6 (six) main things in banking digital transformation which include data, technology, risk management, collaboration, institutional structure and customer. Through OJK Regulation No.11/POJK.03/2022 concerning the Implementation of Information Technology by Commercial Banks, banks are required to assess the bank's digital maturity level or what is known as Digital Maturity Assessment of Bank (DMAB).

In terms of Cyber Security which is part of the Risk Management in the Banking Digital Transformation Blueprint, OJK pays special attention through OJK Circular Letter No.29/SEOJK.03/2022 concerning Cyber Resilience and Security for Commercial Banks
where Commercial Banks are required to carry out cyber security maturity assessments. This assessment is carried out both on the inherent risk aspect (risk inherent in the bank) and on the Quality of Risk Management Implementation (KPMR) aspect. In SEOJK it is also regulated that there must be a unit tasked with handling cyber resilience and security.

2.3 DETERMINANTS OF BANKING VALUATION

Several studies related to the topic of banking valuation have been carried out with various dimensions, scope, methods and specific research objectives. One of the studies that is the main reference in this research is Fang (2013) which examines the impact of institutional reform on bank valuations in European Union member countries. Using Tobin's Q as an analytical approach, the research concluded that there was an increase in valuation in countries that carried out reforms regarding legal aspects and liberalization of banking institutions. Apart from that, Fang's research also revealed that foreign ownership, market power, and asset diversification have a significant effect on the Tobin's Q score.

Hideki (2020) tries to see the relationship between asset growth and bank valuation levels, and compares it between banks in the United States and banks in Japan. Using Tobin's Q as a measure, the study concludes that there is a negative relationship between bank valuation and bank size during non-crisis periods for large banks in the United States. Meanwhile, for large banks in Japan, there is no evidence of a relationship between Tobin's Q and bank size, both before the crisis and throughout the research period. In addition, for Japanese banks that carry out riskier activities, bank valuations will tend to be lower (Sakawa et al. 2020).

Meanwhile, the analysis of approaches to valuing banks also varies. Forte (2018) in his research on valuation accuracy multiples banks in the United States and Europe stated that the accuracy of financial ratios in United States companies was significantly higher than in European companies. Forte also revealed that during a recession or financial crisis, prices do not follow fundamental value references, thereby weakening the accuracy of financial ratios (Gianfranco et al. 2018).

Nevertheless, among the various approaches to measuring bank valuation, research (Leong et al. 2022) concluded that the valuation uses an approach Price to Earning (P/E) has the highest predictive ability compared to approaches Residual Income Model (RIM), Dividend Valuation Model (DVM), nor Free Cash Flow (FCFE).

Company value is determined by various factors, both internal and external (Tobin and Brainard 1976). With various approaches to measuring company value, the determinants of
valuation are also varied, including the business environment (macro) and company-specific (micro) (Leong et al. 2022).

From the company's internal side, several factors influence the valuation of a bank, including the company's financial performance, one of which is the level of bank profitability as measured through Return on Equity (ROE). ROE provides an idea of how much return can be provided to investors (Annabi & Reuben 2017). Another profitability indicator used is interest income, as used by Guerry (2017) who researched the effect of income diversification on bank valuation, or Net Interest Margin (NIM) as in research (Phan et al. 2019) which discusses bank profitability.

Apart from profitability, banking valuation is also influenced by the level of capital held. Capital is essential because it is something that is strictly regulated and monitored by banking industry regulators (Guerry and Wallmeier, 2017). In Indonesia, bank capital levels are regulated by the Financial Services Authority, which is measured through Minimum Capital Compliance Requirements (KPMM)/Capital Adequacy Ratio (CAR) in accordance with the bank's soundness level based on POJK 4 /POJK.03/2016 concerning assessment of the soundness level of commercial banks, as well as POJK 27 of 2022 concerning the second amendment to financial services authority regulation number 11/POJK.03/2016 concerning the obligation to provide minimum capital commercial banks. CAR is calculated by comparing total capital (core and supplementary) to its Risk Weighted Assets (RWA).

Another research was conducted by He and Niu (2017), which discussed the influence of economic policy on banking valuation. This researcher concludes that uncertain economic policies have a negative impact on bank valuations. This happens because uncertainty reduces the growth of bank lending levels, then has an impact on asset growth, and ultimately decreases bank valuations. The impact of these economic conditions is greater for banks that have a higher credit-to-total assets ratio. These results are strengthened by research (Annabi and Reuben 2017), which discusses bank valuation amidst policy changes from the perspective of game theory, and concludes that bank valuation is influenced by risk factors that exist in its business environment.

Meanwhile, from aspects governance also influences company valuations, as Caprio's research shows et al. (2007), that control is owned shareholder will affect the rate of credit growth (loan growth) thus having an impact on bank valuation.

Differences in economic conditions also influence the level of company valuation, as stated by (Guerry & Wallmeier, 2017), who researched bank valuations when the economy experienced a crisis. This research reveals that bank valuations tend to decline during the crisis.
period, and will rise again after the crisis subsides. In addition, in crisis conditions valuation is more influenced by external factors than internal factors.

