A Data Analytics Model of Banking Performance and Economic Condition : East Java Region Case

Hana Aulia Diah Ramadhani
Department of Industrial Engineering
Institut Teknologi Sepuluh Nopember
Surabaya, 602111, Indonesia
Hana14@mhs.ie.its.ac.id

DR.Eng. Erwin Widodo. S.T., M.Eng.
Department of Industrial Engineering
Institut Teknologi Sepuluh Nopember
Surabaya, 602111, Indonesia
Erwin_widodo@yahoo.com

Abstract (12 font)

In the era of industry 4.0, banking activities has embedded in society's daily life. Industry 4.0 drives conventional bank become digital bank. Unfortunarely, only 36% of Indonesia's population is connected to formal financial institutions, and this condition leaves 64% of population in Indonesia is unbanked. Bank Mandiri as leading bank in Indonesia constructed "2018 Digital Banking Strategy" to penetrate the market. Unfortunately, the growth of Indonesia's economy and increasing internet user are not in line with growth of Bank Mandiri E-channel user growth.

This research aimed to to analyze factors that influence banking market in East Java and provide recommendation for Bank Mandiri East Java Region with their Electronic banking service sales strategy using data analytics approach.

Several methods are involved in this research. Started with data and information collection from Bank Mandiri East Java Region, data analytics process by considering banking performance and economic condition by using factor analysis. Recommendation of sales strategy is by using multiple regression analysis to analyze sales enablers.

Output of this reserach will be a marketing and sales recommendation for Bank Mandiri for their banking area in East Java.

Industry 4.0, Digital Bank, Data analytics, Bankability factors, Economic factors.

1. Introduction

In the era of industry 4.0, banking activities has embedded in society's daily life. From savings, paying bills, transaction, cash withdrawal, trading, to investment, bank has become strategic industry which responsible for the stabilization of financial system. Banks allocate savings and deposit of funds to lending to ensure the financial stability and enhance economic growth. The fundamental of the industry is based on trust and loyality from customers. With the existance of industry 4.0, banks have ability deliver value to customers and penetrate market through internet network by their e-channel platform, this industrial revolution drives conventional bank become digital bank.

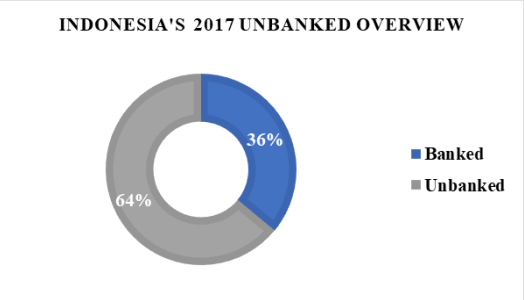

Figure 1. Indonesia Banking Overview 2017

Indonesia as the fourth most populous country in the world (United States Cencus, 2018) has opportunity of digital banking transformation. With 262.787.403 number of population, Indonesia has a great opportunity for banking industry penetration. According to research by Singapore based management consulting firm, Solidiance, in their comparative study on digital banking development in Indonesia in 2017, only 36% of Indonesia's population is connected to formal financial institutions, and this condition leaves 64% of population in Indonesia is unbanked. Digital banking helps open greater opportunity for banks to seize market share with their digital banking products and services (Solidiance, 2017). With number of unbanked population is still dominating in Indonesia, Banks have opportity to focus on pentrating the unbanked population.

Indonesia's banking statistics by Solidiance consulting firm shows that 60% of transactions are concentrated in Java island, and 40% concentrated in greater Jakarta, leaving transaction in Java island is dominated in Jakarta with 67% and 33% respectively for West Java, Central Java, and East Java. Cash transactions in Indonesia is still dominating with 85% of total transactions, leaving 15% of total transactions for non-cash payment.

