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Recommended Citation
DOI: https://doi.org/10.59091/2460-9196.1697
Available at: https://bulletin.bmeb-bi.org/bmeb/vol26/iss3/5

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A Financial Technology Index for Indonesia 2017 - 2020

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ABSTRACT

Financial technology is a type of financial innovation that incorporates technology. Ideally, a composite indices-based measure can be used to track the flow of financial transactions. Indonesia has no financial technology index due to the inexistent of adequate weighing and time-series data requirement. The purpose of this study is to compose a financial technology index in Indonesia and to analyze the contribution of index forming indicators. We use Generalized Dynamic Principal Component Analysis (GDPCA) method to provide the weight of each indicator. The lender account accumulation and several fintech actors are the most contributed variables in the model.

Keywords: Economic digitization; Financial technology; GDPCA; Index.
JEL Classifications: C18; C43; O16.

Article history:
Received : October 1, 2021
Revised : November 20, 2022
Accepted : January 2, 2023
Available Online : September 30, 2023
https://doi.org/10.59091/1410-8046.1697
I. INTRODUCTION
People are encouraged to use digital technology as a result of rapid technological development in globalization. According to data from the Ministry of Communication and Informatics, internet users in Indonesia increased 8.9% from 2018 to 2019 and 17% in 2020. Economic digitization as a result of globalization brought changes on financial innovation particularly the existence of financial technology or fintech. Fintech is a type of financial innovation that incorporates technology.1

According to data from Financial Services Authority, Indonesia has 299 non-banking fintech companies as of June 2020. Fintech peer-to-peer lending (P2PL) firms account for 158 (52.85%), digital financial innovation account for 86 (28.76%), fintech payment companies account for 52 (17.39%), and fintech Equity CrowdFunding (ECF) companies account for 3 (1%) companies.

Figure 1.
Development of the Financial Technology Category in Indonesia as of June 2020
This figure depicts the percentage of the financial technology category in Indonesia as of June 2020. Each category’s contribution is indicated by its percentage value.

Financial technology in Indonesia is intended to increase digital financial literacy, expand digital marketing especially for MSMEs, provide convenience for the community to effectiveness and efficiency of financial transaction activities.2

How accurately can we measure financial technology activities? Ideally, there

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1 According to the Financial Services Authority (2016), fintech is a financial services industry innovation that makes use of technology. Financial technology is also a technological application in the financial system that has an impact on monetary stability, financial system stability, and payment system smoothness and security through generating new types of technological services (Bank of Indonesia, 2018).

2 MSME= Micro Small Medium Enterprises. MSME are businesses owned by individuals, households, or business entities with assets and yearly turnover of not more than Rp 500 million or the income generated is relatively small.
would be a way to track the movement of financial transactions of financial technology such as composite indices. An important issue characterizing previous literature to make a financial technology index is the allocation of equal weights to every dimension.

Financial technology indices have been produced by some governments and organizations around the world with the specific purpose of informing policy decisions on their financial technology conditions. The KBW Nasdaq Financial Technology Index of the United States Geffenberger (1967) construct an index of financial technology using equal weighting in their empirical analysis. The basic for giving weights to this index is that all securities indices have the same capital accumulation market. The UK Economic Departments’ Fintech Index assesses digital and financial inclusion in developing and emerging countries ING Economics Department (2016) construct an index of financial technology does not have an average indicator weight, so it uses unequal weighting in the construction of the index. The Global Fintech Adoption Index of Asia-Pacific financial services that be developed by Ernst and Young (2019) also assign unequal weighting. Although in the construction of the index in previous studies did not consider the relationship between time, our main concern was built by involving for that.

According to the Organisation for Economic Co-operation and Development (OECD) (2008), weights are important that can have significant effect on the overall composite indicator. Most composite indicators used equal weighting that implies all variable worth the same in the composite. On the other hand, if variables are grouped into dimensions may imply unequal weighting of the dimension. In addition, it is necessary to consider the independence of time.

Indonesia does not yet have a comprehensive measure of financial technology development because there is still a lack of officially available financial technology data and no adequate weighting. On the other hand, data from the variable approach of financial technology in creating financial technology indices available in Indonesia in the form of time-series data. This indicates a problem of the gap between ideal and actual conditions. Therefore, it is not yet possible to see which fintech measures are strong or weak. As a result, it must be compiled or built into Indonesia’s financial technology index, so this research is interesting and needs to be researched.