Thus, from an external perspective, the general business environment has a significant influence on a company's valuation (Guerry & Wallmeier, 2017). In the banking sector, changes in government policy will influence the risks in expanding credit distribution and will have an impact on bank valuations (He & Niu, 2017).

Apart from macroeconomic conditions, dynamics in financial markets also influence bank share prices, which are proxy from valuation. English et al. (2018) researched the extent to which movements in the Fed Rate affect stock prices and bank valuations as well as variations in the impact on each bank. The results show that share prices fall significantly if the benchmark interest rate experiences a significant increase, and have a relatively moderate impact on bank profitability. Research conducted on the New Zealand Stock Exchange also shows that share prices are influenced by exchange rates, interest rates, inflation and stock indices (Dassanayake & Jayawardena, 2017).

Thus, external factors that influence banking valuation go public also stems from the dynamics in the country's stock market (Fang et al. 2014). Stock exchange movements become proxy for market sentiment and perception of prospects and risks in certain sectors. In the domestic context, the valuation performance of banking issuers listed on the stock exchange is influenced by the Composite Stock Price Index (IHSG).

Apart from internal and external factors, there are factors that are categorized as digital specific factors, including the level of bank digitalization, bank relationships in the business ecosystem which are proxied by correlation between banks, and the existence of key-persons (Naimi-Sadigh et al., 2021; Diener & Špac’ek, 2021; Filotto et al., 2020).

Based on POJK 12/2018 concerning the implementation of digital banking services by commercial banks, the level of digitalization can be seen from the capability of opening an account via mobile (online onboarding). Ease of access is one of the most basic services so it is a top priority in digital transformation (Sibanda et al. 2020). Furthermore, based on OJK Regulation No.11/POJK.03/2022 concerning the Implementation of Information Technology by Commercial Banks, Commercial Banks are required to form units that carry out cyber resilience and security functions. In practice, banks will form these units at the management level with names IT Security Officer or CISO (Chief of Information & Security Officer). Banking that is not yet fully digital but has implemented various digital services can be defined as a bank with a digital business (service) model (Shanti et al., 2023).
In terms of affiliation and correlation between banks in one ecosystem or conglomeration, this actually leads to lower bank valuations (Sipin, 2021). This is partly because conglomerates have greater opportunities to carry out cross-subsidies between companies in the group which causes inefficiencies thereby reducing company valuation (Lelyveld & Knot, 2009).

On the other hand, there are different perspectives regarding the valuation of digital entities other than banking, namely start-up companies (start-up). In startup companies, factors that significantly influence valuation are profitability and the contribution of the founder(founders). Market players still see that in startup companies, funding efforts (fund raising) as well as the development of the business model is completely carried out by founders so that causes dependence on founders very high (Rashid et al. 2023). This is reinforced by research conducted on start-up in the United States which shows the influence of education and experience founders on startup growth will affect company funding (Xu, 2019). The founders' significant abilities and roles in the company will produce results social capital, which is an important aspect in the company's future journey (Anderson et al. 2007).

3 DATA AND METHODS

3.1 DATA TYPES AND SOURCES

The banks that are the object of this research are commercial banks in Indonesia, which have listed their shares on the Indonesian Stock Exchange. Apart from that, the commercial bank must also have Digital Banking Services (mobile banking) according to POJK 12/3/2018, at least one of the Digital Banking Services is:

1. online onboarding (opening a savings account automatically online without the customer having to come to the Bank Branch Office);
2. biometric (customer verification service through identification of customer anatomy or behavior in the form of face, fingerprints, voice, body shape, retina and so on);
3. digital loan (online customer credit application service and digital credit analysis which is carried out without the customer coming to the Bank Branch Office so that the decision process is very fast).

Service online onboarding is a type of digital banking service that is generally first owned by banks which is then followed by other developments, namely biometric or digital loan. These banks are then grouped into two groups of digitalization levels, namely the initial
Analysis of Valuation Determinants of Commercial Banks with Digital Services in Indonesia

group, namely banks that have at least 2 digital service features, and the advanced group, namely banks that have 3 digital service features.

Analysis of commercial banks that already have Digital Banking Services is carried out by examining the Bank's Annual Report, media publications and proof of application availability. Mobile banking the bank is on playstore. The data period in this research is 2019-2022 (four years) taking into account that the POJK for digital banking services was only released in 2018.

Of the 109 commercial banks in Indonesia, 46 commercial banks have become public banks, including 24 public commercial banks with digital banking services as in Table 2. Thus, the number of observations used in the analysis using the panel data econometric model in this research is 96.