In Indonesia, awareness of digital banking is starting to arise. As the leading and state owned enterprise (SOE) bank, Bank Mandiri sees Indonesia's large population and society unbanked rate as an market opportunity. Bank Mandiri dedicated e-channel services to face the challenge of industry 4.0 and to win the digital banking market. Based on Bank Mandiri 2017 annual report, to able to successfully become a digital bank, Bank Mandiri constructed "2018 Digital Banking Strategy", the strategy is switching (shifting) customer transactions in branch to electronic channel. Currently 94% of Bank Mandiri transactions are conducted by e-channel customers and are expected to be improved so that the branch will transformed as point of sales rather than as a point of transaction (Bank Mandiri , 2017). The e-channel consist of Mandiri Online App (smartphone app based), Mobile Banking (SMS/USSD code), and Internet Banking (Web-based platform).

Internet user penetration in Indonesia shows positive growth year on year with forecasted 68% penetration rate of total population in 2020. This leaves opportunity for banks to penetrate the on growing market with their e-channel services as more people use internet and tackle the issue of 64% of Indonesians are unbanked with 85% of total transactions are in cash.

Report of PT Bank Mandiri (Persero) Tbk 1H 2018 Results Presentation shows that number of subscribers (users) of Bank Mandiri e-channel rose year on year, on the contrary, the growth of user both in Mandiri mobile banking and internet banking as shown in figure 1.4 shows stagnancy in the pas two years. Year on year growth in average for mobile banking is 7% and internet banking for 12%, In 2017, growth of mobile banking is only 3% and for internet banking is 5%, in the second quarter of 2018, the growth for mobile banking 3%, and for internet banking is 4%. The growth in the past two years are below average growth for the past 8 years.

According to research by Lee Kuan Yew School of Public Policy, Singapore, the province of East Java in Indonesia has fared favourably for economic competitiveness for the past two decades. The competitiveness rankings of 33 Indonesian provinces over the years produced by Asia Competitiveness Institute (ACI) for instance has also consistently ranked the province in second place, just below the Special Capital Region of Jakarta (Tan Khee Giap, 2016). As the second largest province with 39.290.000 population, East Java is major economic center in Indonesia and a potential market for bank's e-channel penetration. Based on this status quo, this research will focus on East Java province, due to the fact that there is inequality of transaction between Jakarta and other province in Indonesia, East Java province is chosen in order to equalize the gap between Jakarta and other province in Java island.

Research by Harvard Business School Professor, Sunil Gupta, stated in his research of The Mobile Banking and Payment Revolution (Gupta, 2013) that the winners in the mobile banking and payment industry are likely to be those who have a deep understanding of local markets, its customers and regulations, who are willing to innovate and commit significant resources to the new initiatives, and who are unafraid to forge partnerships with new players. To be able to understand the local markets, and its customers, regional economic performance is considered in this

research and Bank Mandiri East Java Region performance. Economic condition in this research is the regional economic performance of each area, and the performance of Bank Mandiri Reg.8 in each banking area.

2. Literature Review

2.1 E-Business, E-Commerce, and E-Banking

Based on the the book of eBusiness and eCommerce by Prof. Dr. Andreas Meier and Dr. Henrik Stormer (Meier & Stormer, 2009) Electronic business means initiating, arranging, and carrying out electronic business processes; in other words, exchanging services with the help of public or private communication networks, including the Internet, in order to achieve added value. Companies (business), public institutions (administration), as well as private persons (consumer) can be both service providers and service consumers. What is important is that the electronic business relationship generates added value, which may take the form of either a monetary or an intangible contribution.

Dr.James Ohene-Djan from University of London (Ohene-Djan, 2008) defines Electronic commerce, or e-commerce, to be the process of businesses trading with other businesses and the formulation of internal processes using electronic links, while Electronic business, or e-business, is a term often used interchangeably with e-commerce, but is more concerned with the transformation of key business processes through the use of internet technologies. With the existance of e-commerce, making financial activities become digital by e-finance and lead to e-banking.