Our contributions to the literature are threefold. First, to create a financial technology index in Indonesia. The index formed can be used as measuring tool the development of financial technology in Indonesia that did not exist before. Indonesia only has partial indicators describing financial and technological conditions separately. It has not been able to provide a complete picture of financial technology condition in Indonesia. This is important as a form of digitalization of finance, supporting monetary policy transmission, increasing the circulation of money and affecting the economic growth.

\[3 \text{ KBW= Keefe, Bruyette and Woods, is an investment banking firm that specializing in the financial services sector. Nasdaq Global Indexes and Keefe Bruyette and Woods (KBW) have partnered to enhance KBW’s industry-leading family of financial indexes. The KBW Nasdaq Financial Technology Index is index that designed to precisely track the performance of those companies that leverage technology to deliver financial products and services.}
\]

\[4 \text{ UK= United Kingdom; ING= Internationale Nederlanden Groep.}
\]
Second, our work using Principal Component Analysis (PCA) time-series which is reported to be used as a balance in the construction of financial technology indices. The global fintech adoption index of Asia-Pacific shows the value of the financial technology index in all Asia Pacific countries. The limitations of the publication are only released every year. On the other hand, the financial technology index in Indonesia that we build can capture monthly conditions. This more specifically describes the condition of fintech in Indonesia time by time.

Our final contribution is to analyze the contribution of index forming indicators. The financial technology index that built is critical in determining the scale of Indonesia’s financial technology development. The dimension of “money transfer and payment” contributed the most large compared to other dimensions. It means that this dimension must be maintained condition. On the other hand, dimension of “borrowing” gives the lowest contribution. This becomes an evaluation for the government to increase the contribution of borrowing dimension. So, it can be used to informing policy decisions from financial technology conditions in Indonesia.

The rest of this paper is organized as follows. Section II provides the data and methodology used in this study. Section III presents the empirical results. Finally, section IV provides the conclusion of the study.

II. DATA AND METHODOLOGY
Composite indicators can illustrate complex issues and show the progress of a country’s development. The analytical method used in this research is Generalized Dynamic Principal Component Analysis (GDPCA), which is a development of Dynamic Principal Component Analysis (DPCA), which is also a development of the Principal Component Analysis (PCA) method. The GDPCA approach was chosen because it does not require the assumption of stationarity in time-series data, does not require multivariate normality assumptions, works directly between times, and can optimally reduce variables forming composite indexes to simpler indicators (Peña and Yohai, 2016). In this paper, we adapt the financial technology’s dimension and indicators by combination of previous research, because it represents a comprehensive measure of financial technology condition.

5 The combination of previous research are from The KBW Nasdaq Financial Technology Index of the United States Geffenberger (1967), ING Economics Department (2016), The Global Fintech Adoption Index of Asia-Pacific financial services (2019). This study combines several theories from developed countries due to the limited data available in Indonesia. The construction of this index is useful in filling the gap between ideal conditions and actual conditions in Indonesia, which needs to have a financial technology index in determining the size of fintech in Indonesia.
### Table 1.
Indicators Forming Financial Technology Index

This table describes the names of indicator (column 1), definition of the indicator (column 2) and data sources (column 3). US$ = Dollar exchange rate against rupiah; Rp = Rupiah, is the official currency in Indonesia.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Code</th>
<th>Definition</th>
<th>Denomination</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign Exchange Rate</td>
<td>X1</td>
<td>The value of one currency against another currency. It is the midpoint of the Bank Indonesia transaction rate or reference rate which has an impact on the stability of the financial system in Indonesia.</td>
<td>US$</td>
<td>Bank of Indonesia</td>
</tr>
<tr>
<td>Real-Time Gross Settlement</td>
<td>X2</td>
<td>Electronic money transfer system between banks per individual transaction in rupiah currency</td>
<td>Rp</td>
<td>Bank of Indonesia</td>
</tr>
<tr>
<td>Amount of Fund Transfer to Overseas</td>
<td>X3</td>
<td>The value of funds transfer transactions from Indonesia to abroad</td>
<td>Rp</td>
<td>Bank of Indonesia</td>
</tr>
<tr>
<td>Amount of Fund Transfer from Overseas</td>
<td>X4</td>
<td>Money transfer transactions from abroad to Indonesia</td>
<td>Rp</td>
<td>Bank of Indonesia</td>
</tr>
<tr>
<td>Debit Card Transaction</td>
<td>X5</td>
<td>A card of payment whose funds come from the card owner’s account</td>
<td>Rp</td>
<td>Bank of Indonesia</td>
</tr>
<tr>
<td>Credit Card Transactions</td>
<td>X6</td>
<td>A card of payment which the cardholder’s payment obligations are fulfilled first by the issuer</td>
<td>Rp</td>
<td>Bank of Indonesia</td>
</tr>
<tr>
<td>Electronic Money Transactions (X7)</td>
<td>X7</td>
<td>The number of transactions using electronic money</td>
<td>Rp</td>
<td>Bank of Indonesia</td>
</tr>
<tr>
<td>Lender Account Accumulation</td>
<td>X8</td>
<td>Accumulation of accounts from lenders in P2PL</td>
<td>Rp</td>
<td>Financial Services Authority</td>
</tr>
<tr>
<td>Borrower Account Accumulation</td>
<td>X9</td>
<td>Accumulation of accounts from the borrower in P2PL</td>
<td>Rp</td>
<td>Financial Services Authority</td>
</tr>
<tr>
<td>Number of Fintech Actors</td>
<td>X10</td>
<td>The financial technology players</td>
<td>Person</td>
<td>Financial Services Authority</td>
</tr>
</tbody>
</table>