**Table 2**

*Public commercial banks with digital banking services*

<table>
<thead>
<tr>
<th>No</th>
<th>Emiten</th>
<th>Bank</th>
<th>Digital On-boarding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AGRO</td>
<td>Bank Rakyat Indonesia Agroniaga Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>AMAR</td>
<td>Bank Amar Indonesia Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>ARTO</td>
<td>Bank Jago Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>BABP</td>
<td>Bank MNC Internasional Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>BANK</td>
<td>Bank Aladin Syariah Tbk. [S]</td>
<td>Yes</td>
</tr>
<tr>
<td>6</td>
<td>BBCA</td>
<td>Bank Central Asia Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>7</td>
<td>BBHI</td>
<td>Aoho Bank Indonesia Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>BBKP</td>
<td>Bank KB Bukopin Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>BBNI</td>
<td>Bank Negara Indonesia (Persero) Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>10</td>
<td>BBRRI</td>
<td>Bank Rakyat Indonesia (Persero) Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>11</td>
<td>BBYB</td>
<td>Bank Neo Commerce Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>12</td>
<td>BDMN</td>
<td>Bank Daramon Indonesia Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>13</td>
<td>BJBR</td>
<td>Bank Pembangunan Daerah Jawa Barat dan Banten Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>14</td>
<td>BMRI</td>
<td>Bank Mandiri (Persero) Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>15</td>
<td>BNGA</td>
<td>Bank CIMB Niaga Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>16</td>
<td>BNIL</td>
<td>Bank Maybank Indonesia Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>17</td>
<td>BNLI</td>
<td>Bank Permata Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>18</td>
<td>BRIS</td>
<td>Bank Syariah Indonesia Tbk. [S]</td>
<td>Yes</td>
</tr>
<tr>
<td>19</td>
<td>BSIM</td>
<td>Bank Sinarmas Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>20</td>
<td>BTPN</td>
<td>Bank BTPN Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>21</td>
<td>INPC</td>
<td>Bank Artha Graha Internasional Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>22</td>
<td>MEGA</td>
<td>Bank Mega Tbk</td>
<td>Yes</td>
</tr>
<tr>
<td>23</td>
<td>NISP</td>
<td>Bank OCBC NISP Tbk.</td>
<td>Yes</td>
</tr>
<tr>
<td>24</td>
<td>NOBU</td>
<td>Bank Nationalnobu Tbk.</td>
<td>Yes</td>
</tr>
</tbody>
</table>

For quantitative analysis purposes, secondary data is used which comes from financial performance data of banking issuers provided by the Central Statistics Agency (BPS), Bloomberg, and the Indonesia Stock Exchange (IDX) as in table 3.
3.2 DATA PREPARATION

Before data processing is carried out, it is carried out first cleansing to data of a nature outlier, because it has the potential to reduce model accuracy, distort variable relationships, and increase variance, resulting in inaccurate interpretations.

In data that becomes a variable dependent, namely Price to Book Value (PBV), category outlier are determined through the formulation of upper and lower limits by taking the PBV range of the 10 banks with the largest assets that have digital banking services, where the minimum PBV value is 0.48 and the maximum PBV value is 4.77. With these criteria, there is PBV data for certain years from five banks that are in the outlier category so some of this data is not included as research objects in panel data analysis, but is still included in descriptive analysis and T-test. Outlier PBV data for the five banks are Bank Agro (2020, 2021), Bank Jago (2019, 2020, 2021, 2022), Bank Aladin (2020, 2021, 2022), Allo Bank (2020, 2021, 2022), and Bank Neo Commerce (2021).

3.3 DATA ANALYSIS

Analysis-1: To achieve the first objective, namely analyzing differences in the value of public commercial banks based on groups of levels of diversity in digital banking service transformation after the stipulation of digital banking service provisions by the Financial Services Authority, this was carried out using an independent T-test with the following formula.
Analysis of Valuation Determinants of Commercial Banks with Digital Services in Indonesia

\[ t = \frac{\bar{X}_A - \bar{X}_B}{\sqrt{\frac{s^2_A}{n_A} + \frac{s^2_B}{n_B}}} \]

Where:
- \( \bar{X}_A \) = Average group scores A;
- \( \bar{X}_B \) = Average group scores B;
- \( s^2_A \) = Group Variety A;
- \( s^2_B \) = Group Variety B;
- \( n_A \) = Large number of samples A;
- \( n_B \) = Large number of samples B.

In this research, the group of commercial banks with digital banking services will be divided into 2 (two) groups based on their level of digitalization (minimum two adoption group vs three adoption group). The T-test will be carried out with an Independent Sample T-Test to test the two groups of banks which are not related.

At the final stage will also be seen p-value, namely the probability of getting a result like this or more extreme if hypothesis H0 Correct. P-value is an alternative for decision-making other than using the t value. If p-value smaller than the specified significance level, then reject hypothesis H0.

Analysis-2: The second objective is to analyze specific digital factors as determinants that influence the value of public commercial banks with digital banking services, achieved using the panel data regression analysis method.

The variables used in panel data analysis are divided into two categories, namely internal factors and external factors. Internal factors include: Non-Performing Loan (NPL), Loan Growth (LGR), Return on Equity (ROE), Net Interest Margin (NIM), Feebased to Revenue (FBI), Capital Adequacy Ratio (CAR). Meanwhile, those included in the external factors category are Reference Interest Rates (BIR), Inflation (INF), Exchange Rates (EXR), Composite Stock Price Index (IDX). For specific digital factors, including the level of digital capability (DIG), ecosystem share (CN), user growth (USG), IT investment (INV), IT committee meetings (KIT) and Cyber Security (SCR). To differentiate between conventional banks and sharia banks, a DJB dummy variable is added. Mark Price to Book Value (PBV) become a variable dependent, while other factors become variables independent.