E-banking is defined as deployment of retail or wholesale banking services over the internet which involves individual and corporate clients, and includes bank transfers, payments and settlements, documentary collection and credits, corporate and household lending, card businesses and some others. It is a connection between bank and customers in order to prepare, manage, and control financial transactions (Sarlak, 2010).

2.2 Bank Mandiri

PT Bank Mandiri Tbk is Indonesia's second-largest financial institution by assets. Bank Mandiri offers businesses and individuals throughout Indonesia a full set of banking and non-banking products and services. Bank Mandiri Electronic services consist of Automated Teller Machine (ATM) , e-Money, Mandiri e-Cash, with e-channels of Mandiri Mobile Banking, Mandiri Internet Banking, and Mandiri SMS Banking.

Mandiri Electronic Banking services covers 95% of Bank Mandiri national total transaction in 2017 as stated by Director of Distribution, Mr.Hary Gunadi. With 6 million daily transactions and daily financial transaction up to IDR 6.3 billion, making physical transaction via Bank Mandiri branches only cover 5% of total national transaction. It is stated by Mr.Kartika Wirjoatmodjo as Bank Mandiri CEO that in 2018 Bank Mandiri national on going online banking activities daily transaction will be up to IDR 12 billion transactions and by 2020 the national daily transaction forecasted up to 18 million trasactions, which will cover 97% of total trasactions and will leave physical branches only cover 3% of total national transactions. In the Electronic banking services, the customer is able to conduct transaction while mobile by using Electronic Data Capture (EDC) machine, Automated Teller Machine (ATM), Mobile Banking (MB), Internet Banking (IB), and SMS Banking (SMS/USSD Code). With the rapid growth of transaction done via Electronic banking services.

2.3 Gross Domestic Product (GDP)

United Stated of America Department of Commerce Bureau of Economic Analysis (BEA) defines GDP as the value of the goods and services produced in a country. The percentage that GDP grew (or shrank) from one period to another is an important way for government to gauge how their economy is doing. The United States' GDP is also watched around the world as an economic barometer. The White House and Congress use GDP numbers to plan spending and tax policy. The Federal Reserve uses them when setting monetary policy. State and local governments rely on GDP numbers, too. Business people use these stats when making decisions about jobs, expansion, investments, and more. GDP can be used to analyze economic growth, economic comparison between countries, and industries growth evaluation (U.S Bureau of Economic Analysis, 2018).

2.4 Multivariate Analysis

Multivariate analysis method used in this research are Keiser-Meyer Olkin, Barlett's sphrecity test, and Factor analysis.

2.4.1 Keiser Meyer Olkin

The KMO statistic is a Measure of Sampling Adequacy, both overall and for each variable (Kaiser, 2016). KMO values less than .5 occur when most of the zero-order correlations are negative. KMO values less than 0.5 require remedial action, either by deleting the offending variables or by including other variables related to the offenders.
Hypothesis
Ho : The amount of data is enough to be a factor
H_1 : The amount of data is not enough to be a factor

$$\text{KMO} = \frac{\sum_{i=1}^{p}\sum_{j=1}^{p} r_{ij}^2}{\sum_{i=1}^{p}\sum_{j=1}^{p} r_{ij}^2 + \sum_{i=1}^{p}\sum_{j=1}^{p} a_{ij}^2}$$

i = 1, 2, 3, ..., p dan j = 1, 2, ..., p
r_{ij} = Correlation coefficient between variables i and j
a_{ij} = Partial correlation coefficient between variables i and j

There is no statistical test in KMO. There is KMO-value suggested by Kaiser. Kaiser suggests 0.50 as a cut-off value, and a desirable value of 0.8 or higher.should be 0.50 or higher in order to proceed with a factor analysis.

2.4.2 Barlett's Sphrecity Test

Bartlett's test (Snedecor & Cochran, 1967) is used to test if *k* samples have equal variances. Equal variances across samples is called homogeneity of variances. Some statistical tests, for example the analysis of variance, assume that variances are equal across groups or samples. The Bartlett test can be used to verify that assumption.