(i) *Money transfer and payment*. This dimension measures of payment that use technology. It implies that financial technology is used technology in their transactions. We use seven indicators to measures the technology transactions, there are foreign exchange rate, real-time gross settlement, amount of fund transfer to overseas, amount of fund transfer from overseas, debit card transaction, credit card transaction, and electronic money transaction.

(ii) *Saving*. This dimension describes that obtained from providing loans online. The indicator in this dimension is lender account accumulation that a proxy variable from lending on peer-to-peer platforms.

(iii) *Borrowing*. This dimension describes from online loans. The indicator in this dimension is borrower account accumulation that a proxy variable from online only loan provides.
(iv) Fintech ecosystem. This dimension measures of fintech actor. The indicator in this dimension is number of fintech actor that a proxy variable from star-up attractiveness.

Using four dimensions, we construct an index of financial technology Indonesia, IFI. The researchers used monthly time-series data from August 2017 through December 2020, totaling 41 observations. The scope of this research period is based on the development of financial technology in Indonesia and the availability of data from all variables used. The methodology used to construct the index of financial technology in this paper follows of the OECD (2008). The following are the procedures are:

(i) Develop a theoretical framework: In this research, the phenomenon that will be measured is the development of financial technology in Indonesia by forming a financial technology index. Determination of indicators and weighting on previous research to develop of financial technology indexes.

(ii) Determine the variables that be used: There is no theoretical framework in this study that forms the financial technology index in Indonesia, which has been carried out as a variable proxy from combination of previous research in the construction of the financial technology index.

(iii) Normalize data: When the study variables have varied units or value ranges, data must be normalized. In this study, data normalization was carried out with the min-max method. Using this normalization procedure, the values of each indicator vary between 0 and 1. The formula for normalization using the min-max method is as follows:

\[ I_{\text{it}n} = \frac{I_{\text{it}} - \text{Min}(I_i)}{\text{Max}(I_i) - \text{Min}(I_i)} \]

In term of variables that have an inverse association with the financial technology index, then (Economist Intelligence Unit, 2018):

\[ I_{\text{it}n} = \frac{\text{Max}(I_i) - I_{\text{it}}}{\text{Max}(I_i) - \text{Min}(I_i)} \]

Here \( I_{\text{it}n} \) is the value of individual indicator \( i^{\text{th}} \) in month \( t^{\text{th}} \) that has been normalized, \( I_{\text{it}} \) is the value of individual indicator \( i^{\text{th}} \) in the month \( t^{\text{th}} \), \( \text{Max}(I) \) is the best value of indicator \( i^{\text{th}} \) during the observation period, \( \text{Min}(I) \) is the worst value of indicator \( i^{\text{th}} \) during the observation period. In our analysis, we use 10 indicators to construct the financial technology index. In terms of research time, we use 41 months from August 2017 to December 2020.

(iv) Test for stationarity: Because the data is time-guided, a stationary test is required to determine the data distribution over time. Stationarity testing with the Dickey-Fuller Augmented test (ADF) and the following common forms (Gujarati and Porter, 2008).

\(^{6}\) Based on OECD (2008) there are at least 10 observation used in the principal component analysis.
\[ \Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum \alpha_i \Delta Y_{t-i} + \varepsilon_t \] (3)

Here, \( Y_t \) is the observed value at time \( t \), \( \beta_1 \) is the intercept, \( \beta_2 t \) is the trend, \( \delta \) is \( \rho - 1 \), \( \varepsilon_t \) is the error term to \( t \), \( \Delta Y_t \) is the difference between \( Y_t \) and \( Y_{t-1} \).