Mathematically, the research model is written as follows:
\[ PBV_{it} = \alpha + \beta_1 FEE_{it} + \beta_2 \text{CapitalR}_{it} + \beta_3 \text{NIM}_{it} + \beta_4 \text{NPL}_{it} + \beta_5 \text{ROE}_{it} + \beta_6 \text{Loan_Gr}_{it} + \beta_7 \text{Digital}_{it} + \beta_8 \text{Saham_Eko}_{it} + \beta_9 \text{User_Gr}_{it} + \beta_{10} \text{Investasi_IT}_{it} + \beta_{11} \text{Komite_IT}_{it} + \beta_{12} \text{Cyber_Sec}_{it} + \beta_{13} \text{Currency}_{it} + \beta_{13} \text{Inflation}_{it} + \epsilon_{it} \] (1)

Where:

PBV: *Price to Book Value*, is the bank's valuation value which compares the intrinsic value of shares with the share price in the capital market of bank *i* in year *t* (percent);  
FEE: Fee-based to Revenue, is the level of service income to the total income of the *i*-th bank in the *t*-th year (percent);  
CapitalR: Capital Adequacy Ratio, is the level of bank capital adequacy calculated from the value of risk-weighted assets (RWA) with the equity of the *i*-th bank in the *t*-th year (percent);  
NIM: Net-Interest Margin, is the level of net income of bank *i* in year *t* (percent);  
NPL: Non-Performing Loans, are credit o/s with a collectibility of 3, 4, 5 of the total credit o/s for the *i*-th bank in the *t*-th year (percent);  
ROE: Return on Equity, is the level of return obtained by investors or shareholders of bank *i* in the *t* year (percent);  
Loan_Gr: Loan Growth, is the growth rate of total credit of the *i*-th bank in the *t*-th year (percent);  
Digital: The level of banking digitalization as measured by three digital capabilities for bank *i* in year *t* (where =3 if the bank has all three digital capabilities, =2 if it has only two digital capabilities, and =1 if it has only one digital capability);  
Eco_Shares: Ecosystem Shares, is the percentage of share ownership affiliated with the digital ecosystem for the *i*-th bank in the *t*-th year;  
User_Gr: Growth rate of registered mobile banking users for bank *i* in year *t*;  
IT_Investment : IT Capex used for *i*-th bank in *t*-year;  
Komite_IT: Number of Technology Steering Committee meetings for bank *i* in year *t*;  
Cyber_Sec: The existence of a Chief Information & Security Officer (CISO) or similar function in the bank's organizational structure (where = 1 if the CISO is below the level of Executive Officer and = 0 if the CISO is at the minimum level of Executive Officer above the Board of Directors);  
Currency: Currency, is the Rupiah exchange rate against USD in the *t*-th year (nominal);  
Inflation: Inflation, is the national inflation rate in year *t* (percent);  
a: intercept;  
b: regression coefficient;  
i: commercial banks with digital services totaling 24 banks;  

There are 7 models estimated, namely model 1 is a model without interaction with specific digital factor determinants, financial variables and macroeconomics as controls. Then, model 2-
7 is an interaction model to identify the moderating influence of digitalization level variables on financial variables in influencing bank value. The equations for model 2-7 are as follows:

\[
PBV_{it} = \alpha + \beta_1 FEE_{it} + \beta_2 CapitalR_{it} + \beta_3 NIM_{it} + \beta_4 NPL_{it} + \beta_5 ROE_{it} + \beta_6 LoanGr_{it} + \beta_7 Digital_{it} + \beta_8 Saham_Eko_{it} + \beta_9 UserGr_{it} + \beta_{10} Investasi_IT_{it} + \beta_{11} Komite_IT_{it} + \beta_{12} Cyber_Sec_{it} + \beta_{13} Currency_{it} + \beta_{13} Inflation_{it} + (\beta_{14} Digital * FEE_{it}) + \epsilon_{it} \quad (2)
\]

\[
PBV_{it} = \alpha + \beta_1 FEE_{it} + \beta_2 CapitalR_{it} + \beta_3 NIM_{it} + \beta_4 NPL_{it} + \beta_5 ROE_{it} + \beta_6 LoanGr_{it} + \beta_7 Digital_{it} + \beta_8 Saham_Eko_{it} + \beta_9 UserGr_{it} + \beta_{10} Investasi_IT_{it} + \beta_{11} Komite_IT_{it} + \beta_{12} Cyber_Sec_{it} + \beta_{13} Currency_{it} + \beta_{13} Inflation_{it} + (\beta_{14} Digital * CapitalR_{it}) + \epsilon_{it} \quad (3)
\]