2.4.3 Factor Analysis

The essential purpose of factor analysis is to describe, if possible, the covariance relationships among many variables in terms of a few underlying, but unobservable, random quantities called factors. Basically, the factor model is motivated by the following argument: Suppose variables can be grouped by their correlations. That is, suppose all variables within a particular group are highly correlated among themselves, but have relatively small correlations with variables in a different group. Then it is conceivable that each group of variables represents a single underlying construct, or factor, that is responsible for the observed correlations

Based on the book of Applied Multivariate Statistical Analysis by Prof.Dean W. Wichern from Texas A&M University and Prof. Richard A. Johnson from Univeristy of Wisconsin (Wichern & Johnson, 2012), the factor analysis model is

$$\begin{aligned} X_1 - \mu_1 &= \ell_{11}F_1 + \ell_{12}F_2 + \cdots + \ell_{1m}F_m + \varepsilon_1 \\ X_2 - \mu_2 &= \ell_{21}F_1 + \ell_{22}F_2 + \cdots + \ell_{2m}F_m + \varepsilon_2 \\ &\vdots \qquad\qquad\qquad\qquad \vdots \\ X_p - \mu_p &= \ell_{p1}F_1 + \ell_{p2}F_2 + \cdots + \ell_{pm}F_m + \varepsilon_p \end{aligned}$$

2.5 Multiple Regression Analysis

Based on the book of Applied Regression Analysis: A Research Tool by John O. Rawlings (Rawlings, et al., 1998) Multiple Regression Analysis refers to a set of techniques for studying the straight-line relationships among two or more variables. Multiple regression estimates the β's in the equation. The linear additive model for relating a dependent variable to p independent variables is

$$Yi = \beta 0 + \beta 1Xi1 + \beta 2Xi2 + \cdots + \beta pXip + i$$

Subscript i denotes the observational unit from which the observations on Y and the p independent variables were taken. The second subscript designates the independent variable. The sample size is denoted with n,i = 1,...,n, and p denotes the number of independent variables. There are (p +1) parameters βj,j=0,...,pto be estimated when the linear model includes the intercept β0. For convenience, we use p' =(p+1). In this book we assume that n>p '. Four matrices are needed to express the linear model in matrix notation:

- Y : the n×1 column vector of observations on the dependent variable Yi;
- X: the n×p' matrix consisting of a column of ones, which is labeled 1, followed by the p column vectors of the observations on the independent variables;
- β: the p'×1 vector of parameters to be estimated; and
- ϵ: the n×1 vector of random errors.

With these definitions, the linear model can be written as $Y = X\beta + \epsilon$.

2.5 Variables

Variables used in this research is based on several literature study conducted by the researcher. Based on the publication of Regional GDP Compilation: Production, Income, and Expenditure approach by University of Ecnomics Prague, Czech Republic adn Czech statistical office, the method to calculate regional gross domestic produxt is by using production approach, which measures the regional gross domestic product at market prices as the sum of gross value added at basic prices and taxes on products without the subsidies. Gross value added at basic prices is calculated as the difference between output at basic prices and intermediate consumption at purchase prices (Czech Statistical Office and University of Economics in Prague, Czech, 2013). The regionalization method of regional gross domestic product according to industries in Indonesia will be based on Badan Pusat Statistik data.

Based on research by National Bureau of Economic Research in Cambridge, United States of America, number of population, labor force, and labor markets relatively successful in improving economic positions (Bloom & Freeman, 1986). Research by Asian Development Bank on minimum wages and changing wage inequality in Indonesia explains that minimum wage policy is a common and popular tool of policy makers to improve the circumstances of the poor relative to the rich. Since the 1990s Indonesia has implemented a fairly aggressive minimum wage policy with frequent changes (Chun & Khor, 2010), raising minimum wage will also stimulate consumer spending, help businesses' bottom lines, and grow the economy. A modest increase would improve worker productivity, and reduce employee turnover and absenteeism. It would also boost the overall economy by generating increased consumer demand (Scott, 2018).