(v) Use the Generalized Dynamic Principal Component Analysis (GDPCA) method to analyze the data: The results of the stationary test revealed that there were stationary research data that were not stationary, the GDPCA analysis was used. In the GDPCA analysis, the optimal model was selected based on criteria such as Kaiser-Meyer-Olkin (KMO) values greater than 0.5, significant Bartlett test results, the cumulative variance described by at least 80%, small MSE values, small GDPCA criterion values, and the number of major components created. The optimal GDPCA model selection criteria include Leave-One-Out (LOO), Akaike Information Criterion (AIC), BIC, and \( I^\alpha \). The best model can be used to determine weighting. We obtained the best model using AIC criteria (Akaike, 1974):

\[ AIC_k = T \log(\text{trace}(\Sigma)) + m(k + 2)2, \quad \text{with} \quad \Sigma = \frac{R^TR}{T} \] (4)

Here, \( AIC_k \) is GDPCA model selection criteria, \( T \) is the number of research periods, \( m \) is the number of research variables, \( k \) is the number of lags, \( R \) is the residual matrix that corresponds to the principal components. The main components formed have similarities (Peña and Yohai, 2016):

\[ z_{i,t} = b_{0,i} f_t + b_{1,i} f_{t-1} + \ldots + b_{m,i} f_{T-1}, \quad \text{dengan} \ 1 \leq t \leq T, 1 \leq i \leq m \] (5)

Where \( z_{i,t} \) is the main component of the \( i \)th indicator, the \( t \)th month, \( b_{0,i}, b_{1,i} \) is the loading value, \( f_t, f_{t-1} \) is the time-series research variable.

(vi). Determine the weighting value/weight: Weighting is calculated using unequal weighting because the indicators that comprise financial technology indexes are mutually independent and can be used as a counterweight for future financial technology development. The balance in this study was determined by the optimal arrangement of major components that comprise the financial technology index. The loading value on the main component produced as well as the variance value that reflects the balance of each indicator in the GDPC method formulated by:

\[ B_i = \frac{LPC_j}{RLPC_j} \times RSSL_j \] (6)

Where \( B_i \) is the weight value of the \( i \)th indicator, \( LPC_j \) is the loading value on the \( j \)th main component, \( RLPC_j \) is the average loading value on the \( j \)th main component, \( RSSL_j \) is the rotation sums of squared loading value (\% of the variance of the \( j \)th principal component).

---

7 Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is a test to assess the appropriateness (Mikkelsen, 2019). Bartlett test is used to test the null hypothesis that the variables in the population correlation matrix are uncorrelated (Mikkelsen, 2019).
Furthermore, the calculation of the contribution of each indicator is formulated by:

\[ b_i = \frac{b_i}{JB} \quad (7) \]

With \( \sum_{i=1}^{10} b_i = 1 \). Here \( b_i \) is \( i \)th indicator contribution value, \( B_i \) is weight value of the \( i \)th indicator, \( JB \) is the sum of all the weights of the \( j \)th main component. The contribution value of each indicator is then used as a balance to create a financial technology index.

(vii). **Determine the financial technology index score in Indonesia**: The index scores or aggregation stages utilized in this work are calculated using linear aggregation, which is formulated as follows (OECD, 2008):

\[ IFI_t = \sum_t \sum_{i=1}^{10} b_i c'_{it} \quad (8) \]

Where \( IFI_t \) is \( t \)th month financial technology index, \( b_i \) is weighting \( i \)th indicator, \( c'_{it} \) is original data that has been standardized on the \( i \)th indicator, the \( t \)th month.

(viii). **Conduct descriptive analysis**: Descriptive analysis is used to describes the formation of Indonesia’s financial technology index. There is also a comparison of the growth of the Indonesian financial technology index with the growth of the international financial technology index.

(ix). **Validation of the results of the financial technology index**: Pearson correlation tests were used to compare the findings of the financial technology index in Indonesia to variable of financial indices, technology indices, economic growth, and the Gini ratio. According to OECD (2008) checking the relationship with other indicators can used in testing the relevance of the explanation of the resulting composite index. This step for validity of our index in capturing information on the degree of financial technology in Indonesia.

### III. RESULTS

A. **Overview of Financial Technology Index Building Indicators in Indonesia**

This section presents the results. This summary provides an overview the development of each indicator.
According to the image below, each indicator of the financial technology index provides a different picture from time to time.
Figure 2.
Overview of Indonesian Financial Technology Index Constituent Indicators
From August 2017 – December 2020 (Continued)

(X4)

(X5)

(X6)
Figure 2.
Overview of Indonesian Financial Technology Index Constituent Indicators
From August 2017 – December 2020 (Continued)
Figure 2.
Overview of Indonesian Financial Technology Index Constituent Indicators
From August 2017 – December 2020 (Continued)
Graph X1 in Figure 2 shows an overview of the dollar’s exchange rate against the rupiah. It can be seen that the dollar exchange rate against the rupiah tends to change from August 2017 to December 2020. This is because exchange rates are affected by uncertain international transactions. Graph X2 shows an overview of real-time gross settlement which is an electronic funds transfer system between banks that is of great value (more than Rp 100,000,000) and is immediate. Based on the picture above it can be said that the value of BI-RTGS from August 2017 to December 2020 tends to be random and erratic. This is because BI-RTGS transactions are carried out per the needs of each group of transaction actors. In addition, it is also influenced by the condition of international financial transactions.