\[
PBV_{it} = \alpha + \beta_1 FEE_{it} + \beta_2 CapitalR_{it} + \beta_3 NIM_{it} + \beta_4 NPL_{it} + \beta_5 ROE_{it} + \beta_6 LoanGr_{it} + \beta_7 Digital_{it} + \beta_8 Saham_Eko_{it} + \beta_9 UserGr_{it} + \beta_{10} Investasi_IT_{it} + \beta_{11} Komite_IT_{it} + \beta_{12} Cyber_Sec_{it} + \beta_{13} Currency_{it} + \beta_{13} Inflation_{it} + (\beta_{14} Digital * NIM_{it}) + \epsilon_{it} \quad (4)
\]

\[
PBV_{it} = \alpha + \beta_1 FEE_{it} + \beta_2 CapitalR_{it} + \beta_3 NIM_{it} + \beta_4 NPL_{it} + \beta_5 ROE_{it} + \beta_6 LoanGr_{it} + \beta_7 Digital_{it} + \beta_8 Saham_Eko_{it} + \beta_9 UserGr_{it} + \beta_{10} Investasi_IT_{it} + \beta_{11} Komite_IT_{it} + \beta_{12} Cyber_Sec_{it} + \beta_{13} Currency_{it} + \beta_{13} Inflation_{it} + (\beta_{14} Digital * NPL_{it}) + \epsilon_{it} \quad (5)
\]

\[
PBV_{it} = \alpha + \beta_1 FEE_{it} + \beta_2 CapitalR_{it} + \beta_3 NIM_{it} + \beta_4 NPL_{it} + \beta_5 ROE_{it} + \beta_6 LoanGr_{it} + \beta_7 Digital_{it} + \beta_8 Saham_Eko_{it} + \beta_9 UserGr_{it} + \beta_{10} Investasi_IT_{it} + \beta_{11} Komite_IT_{it} + \beta_{12} Cyber_Sec_{it} + \beta_{13} Currency_{it} + \beta_{13} Inflation_{it} + (\beta_{14} Digital * ROE_{it}) + \epsilon_{it} \quad (6)
\]

\[
PBV_{it} = \alpha + \beta_1 FEE_{it} + \beta_2 CapitalR_{it} + \beta_3 NIM_{it} + \beta_4 NPL_{it} + \beta_5 ROE_{it} + \beta_6 LoanGr_{it} + \beta_7 Digital_{it} + \beta_8 Saham_Eko_{it} + \beta_9 UserGr_{it} + \beta_{10} Investasi_IT_{it} + \beta_{11} Komite_IT_{it} + \beta_{12} Cyber_Sec_{it} + \beta_{13} Currency_{it} + \beta_{13} Inflation_{it} + (\beta_{14} Digital * LoanGr_{it}) + \epsilon_{it} \quad (7)
\]

The use of the level of digitalization as a moderating variable follows previous research from Silva et. al. (2023) who researched the moderating effect of digitalization on bank branch credit in the Covid-19 era.
4 RESULTS AND DISCUSSION

4.1 DESCRIPTIVE ANALYSIS

Data from specific digital factors in the 2019-2022 period shows that there is a consistent increase in the digitalization aspect as the need for digital services increases and competition in the banking industry becomes increasingly intense. Parallel to this, the presence of CISOs in bank organizational structures shows a significant increase from 9 banks in 2019 to 13 banks in 2022. This increase confirms the growing awareness of the importance of information security and data protection in the banking sector, where cyber risk management is a priority strategic in facing the digital era. Meanwhile, other digital specific factors, namely the number of IT committee meetings, level of IT investment, growth in mobile service users, and level of affiliation with the retail ecosystem all show an upward trend in the 2019-2022 period.

There are interesting dynamics in various financial variables which are indicators of banking sector performance from 2019 to 2022. Variables related to valuation and profitability are Price to Book Value (PBV), Fee-based to total revenue, and Net-Interest Margin (NIM) consistently shows an increase from year to year. However, Return-on-Equity (ROE) shows quite significant variations between banks. On the other hand, variables Non-Performing Loan (NPL) shows a decreasing trend, which indicates an improvement in the quality of fund distribution by banks. Meanwhile, other financial variables, namely Capital Adequacy Ratio (CAR) shows fluctuations in the research period.