Human development index has important effects on economic growth according to research by Yale University on Human Development and Economic Growth. If a central element of economic growth is allowing agents to discover and develop their comparative advantage, an increase in the capabilities and functionings available to individuals should allow more of them to pursue occupations in which they are most productive. In this sense human development can be seen as the relaxing of constraints which may have interfered with profit maximization. Furthermore, although human development represents a broader concept, many of its elements overlap significantly with the more traditional notion of human capital. Thus, to the extent that human development is necessarily correlated with human capital and human capital affects the economic growth of a nation, human development is bound to have an impact on economic growth (Ranis, 2004).

3. Methodology

3.1 Data Collection

The first step of doing the research is to collect the data. Data needed in this research is economic data of East Java and Bankability data of East Java. The source of this data is based on "Jawa Timur Dalam Angka 2017" report published by East Java Statistic Bureau (*Badan Pusat Statistik)* , and Bank Mandiri Reg.8 first half performance level.

Gross Domestic Regional Product (GDRP) is used to evaluate the economic performance of each area, GDRP is break downed into several sectors defined by the government. Other economic aspects include total area, number of populations, minimum wages, Human Development Index, Establishment of Industry, and number of labor force for the geographical and demographic aspects.

Bankability factor consist of number of Automated Teller Machines (ATMs), number of branches, number of user registered, and number of transaction. Bankability factors are grouped into one group because the data is based on performance of Bank Mandiri Reg.8.

Table 1 Variables

Aspect	Variable Symbol	Operatioal Definition (in each Banking Area in East Java)
Gross Regional Domestic Product (GRDP)	X_1	Farm Food Crops, Estate crops Livestock & products, Forrestry, Fishery sector
	X_2	Mining and Quarrying sector
	X_3	Manufacturing Industries sector
	X_4	Electricity, and Gas sector
	X_5	Water supply, waste process, and recycle sector
	X_6	Construction sector
	X_7	Wholesale and Retail Trade, Car and Motorcycle Repair
	X_8	Transport and Warehouse sector
	X_9	Accomodation and Food consumption
	X_{10}	Information and Communication sector
	X_{11}	Finance Dwelling and Business Service sector
	X_{12}	Real Estate sector
	X_{13}	Company services sector
	X_{14}	Government administration, Defense, and Compulsory social grant sector
	X_{15}	Education service sector
	X_{16}	Health and Public health sector
	X_{17}	Other services sector
Population	X_{18}	Population
Wages	X_{19}	Minimum Wages
Human Development	X_{20}	Human Development Index
Establishment of Industry	X_{21}	Number of Establishment
Labor Force	X_{22}	Number of Labor Force
Banking Performance	X_{23}	Number of ATMs
	X_{24}	Number of Branches
	X_{25}	Number of User Registered
	X_{26}	Number of Active User
	X_{27}	Number of Financially Active User
	X_{28}	Number of Transaction

3.2 Keiser Meyer Olkin

Kaiser-Meyer-Olkin Measure of Sampling Adequacy to indicates the proportion of variance in variables that might be caused by underlying factors. High values (close to 1.0) generally indicate that a factor analysis may be useful with the data. If the value is less than 0.50, the results of the factor analysis probably will not be very useful.

3.3 Barlett's Sphericity Test

Bartlett's test of sphericity tests the hypothesis that the correlation matrix is an identity matrix, which would indicate that variables used are independent. Small values (less than 0.05) of the significance level indicate that a factor analysis may be useful with the data.

3.4 Factor Analysis

Factor analysis is performed to reduce many variables into fewer numbers of factors. This technique extracts maximum common variance from all variables and puts them into a common score. The first step of factor analysis is Factor determination, it can be determined using scree plot and with eigenvalue greater than 1, and variables are grouped based on their loading score.