Graph X3 shows an overview of the nominal transfer of funds abroad which is a service that facilitates the safe transfer of money abroad. It can be said that the face value of funds transfers abroad tends to be stable and volatile. This means that at certain times the value is stable, other times showing high turmoil as in August 2018 there was a significant increase compared to the previous month. Then followed by an increase in November 2018 during the period of August 2017 to December 2020. This is possible because the import of capital goods is higher than exports carried out in Indonesia. Graph X4 describe the nominal transfer of funds from abroad which is a remittance transaction from abroad into the country. Funds transfer transactions from abroad tend to be random from August 2017 to December 2020. This is because the most commonly used remittances are Indonesian Workers abroad who send money to their families in Indonesia. This remittance becomes the driving force of the economy in terms of contribution to the country’s foreign exchange.

Graph X5 tell of debit card transactions. It can be known that debit card usage transactions tend to be random and erratic. This is because the use of debit cards is tailored to the needs of its users. Graph X6 represent of credit card transactions. It can be known that credit card usage transactions tend to be volatile from August 2017 to December 2019. But starting in January 2020 experienced a significant decrease until May 2020, which then increased until the end of the month. The condition of credit card transactions that can be said to tend to be volatile remains because the number of credit cards circulating in Indonesia tends to stagnate. In addition, due to government rules that limit the maximum number of bills on credit cards result in a lack of interest in buying people. Graph X7 shows an overview of electronic money transactions. It can be known that electronic money transactions from August 2017 to December 2020 tend to show a positive trend. This is due to the ease and practicality in the use of electronic money to transact. In addition, there are government policies that continue to encourage the use of electronic money to face the digitization of the economy with the existence of digital banking.

Graph X8 indicate the accumulation of lender accounts which is the accumulation of accounts from lenders at peer-to-peer lending in the financial services authority’s fintech statistics. It can be seen that the accumulation of lender accounts tends to increase and show a positive trend. This is due to the ease of lending from lenders to those who borrow on terms that are easier than in the bank. The existence of peer-to-peer lending can provide considerable interest to lenders, so many foreign lenders are channeling funds in peer-to-peer leading
Indonesia. Graph X9 tell the accumulation of borrower accounts which are the accumulation of accounts on the part of borrower funds on peer-to-peer lending in fintech statistics financial services authority. It can be known that the accumulation of borrower accounts increases every month. This is due to the ease of demanding loans to lenders even with greater interest dependents than borrowing money in the bank. In addition, fund borrowers can borrow money quickly according to the needs of the borrower of the fund. X10 describe of the number of fintech players registered officially with the Financial Services Authority. It can be known that from August 2017 to December 2020 the number of financial technology actors registered and officially registered with the Financial Services Authority increased and showed a positive trend. This is because of the development of technology that encourages people to participate and follow existing developments, especially the existence of financial technology.

B. Preparation of Financial Technology Index in Indonesia

Referring to the stage of preparing a financial technology index, the first stage is to develop a theoretical framework. The determination of indicators and weighing on research is based on the development of financial technology indices from previous research. Furthermore, in determining variables using the variable approach in Indonesia, which is as many as 10 variables in 4 dimensions. From the existing variables, the normalization of min-max is done according to the equation (1) and (2) because the research data has different units to be compared in the formation of financial technology indices. The research data is time-series data so that the necessary tests to determine the stationary distribution of the data over time. Testing stationarity using the test Augmented Dickey-Fuller (ADF) with the results from Table 2

<table>
<thead>
<tr>
<th>Indicators</th>
<th>P-value</th>
<th>Conclusions</th>
<th>Indicators</th>
<th>P-value</th>
<th>Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>0.01</td>
<td>Stationary</td>
<td>X6</td>
<td>0.08</td>
<td>Stationary</td>
</tr>
<tr>
<td>X2</td>
<td>0.02</td>
<td>Stationary</td>
<td>X7</td>
<td>0.77</td>
<td>Nonstationary</td>
</tr>
<tr>
<td>X3</td>
<td>0.00</td>
<td>Stationary</td>
<td>X8</td>
<td>0.65</td>
<td>Nonstationary</td>
</tr>
<tr>
<td>X4</td>
<td>0.00</td>
<td>Stationary</td>
<td>X9</td>
<td>0.00</td>
<td>Stationary</td>
</tr>
<tr>
<td>X5</td>
<td>0.00</td>
<td>Stationary</td>
<td>X10</td>
<td>0.10</td>
<td>Stationary</td>
</tr>
</tbody>
</table>