Macroeconomic variables represented by currency exchange rates (Currency) and inflation rates (Inflation) provide insight into Indonesia's economic conditions from 2019 to 2022. During this period, the rupiah exchange rate against the United States dollar showed a continuous depreciation trend, with an increase of IDR 13,866 per US dollar in 2019 to IDR 15,573 in 2022. This depreciation reflects external and internal pressures on the Indonesian economy, including the impact of the COVID-19 pandemic and changes in global trade dynamics. These exchange rate movements can affect banks in terms of increasing import costs and their impact on foreign currency credit. Meanwhile, the inflation rate, which is an important indicator of price stability, decreased from 2.8% in 2019 to 1.6% in 2021, before increasing again to 4.2% in 2022. A period of low inflation in 2020 and 2021 likely reflects a decline in aggregate demand due to the pandemic, leading to lower price pressures. However, a spike in inflation in 2022 may indicate a faster-than-expected economic recovery, which may also be fueled by expansionary monetary policy and rising commodity prices.
4.2 DIFFERENCES IN FINANCIAL PERFORMANCE BASED ON THE LEVEL OF DIGITALIZATION

Based on the results of this statistical test, there is a significant difference at the 5% real level in the variables *Price to Book Ratio* (PBV) between the two groups, where the advanced level group showed a higher average than the initial level group (*p*-value = 0.006). Variable *Commissions & Fees to Total Revenue* also shows a very significant difference (*p*-value < 0.05), with the advanced group having a higher mean, indicating greater income from commissions and fees relative to total income. Then variables *Return on Common Equity* also shows a very significant difference (*p*-value < 0.05), with the advanced group having a higher mean, indicating better equity efficiency.

The significant difference in valuation between the entry-level and advanced digital service bank groups shows that the level of digitalization is an element considered by investors in assessing a bank's business prospects. Market expectations regarding the business prospects will ultimately shape prices in the market (*market price*) of a stock so that it will influence *Price to Book Value* company. This is in accordance with theory *behavioral economics*, where at high PBV there are optimistic expectations, while at low PBV there are less optimistic expectations (Donnelly, 2014).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Rata-Rata Initial Group</th>
<th>Rata-Rata Forward Group</th>
<th><em>P</em>-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price to Book Ratio (PBV)</td>
<td>1.189</td>
<td>1.830</td>
<td>0.006*</td>
</tr>
<tr>
<td>Commissions &amp; Fees to Total Revenue</td>
<td>7.070</td>
<td>10.401</td>
<td>0.003*</td>
</tr>
<tr>
<td>Tier 1 Common Equity Ratio</td>
<td>31.017</td>
<td>22.253</td>
<td>0.265</td>
</tr>
<tr>
<td>ARD Ref Net Interest Margin %</td>
<td>5.983</td>
<td>4.983</td>
<td>0.226</td>
</tr>
<tr>
<td>Non-Performing Loans to Total Loans</td>
<td>2.992</td>
<td>2.661</td>
<td>0.458</td>
</tr>
<tr>
<td>Return on Common Equity</td>
<td>2.023</td>
<td>9.462</td>
<td>0.002*</td>
</tr>
<tr>
<td>Total Loans – 1 Yr Growth</td>
<td>19.139</td>
<td>5.545</td>
<td>0.323</td>
</tr>
</tbody>
</table>

On the other hand, Non-Performing Loans to Total Loans, and Total Loans – 1 Yr Growth do not show significant differences with *p*-values of 0.458 and 0.323, respectively, indicating relative consistency in loan quality and annual loan growth between the two groups. ARD Ref Net Interest Margin % also does not show a significant difference (*p*-value = 0.226 > 0.05), indicating that the net interest margin is relatively consistent between the two groups. Lastly, Tier 1 Common Equity Ratio also does not show a significant difference (*p*-value = 0.226 > 0.05).
Overall, these findings highlight how the level of digitalization can influence a company's financial and operational performance.

Meanwhile, the inflation rate, which is an important indicator of price stability, decreased from 2.8% in 2019 to 1.6% in 2021, before increasing again to 4.2% in 2022. A period of low inflation in 2020 and 2021 likely reflects a decline in aggregate demand due to the pandemic, leading to lower price pressures. However, a spike in inflation in 2022 may indicate a faster-than-expected economic recovery, which may also be fueled by expansionary monetary policy and rising commodity prices.

### 4.3 DETERMINANTS OF VALUE FOR PUBLIC COMMERCIAL BANKS WITH DIGITAL SERVICES

Panel data testing begins by using the Hausman method to determine which is more appropriate to apply, between the fixed effects model (Fixed Effects, FE) or the random effects model (Random Effects, RE). The Hausman test results do not show sufficient statistical evidence to reject the null hypothesis, which states that the random effects (RE) model is consistent (Hausman, 1978). Thus, the RE approach was used to estimate all models.

<table>
<thead>
<tr>
<th>Test</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
<th>Model 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hausman test</td>
<td>0.9999</td>
<td>0.9998</td>
<td>0.9945</td>
<td>0.9992</td>
<td>0.9934</td>
<td>0.9735</td>
<td>0.9998</td>
</tr>
</tbody>
</table>

The numbers in the table above are the p values (p-value) for the Hausman test of all models. Model 1 is a model without interaction, while models 2-7 are a moderation model where there is an interaction between the level of digitalization and financial variables.