3.5 Multiple Regression Analysis

Multiple regression analysis is a technique used for predicting the unknown value of a variable from the known value of two or more variables- also called the predictors. In this research, variable whose value is to be predicted is known as the dependent variable is fee-based income (FBI) of each banking area and the ones whose known values are used for prediction are known independent (exploratory) variables are number of transaction frequency and customer funding.

4. Results and Discussion

4.1 Keiser Meyer Olkin and Barlett's Test of Sphrecity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy test shows value of 0.754 which indicates value more than 0.50 thus factor analysis may be useful with the data. Bartlett's test of sphericity test shows significance level of 0.0000 indicate that a factor analysis may be useful with the data.

Kaiser-Meyer-Olkin Measure of Sampling		0,754
Bartlett's Test of Sphericity	Approx. Chi-Square	2628,217
	df	378
	Sig.	0,000

Figure 2 Keiser Meyer Olkin and Barlett's Test of Sphrecity Result

4.2 Factor Analysis

Factor determination is by identifying value more than 1 based on the scree plot and eigenvalue.

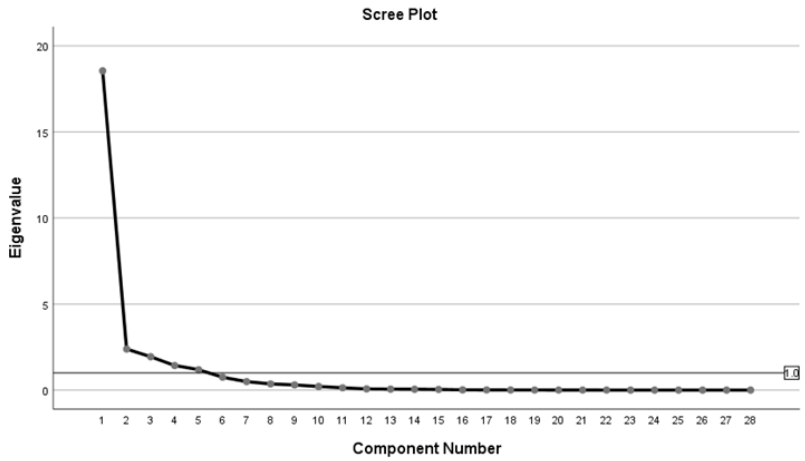

Figure 3 Scree Plot Result

From the scree plot result, there are five independent factors which identify value more than 1.

	Eigenvalue		
Component	Total	% of Variance	Cumulative %
1	18,546	66,234	66,234
2	2,386	8,521	74,756
3	1,940	6,928	81,683
4	1,430	5,109	86,792
5	1,186	4,235	91,027

Extraction Method: Principal Component

Figure 4 Eigenvalue result

From the eigenvalue result, the variability of all variables shows 91.027%, thus all five factors represent all variables. Factor number 1 has the highest variants of 66.234% which indicates factor number 1 able to become

dominant factor for Bank Mandiri East Java region to potential industry to be marketed by Bank Mandiri E-channel services.

Table 2 Factor Loading Score for analysis

Factor Score					
Variable	Component				
	1	2	3	4	5
Agriculture, Forestry and Fishing				0,850	
Mining and Quarrying				0,671	
Manufacturing			0,705		
Electricity and Gas	0,860				
Water supply, Sewerage, Waste Management and Remediation Activities	0,935				
Construction	0,852				
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	0,921				
Transportation and Storage	0,664				
Accommodation and Food Service Activities	0,960				
Information and Communication	0,910				
Financial and Insurance Activities	0,957				
Real Estate Activities	0,952				
Business Activities	0,968				
Other Services Activities	0,907				
Population					
Minimum Wages			0,591		0,626
Human Development Index					0,571
Industry Establishment					-0,914
Labor Force			0,808		
ATMs	0,837				
Branches	0,867				
User Registered		0,910			
Active User		0,907			
Financial Active User		0,858			
Number of Transaction		0,876			
Extraction Method: Principal Component Analysis.					
a. Rotation converged in 6 iterations.					