Based on this, the use of the method Generalized Dynamic Principal Component Analysis (GDPCA) is appropriately used for being able to cope with not being stationary on research data. After obtaining the indicators that describe financial technology in Indonesia, a GDPCA analysis was carried out. Testing the feasibility of indicators in the construction of the financial technology index is carried out using the Kaiser Meyer Olkin (KMO) test and the Bartlett test which
gives the KMO test results a value of 0.720 and the significant Bartlett test so that it is feasible for further analysis with GDPCA. From the existing GDPCA criteria, the model from the AIC criteria is the best criterion. This is because when a comparison is made with other criteria models, the smallest AIC criterion value is -82.493, with an accuracy rate of 0.005 MSE and the explained variance is 93.1 %. In addition, the AIC criteria model can produce four components according to the theoretical framework, namely four dimensions. The following is the contribution per indicator and per dimension forming the financial technology index in Table 3:

### Table 3.
**Contribution of Per-indicator and Per-dimensional Forming Fintech Index**

This table describes the contribution of each per-indicator and per-dimension in the formation of financial technology indices using the GDPCA method. Column 1 is the name of the fintech information index formation category. Column 2 is an indicator forming the fintech index. As well as columns 3 and 4 respectively explain the per-indicator and per-dimensional balance in the development of Indonesia’s fintech index.

<table>
<thead>
<tr>
<th>Category</th>
<th>Indicator</th>
<th>Indicator Weighting</th>
<th>Dimensional Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Money Transfer and Payment</td>
<td>X1</td>
<td>0.03999</td>
<td>0.46564</td>
</tr>
<tr>
<td></td>
<td>X2</td>
<td>0.04930</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X3</td>
<td>0.02950</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X4</td>
<td>0.09160</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X5</td>
<td>0.04005</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X6</td>
<td>0.05021</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X7</td>
<td>0.16498</td>
<td></td>
</tr>
<tr>
<td>Saving</td>
<td>X8</td>
<td>0.19566</td>
<td>0.19566</td>
</tr>
<tr>
<td>Borrowing</td>
<td>X9</td>
<td>0.15246</td>
<td>0.15246</td>
</tr>
<tr>
<td>Fintech ecosystem</td>
<td>X10</td>
<td>0.18623</td>
<td>0.18623</td>
</tr>
</tbody>
</table>

The dimension of money transfers and payment contributes the most compared to other dimensions of 46.56%. When viewed from the balance of indicators in dimensions, the variable of electronic money transactions contributes the most compared to other indicators in the dimension, which is 16.49% due to the increasing use of electronic money over time and the ease of the government that continues to advocate the use of electronic money. Furthermore, the nominal variable of funds transfer from abroad is 9.16%, this is because the nominal transfer of funds from abroad applies the nature of financial technology which is a form of technology-based financial transaction. After all, transactions are carried out between countries. Then followed by credit card variables contributed 5.02% because of the ease of use. The fourth-largest contribution is the real-time gross settlement variable of 4.93% this is because the transaction in it is a transaction of great value. The next largest contribution is the variable debit card transaction contributes 4.00%. Then the variable exchange rate of the rupiah against the dollar is 3.99%. And the least contribution to the dimension of money transfer and payment is the nominal variable contribution of funds transfer abroad which is 2.95%.

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8 The KMO value is 0.720 which is included in the middling category (Hair et al., 1998).
The saving dimension contributes to the development of the financial technology index by 19.56% in the index and the indicator, namely the variable accumulation of lender accounts. The contribution given is quite large because the lender’s account accumulation variable always increases from time to time. The borrowing dimension contributes to the development of the financial technology index by 15.24% in the index and the indicator, namely the borrower account accumulation variable. The borrowing dimension occupies the fourth position of the four dimensions that contribute to the formation of the financial technology index. Although the variable of borrower account accumulation has increased, it is still looking for trust from the public in its use with the need for binding regulations.

The fintech ecosystem dimension contributes 18.62% in the index and the indicator, namely the number of fintech players officially registered with the Financial Services Authority. The contribution given is quite large because the number of fintech players increases from time to time, but legal guarantees are needed for fintech players in Indonesia to feel more comfortable and safe. Special attention is needed in improving the indicators forming the financial technology index, especially the forming indicators that have a low contribution to the development of the financial technology index in Indonesia.