After the RE model was estimated, the model assumptions were checked using the Breusch-Pagan test to detect the presence of heteroscedasticity and the Breusch-Godfrey/Wooldridge test to check for autocorrelation. The results of the Breusch-Pagan test show p values above the threshold of 0.05 for all models, which does not provide a basis for rejecting the null hypothesis of homoscedasticity (Breusch & Pagan, 1979). Similarly, the Breusch-Godfrey/Wooldridge test yielded p values greater than 0.05 in all models, which does not provide significant evidence of autocorrelation (Godfrey, 1978; Wooldridge, 2010). The absence of heteroscedasticity and autocorrelation demonstrated by these tests supports the validity of the standard errors used in inference and the reliability of the models under study.
Table 3

Model diagnostics

<table>
<thead>
<tr>
<th>Test</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
<th>Model 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breusch-Pagan for Heteroscedasticity</td>
<td>0.5161</td>
<td>0.5446</td>
<td>0.5769</td>
<td>0.5352</td>
<td>0.4255</td>
<td>0.2067</td>
<td>0.4493</td>
</tr>
<tr>
<td>Breusch-Godfrey/Wooldridge for autocorrelation</td>
<td>0.9050</td>
<td>0.8154</td>
<td>0.7478</td>
<td>0.9618</td>
<td>0.2027</td>
<td>0.8634</td>
<td>0.8116</td>
</tr>
</tbody>
</table>

The numbers in the table above are the p values (p-value) to test heteroscedasticity and autocorrelation assumptions for all best models. Model 1 is a model without interaction while models 2-7 are a moderation model where there is an interaction between the level of digitalization and financial variable.

In this study, we evaluate the best model by estimating without control variables and with control variables. The consistency of the results from these two approaches is indicative robustness from the model used. Table 4 shows the results of the best model by including all variables. The results of this model can be relied on in analyzing the influence of specific digital and financial factors on the PBV of digital banks in Indonesia. There are 7 models consisting of model 1 as a model without interaction, and models 2 to 7 have interactions between digitalization level variables and financial variables. The total number of observations in each model is 96 company-years with R2 above 50% and F statistic significant, meaning that the model explains PBV variations well enough and there is at least one variable that has a significant influence.

From Model 1, it can be seen that several financial variables have a significant influence on the dependent variable, PBV. Commission fee based income to total revenue (FEE) and net interest margin (NIM) has a positive effect on PBV, meanwhile tier 1 common equity ratio (CapitalR) has a negative influence. Meanwhile, on specific digital factors, only the level of digitalization (Digital) has a significant influence. The positive and significant coefficient for the digitalization level variable indicates that increasing the level of digitalization of a bank has an effect on increasing the Company's PBV. Furthermore, models 2 to 7 incorporate interaction effects between digital factors and financial variables, the aim of which is to pay attention to how digitalization affects financial metrics. For example, the interaction between the level of digitalization and tier 1 common equity ratio (Digital*CapitalR) which is significant indicates that the impact of digitalization on company value or PBV is stronger when it is related to the company's capital ratio. This indicates that the level of digitalization is very effective in companies with a solid financial foundation.
The table above is the result of panel data regression estimation with the dependent variable PBV and the independent variables finance, digital specific factors and macroeconomics. Model 1 is a model without interaction, while Models 2 to 7 have interactions between digitalization level variables and financial variables. Symbol *p<0.1; **p<0.05; ***p<0.01 indicates significance level. The numbers in brackets () are the standard errors of the coefficients.
Outside of financial factors, there are specific digital factors that also show a positive influence on bank valuation, namely the level of digitalization. The level of digitalization of a bank is the result of a digital transformation process that requires IT investment allocation, management commitment, and ecosystem support. Naimi-Sadigh, Asgari, & Rabiei (2021) stated in their research that the level of bank digitalization has a significant influence on company valuation.

Figure 5
Summary of Panel Data Processing Results

Other significant interaction variables, namely Digital*ROE and Digital*NPL, reveal that the effect of the level of digitalization on PBV is strengthened through financial variables. The significant positive coefficient for Digital*ROE suggests that the impact of the level of digitalization on firm value is stronger when linked to corporate profitability or ROE. Meanwhile, the significant negative coefficient for Digital*NPL suggests that the level of digitalization can be an effective tool in reducing NPLs, considering that credit risk also influences valuation (He & Niu, 2017). Overall, the analysis results from model 1 to model 7 show that only the level of digitalization as a specific digital factor has a positive and significant influence on company value. However, the level of digitalization can strengthen the influence of other financial variables (CAR, NIM, NPL) on company value, especially in specific financial conditions.
5 CONCLUSIONS AND IMPLICATIONS

5.1 CONCLUSION

The research results show that the transformation of digital banking services has a significant impact on a bank's valuation. Banks that have more complete digital services tend to have higher PBV than banks that have just started digital service transformation, as shown in the T-test results for these two groups of banks. Meanwhile, if we look at the determinant factors, the variables that significantly influence the Price to Book Value (PBV) of banks with digital services are variables related to profitability, namely fee-based to total revenue and Net-interest Margin (NIM).

Positive bank profitability has a significant impact on the price-to-book value (P/BV) ratio, which is a measure of the market's assessment of a bank relative to its net asset value. When a bank's income (which is reflected through NIM) grows positively, its retained earnings increase, which causes its book value to increase over time. This growth in book value may contribute to an increase in the P/BV ratio, as investors may perceive the bank as more valuable due to its ability to generate sustainable income and grow its net asset base.