Variables are grouped into five factors. Table 2 shows factor loading score from SPSS Output. Factor number 1 consist of Economic Condition aspect and Banking Performance aspect. The economic condition variables are Electricity and Gas, Water Supply, Construction, Wholesale and Retail trade, Transportation and Storage, Accomodation and Food service Activities, Information and Communication, Financial and Insurance Activities, Real Estate Activities, Business Activities, Other Service Activities. For the banking performance variables consist of

number of ATMs, and Number of Branches. Contribution of Factor number 1 for Bank Mandiri potential market is 18.546.

4.3 Multiple Regression Analysis

Multiple Regression Analysis consist of dependent variable (Y) and independent variable (X). In this research, the dependent variable is Fee-Based Income (FBI) of Bank Mandiri East Java Region, and independent variable consist of number of registered user, number of transaction, and total funding of East Java customer. Confidence level is 95%, and P-value must not above 0.05. P-value with value more than 0.05 is eliminated. Number of registered user shows P-value of 0.7 and number of transaction shows P-value of 0.6, thus these variables must be eliminated.

Regression Statistics								
Multiple R	0,950518832							
R Square	0,903486051							
Adjusted R Square	0,884183261							
Standard Error	51593699,9							
Observations	7							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	1,24593E+17	1,25E+17	46,80598	0,001018458			
Residual	5	1,33095E+16	2,66E+15					
Total	6	1,37903E+17						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	122.499.205	45910976,16	2,66819	0,044445	4481283,812	240517126,5	4481283,812	240517126,5
FUNDING	0,000071	1,03723E-05	6,84149	0,001018	4,4299E-05	9,76245E-05	4,4299E-05	9,76245E-05

Figure 5 Multiple Regression Analysis from Excel Data Analysis

From the output of regression of Transaction Frequency and FBI, the adjusted R square is maintained is 90%, indicates that the dependent variable (FBI) is 90% influenced by the independent variable (funding). The P-value of funding does not exceed the maximum value (0.05) thus indicates that predictor's value is related to changes in the response variable. From the summary output, the regression formula of FBI (Y) is shown below.

$$Y\ (FBI) = 122.499.205 + FUNDING\ *(0.000071) + ...BnXn$$

With the regression formula, the FBI can be calculated by inputing value of funding (X) in the formula. The Y (FBI) is obtained by adding 11.150.737 as constant to the calculation result of 0.000071 coefficient of funding) times desired amount of funding.

5. Conclusions and Implications of Research Findings

The finding of this research indicated that Electricity and Gas, Water Supply, Construction, Wholesale and Retail trade, Transportation and Storage, Accomodation and Food service Activities, Information and Communication, Financial and Insurance Activities, Real Estate Activities, Business Activities, Other Service Activities industries are dominant variables that dominate banking market and should become priority industry for Bank Mandiri to market their Electronic Banking services. Banking aspects such as number of ATMs and number of branches of Bank Mandiri also become priority variable to support the market penetration.

Bank Mandiri East Java region must conduct a program to increase their amount of funding. Increase in amount of funding influence 90% for the increase of Fee-based Income of Bank Mandiri East Java Region.

References

Bank Mandiri , 2017. *Annual Report Bank Mandiri.* [Online] Available at: https://www.bankmandiri.co.id/documents/38265486/38265681/Bank+Mandiri+2017+Annual+Report+-+Indonesia.pdf/7cf15373-9eab-5f22-3dfb-c50e424386a3
[Accessed 20 September 2018].

Bloom, D. E. & Freeman, R. B., 1986. Population Growth, labor Supply, and Employment in Developing Countries. *NBER Working Paper Series,* Issue 1837, p. 44.