When the weighing value has been obtained for the formation of the financial technology index, the next step is to perform aggregation. A migration can be done by multiplying the weight of each indicator in the dimensions and the original standardized research data as follows:

\[
IF_{Ij} = 0.03999 \times c'_{1j} + 0.04930 \times c'_{2j} + 0.02950 \times c'_{3j} + 0.09160 \times c'_{4j} + \\
0.04005 \times c'_{5j} + 0.05021 \times c'_{6j} + 0.16498 \times c'_{7j} + 0.19566 \times c'_{8j} + \\
0.15246 \times c'_{9j} + 0.18623 \times c'_{10j}
\] (9)

The average role of foreign exchange rate in construction of the financial technology index is 3.99%, for real-time gross settlement is 4.93%, amount of fund transfer to overseas is 2.95%, amount of fund transfer from overseas is 9.16%, debit card transaction is 4%, credit card transaction is 5%, electronic money transaction is 16.49%, lender account accumulation is 19.56%, borrower account accumulation is 15.24%, and number of fintech actors is 18.62%.

A series of measures in the construction of composite indexes have been carried out to produce Indonesia’s financial technology index. Here is a picture of the financial technology index in Indonesia that was formed:
Based on Figure 3. The above shows that from August 2017 to December 2020 the development of financial technology in Indonesia showed a positive and increasing trend. The financial technology index has the lowest value in August 2017 and the highest in December 2020. The weighting of each indicator in the dimensions can capture the condition of each indicator forming the financial technology index. The description of the condition of financial technology that is increasing from time to time is possible because of the increasing variable of the financial technology index builder, which shows the increasing condition of financial technology as well. In addition, there are other factors caused by global economic pressure due to the heating up of the trade war between the United States and China so that it also has an impact on the financial sector, especially in Indonesia as well as domestic financial conditions. The increasing graph of the financial technology index means that technology-based financial conditions in Indonesia are improving.

C. The Contribution of Each Indicator in the Formation of the Indonesian Financial Technology Index

The contribution of each indicator in the formation of the Indonesian financial technology index is the involvement of each indicator in the formation of the Indonesian financial technology index during the research period. The following is the contribution of each indicator in the formation of the Indonesian financial technology index.

Figure 3.
Indonesia Financial Technology Index Results August 2017 - December 2020

The following image shows the development of the financial technology index in Indonesia which was formed using the GDPCA method from August 2017 to December 2020. The value of this index ranges from 0 - 1. The higher the index value indicates the development of financial technology the better. The financial technology index formed can be a measuring tool for the development of financial technology in Indonesia and formed a financial technology index that has not existed before in Indonesia.
Based on the picture above, it can be seen that the variable rupiah exchange rate against the dollar contributed to the highest value range compared to other variables. However, it has a downward trend. This is due to the weakening of the rupiah against the dollar. Meanwhile, those that contributed to the lowest value range were debit card transactions. During the research period, on average, the largest contributer to the development of the Indonesian fintech index was the variable number of fintech players and the variable with the smallest contribution was the debit card transaction variable. The variable which contributes tends to increase over time is a variable electronic money transaction, account accumulation lenders, accumulation accounts borrower, and the number of actors fintech. On the other hand, the variables that contributed to the declining trend in the development of the fintech index were the exchange rate of the dollar against the rupiah, real-time gross settlement, nominal fund transfers abroad, and credit card transactions.
D. Comparison of the Financial Technology Index in Indonesia with the Financial Technology Index in Overseas

The countries with the development of financial technology fee that is already well have size of the development of financial technology with the index fintech. One of them is in the United States which has a measure of financial technology development with the Nasdaq financial technology index commonly called KBW and Nasdaq’s Fintech Index (KFTX). This index is used in the United States as an indicator of the performance of stocks of financial technology companies. The following is a comparison of the movement of the KFTX index with the financial technology index in Indonesia:

![Comparison of the Movement of the Indonesian Financial Technology Index with KFTX Index](image)

Based on the picture above, the two indices show an increasing trend. From August 2017 to October 2018, the movement of fintech in Indonesia was in line with the movement of international fintech. Furthermore, from November 2018 to December 2018 the KFTX index experienced a significant decline, on the other hand, the financial technology index in Indonesia continued to increase. Then from January 2019 to January 2020, there was an increasing movement between national

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9. KFTX is the world’s first stock exchange rooted in the financial technology market. This comparison was chosen because the timing of KFTX in accordance with the financial technology index that built in Indonesia. In addition, it is still rare for developing countries to have a financial technology index. So, with globalization, policies in developed countries can be adopted by developing countries.
fintech conditions and international fintech. From February to April 2020, the condition of fintech in Indonesia experienced a significant increase, but in contrast to the condition of international fintech, it experienced a sharp decline from February to March 2020. This was possible because of the COVID-19 pandemic, which attacked the United States earlier than Indonesia. This was only felt in Indonesia from April to June 2020 due to covid-19 and began to improve from July to December 2020. On the other hand, the condition of US fintech improved from April to December 2020, reaching its highest point even though it had dropped back from August to October. 2020 which is not so meaningful because the economic condition of the United States began to recover in the third quarter.