Apart from that, good profitability will also influence the market's perception of risk. Profitable banks with strong earnings growth and strong risk management practices may be considered low-risk investments by the market. As a result, investors may be willing to pay a premium for bank shares, leading to a higher P/BV ratio. Conversely, banks with lower profitability or higher perceived risk may trade with lower P/BV ratios because investors demand a greater margin of safety.

In short, a bank's profitability plays an important role in determining the market's assessment of a bank, as reflected in its P/BV ratio. Higher profitability, driven by earnings growth, strong ROE, perceived effectiveness of risk management, and dividend policy, can contribute to a higher P/BV ratio by signaling a bank's ability to generate returns for shareholders and create value over time. time.

Therefore, to optimize the valuation of commercial banks through the development of digital services, the digital service transformation carried out must be designed to increase income for banks and be able to provide value optimal for shareholders. Accelerating the development of digital services also needs to be carried out by banks that are still in existence early stage, both through organic and inorganic strategies.
5.2 MANAGERIAL IMPLICATIONS

The development of digitalization in the financial industry is growing rapidly, driven by various factors such as technological advances, changing consumer preferences, regulatory initiatives, and industry competition. Key aspects of these developments include the adoption of digital payment solutions, the emergence of fintech startups and digital banks, the utilization of artificial intelligence and machine learning for risk management and customer service, and the application of blockchain technology for secure transactions and smart contracts. Several trends contribute to accelerated digitalization in the financial sector. This includes the increasing use of mobile devices for banking and financial transactions, the rise of contactless payments and digital wallets, the expansion of online lending platforms, and the integration of financial services into other digital platforms such as e-commerce and social media. Overall, the pace of digitalization in the financial industry is currently fast and dynamic, characterized by continuous innovation, strategic partnerships, and regulatory adaptation to take advantage of opportunities and overcome challenges posed by digital technology.

Banks must respond to the digitalization trend by exploiting it as an opportunity to innovate, improve customer experience, increase operational efficiency, and maintain competitiveness in an ever-evolving financial landscape. By embracing digitalization and implementing these strategies, banks can position themselves to thrive in an increasingly digital and competitive environment while delivering value to customers and stakeholders.

Overall, shareholders generally view effective digitalization as a positive driver of value creation for banks, as it can generate revenue growth, cost efficiencies, competitive advantages, improved risk management and potential for future growth. These factors can collectively contribute to increases in bank share prices and PBV over time. However, the specific impact on shareholder value and PBV will depend on the bank's implementation of digitalization initiatives and its ability to realize the expected benefits.

In Indonesia itself, it has been empirically found that the transformation of digital banking services is still very dependent on the size of the company, especially on the strength of its capital. This is understandable, considering that investment in the IT sector requires quite high capital expenditure. For banks that have large capital, it will be easy to accelerate digitalization. Meanwhile, banks with relatively limited capital are faced with two choices. Namely between carrying out independent transformation gradually but tending to be left behind time-to-market, or collaborating with large banks or fintech but lacking the freedom to carry out other developments.
This research will be useful for bank management in determining priorities in the digital banking service transformation process. Organizationally, banks need to adopt digital technology in the future, which is the core competency of digital banking (Bank 4.0), which includes aspects Business Operation (Finance, Compliance & Legal, Research & Development, Communications, Organizational Development), Technology Operation (Core Banking System, Internal System, Artificial Intelligence, Emerging Tech), Banking (Funding, Lending, Investment), and Delivery (UI/UX, Big Data Utilization, Retention, Brand & Advocacy).

5.3 LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

This research has several limitations that can be noted for future research, including the sample used only from digital banks operating in Indonesia, which are currently limited in number, not including digital banks from other countries. Therefore, future research must expand its scope to include samples that reflect the experience of various countries, for example ASEAN 5. In addition, the number of listed Sharia banks is also very limited, making comparisons between conventional banks and Islamic banks less representative of the industry as a whole. The relatively short research duration is also a limitation of this research, considering that regulations regarding digital banking services in Indonesia were only launched in 2018. A longer post-transformation period would allow for more in-depth analysis. Future research could benefit from including more digital banks and expanding the observation period post digital transformation to produce more accurate predictions regarding the time lag between digital transformation and realized profitability and its impact on bank valuation.

In addition, due to changes in bank classification provisions that affect banking business activities, future research should test the stability of data from 2019 to 2022, by comparing before and after the change in bank classification. This comparison has not been carried out in this study due to limited data.

Because this research focuses on the impact of digital banking service transformation on bank valuations, future research recommendations could explore additional dimensions such as operational efficiency, key factors influencing the competitive landscape of digital banks, as well as the impact of digital transformation on limited credit availability faced by farmers or MSMEs as in research by Farida, Siregar, Nuryantono, & Intan (2015). In addition, future research may utilize other digital transformation metrics, such as digital maturity assessment and the latest trends related to it Environmental, Social, and Governance (ESG).
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