Chun, N. & Khor, N., 2010. Minimum Wages and Changing Wage Inequality in Indonesia. *ADB Economics Working Paper Series,* Volume 196, p. 8.

Czech Statistical Office and University of Economics in Prague, Czech, 2013. Regional GDP Compilation: Production, Income and Expenditure Approach. *Regional estimates of gross domestic product based on the expenditure approach,* p. 24.

Gupta, S., 2013. *The Mobile Banking and Payment Revolution.* [Online] Available at: https://www.hbs.edu/faculty/Publication%20Files/The%20Mobile%20Banking%20and%20Payment%20Revolution1_b37fc319-e15f-46c8-b2f9-c0d4c8327285.pdf [Accessed 19 October 2018].

Kaiser, H. F., 2016. *kaiser_citation_classic_factor_simplicity.* [Online] Available at: https://www.psychometricsociety.org/sites/default/files/kaiser_citation_classic_factor_simplicity.pdf [Accessed 22 October 2018].

Meier, A. & Stormer, H., 2009. *eBusiness and eCommerce.* German: Springer-Verlag Berlin Heidelberg.

Mitchell, D. J., 2005. The Impact of Government Spending on Economic Growth. *Backgrounder,* Issue 1831, p. 4.

Ohene-Djan, J., 2008. *Electronic Commerce.* London: Univeristy of London .

Ranis, G., 2004. Human Development and Economic Growth. *Center Discussion Paper,* Issue 887, p. 7.

Rawlings, J. o., Pantula, S. G. & Dickey, D. A., 1998. *Applied Regression Analysis: A Research Tool.* 2nd ed. New York: Springer.

Sarlak, M. A., 2010. *E-Banking and Emerging Multidisciplinary Processes: Social, Economical and Organizational Models: Social, Economical and Organizational Models.* 1st ed. New York: IGI Global.

Scott, H. R., 2018. *Raising the Minimum Wage: Good for Workers, Businesses, and the Economy,* Washington D.C: U.S Committee on Education and The Workforce Democrats.

Snedecor, G. & Cochran, W., 1967. *Statistical Methods.* 6th ed. Iowa: Iowa State University Press.

Solidiance, 2017. *DIgital Evolution In Indonesia's Banking Industry.* [Online] Available at: https://solidiance.com/insights/white-papers/digital-evolution-in-indonesias-banking-industry/download?token=L6xZaD9X5K [Accessed 21 September 2018].

U.S Bureau of Economic Analysis, 2018. *Gross Domestic Product.* [Online] Available at: https://www.bea.gov/resources/learning-center/what-to-know-gdp [Accessed 20 October 2018].

United States Cencus, 2018. *U.S. Census Bureau Current Population.* [Online] Available at: https://www.census.gov/popclock/print.php?component=counter [Accessed 21 September 2018].

Wichern, D. W. & Johnson, P. R. A., 2012. *Applied Multivariate Statistical Analysis.* 6th ed. New Jersey: Pearson Education, Inc..

Biographies

Hana Aulia Diah Ramadhani is a final year student at Department of Industrial Engineering at Institiut Teknologi Sepuluh Nopember, Surabaya, Indonesia. Hana Ramadhani has experienced a five months internship at Bank Mandiri, one month internship at Telkomsel Indonesia, and attended winter university program at Darmstadt University of Applied Sciences in Germany, under international marketing and sales modules. Her research interests include big data and analytics, digital banking, and financial technology.

DR.Eng. Erwin Widodo. S.T., M.Eng. holds his bachelor degree from Department of Industrial Engineering at Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia, and holds his doctorate degree from Hiroshima University, Japan. Dr.Eng. Erwin Widodo has h-index of 4 and i10-index of 1, and has been cited in numerous reserach for 43 times. His research interest include game theory, dual channel supply chain, and e-Business.Currently, he is an active lecturer and head of postgraduate program in Department of Industrial Engineering, Institut Teknologi Sepuluh Nopember, Indonesia.