E. Index Validation

Evaluation of the results of the Indonesian financial technology index is carried out by conducting a correlation test between the composite index formed and other indicators, namely the financial index, technology index, economic growth, and the Gini ratio. The following is the result of the correlation test between the financial technology index and the validation variable:

<table>
<thead>
<tr>
<th>Variables</th>
<th>Financial Technology Index</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDX Finance</td>
<td>0.379</td>
<td>0.01</td>
</tr>
<tr>
<td>IDX Techno (MTDL.JK)</td>
<td>0.939</td>
<td>0.00</td>
</tr>
<tr>
<td>GDP</td>
<td>0.708</td>
<td>0.01</td>
</tr>
<tr>
<td>Gini Ratio</td>
<td>-0.682</td>
<td>0.09</td>
</tr>
</tbody>
</table>

10 Validity can be interpreted as the level of goodness of measurement that has been produced in measuring the characteristics to be measured. One way that can be done to test validity is through a correlation test (Karras, 1997)

11 Fintech as the eighth largest economy in term of gross domestic product (Batunanggar, 2019). Based on INDEF and Indonesia Fintech Association (2019) fintech has a positive impact on economic growth of 0.45%. Mankiw (2000) states that GDP is the best measure of economic performance. Because fintech has a positive impact on economic growth, the economic growth variable or GDP is rightly chosen as the validation variable.

12 The existence of fintech has an impact on reducing the poverty rate by 117,000 people and reducing the Gini ratio by 0.01 (INDEF and Indonesia Fintech Association, 2019). Because of this, Gini ratio is rightly chosen as the validation variable.
Based on the results of the Pearson correlation test in Table 4, above it can be concluded that there is a significant correlation between the financial index, technology index, economic growth, and the Gini ratio to the financial technology index. The relationship between the financial index, namely the IDX Finance variable and the financial technology index, is weak and positive based on the category of Hinkle et al. (2003). This means that the greater the value of the financial index, the greater the value of the financial technology index. So it can be said that the index formed is valid and able to explain the financial condition of the financial technology department in Indonesia. Then when viewed from the technology index variable of technology stock companies with the largest returns, it shows a significant correlation between the financial technology index formed and the technology index. The relationship between the stock variables of technology companies Metrodata Electronics (MTDL.JK) and the financial technology index has a very strong and positive correlation with the formed financial technology index. This means that the greater the value of the technology index, the greater the value of the financial technology index. So it can be said that the index formed is valid and able to explain the technological condition of the financial technology department in Indonesia.

If you look at the correlation with macroeconomic variables, namely GDP, the financial technology index has a strong significant correlation. This shows that the greater the value of GDP, the greater the value of the financial technology index. So it can be said that the index formed is valid and able to explain the conditions of economic growth in Indonesia. In terms of expenditure inequality, the Indonesian population can see the correlation between the Gini ratio and the financial technology index, which shows a fairly strong and negative relationship. This means that the greater the Gini ratio value, the smaller the Financial Technology Index value. This means that when there is a large population expenditure inequality, the value of the financial technology index is small. So it can be concluded that the financial technology index in Indonesia which was built using a weighting of each indicator in the dimensions can provide a good picture of financial conditions, technology, economic growth, and income inequality in Indonesia.

IV. CONCLUDING REMARKS
This study focuses on the development of a financial technology index for Indonesia that has not existed before in Indonesia. The urgency of the development of this index is that fintech services have started to develop rapidly since the establishment of the Indonesia Fintech Association. The highest weighting is made by the variable lender account accumulation and the highest contribution is made by the variable number of fintech actors. The financial technology index in Indonesia that was formed increased from August 2017 to December 2020. The index formed was valid and able to explain the condition of financial technology and economic conditions in Indonesia. The financial technology index can be used as a pioneer and the basis for the development of a financial technology index in Indonesia that does not yet exist, it can be used as a tool for the government in making decisions related to financial technology in Indonesia. In addition, it is necessary to develop
and intensify the borrowing dimension which still makes a small contribution to the financial technology index. The development can be in the form of a safe and firm legal guarantee. On the other hand, it is necessary to maintain the condition of the dimensions of money transfer and payment by providing easy services for online payments and guaranteeing security for it.

REFERENCE


Ernst & Young. (2019). *Global FinTech Adoption Index of Asia Pasific Financial Services* 2019, 1–44.


