[1] La Fariki

[2] Muhammad Natsir

[3] Mustarum Musaruddin

[4] La Ode Suriadi

The Influence of Information and Communication Technology (Ict) Infrastructure on the Volume of Card-Based Non-Cash Financial Transactions in Indonesia

Abstract: - This research aims to analyze the influence of Information and Communication Technology (ICT) infrastructure on the volume of card-based non-cash financial transactions in Indonesia from 2019 to 2021. This is a quantitative study. Data analysis in this research employs multiple regression with a fixed-effect model. The study utilizes panel data of longitudinal type, consisting of data on Base Transceiver Stations (BTS), Villages/Subdistricts Served by Internet, Automatic Teller Machines (ATMs), ATM/debit cards and credit cards, and non-cash financial transaction volume based on cards across 33 provinces in Indonesia as cross-sectional data, spanning a period of three (3) years from 2019 to 2021 as time-series data. Secondary data for this research were obtained from the Bank of Indonesia, the Central Bureau of Statistics, and the Financial Services Authority. The research findings conclude that Base Transceiver Stations (BTS), Villages/Subdistricts Served by Internet, Automatic Teller Machines (ATMs), ATM/debit cards, and credit cards simultaneously had a significant influence on the volume of card-based non-cash financial transactions as shown by the F-test results. While partially as shown by the result of the t-test. Base Transceiver Stations (BTS) and Villages/Subdistricts Served by Internet do not have a significant influence on the volume of card-based non-cash financial transactions. Automatic Teller Machines (ATMs) and ATM/debit cards and credit cards have a significant influence on the volume of card-based non-cash financial transactions.

Keywords: Infrastructure, ICT, non-cash transactions

I. INTRODUCTION

Humans are creatures capable of utilizing natural resources with the assistance of tools, which are later known as technology. Technology has caused significant disruptions today, triggered by the discovery and development of Information and Communication Technology (ICT) [1], [2]. Information and Communication Technology has enabled non-cash payment systems. One of the sub-systems of non-cash transactions is non-cash financial transactions based on cards, where the value of money is stored within. This system no longer relies on physical currency as a transaction instrument but uses cards powered by electricity and electronic media [3], [4].

In Indonesia, non-cash financial transactions based on cards are known as "Alat Pembayaran dengan Menggunakan Kartu" (APMK), which translates to Card-Based Payment Tools. The advantages of APMK include efficiency in cash handling, practicality, mobility, broader accessibility, security, and transaction transparency. Individuals no longer incur expenses when holding physical cash; instead, they receive additional value from interest on their savings [1].

The implementation of non-cash financial transaction systems based on cards is influenced by various factors [5]. Some of these factors include the availability of Information and Communication Technology (ICT) infrastructure in a region. This is because all system platforms, such as web, mobile, Unstructured Supplementary Service Data (USSD), and SIM Toolkit (STK), are operated by Information and Communication Technology (ICT). Another factor determining the implementation of non-cash financial transaction systems is social conditions. Uncomfortable social conditions resulting from natural disasters can disrupt financial transactions. This is because uncomfortable social conditions always hinder social interactions, which in turn affect financial transactions. An example of such a condition is the Covid-19 pandemic [6]. The Covid-19 pandemic that occurred between 2019 and 2021 triggered a decline in economic activities due to a reduction in social interactions.

Non-cash financial transactions have received significant attention in Indonesia since Bank Indonesia, the central bank institution, initiated the National Non-Cash Movement (Gerakan Nasional Non Tunai - GNNT) on

[1,] Student on Doctoral of Economic of Halu Oleo University. Indonesia

[2,] Faculty of Economic and Business of Halu Oleo University. Indonesia

[3,] Faculty of Engineering of Halu Oleo University. Indonesia

[4,] Faculty of Economic and Business of Halu Oleo University. Indonesia

fariki.iki@gmail.com

August 14, 2014 [5]. This initiative was supported by the Indonesian government through the construction of digital infrastructure starting in 2014. This development includes the improvement of electrification ratios, the Palapa Ring project to enhance internet network quality, and the Internet Access for Villages program to support village and regional information systems (Sideka), as well as the Indonesia Go Digital 2020 target [7]. This development has been accelerated in 33 provinces in Indonesia, including Bali, Banten, Bengkulu, D.I. Yogyakarta, DKI Jakarta, Gorontalo, Jambi, West Java, Central Java, East Java, West Kalimantan, South Kalimantan, Central Kalimantan, East Kalimantan, Bangka Belitung Islands, Riau Islands, Lampung, Maluku, North Maluku, Nanggroe Aceh Darussalam, West Nusa Tenggara, East Nusa Tenggara, Papua, West Papua, Riau, West Sulawesi, South Sulawesi, Central Sulawesi, Southeast Sulawesi, North Sulawesi, West Sumatra, South Sumatra, and North Sumatra.

In addition to studies by [1-5], also supported by similar researchers, including is [8], [9], [10], [11], [12] , [13], [14], [15]. The research position as well as the problem raised in this research is how the Information and Communication Technology (ICT) infrastructure consists of Base Transceiver Station (BTS), Villages/Kelurahan Served by Internet, Automated Teller Machines (ATM), ATM/Debit Cards, and Credit cards, influence on the volume of card-based non-cash financial transactions in Indonesia from 2019 to 2021. Therefore, the objective of this research is to analyze the influence of Information and Communication Technology (ICT) infrastructure, including Base Transceiver Stations (BTS), Villages/Subdistricts Served by Internet, Automatic Teller Machines (ATMs), ATM/debit cards, and credit cards, on the volume of card-based non-cash financial transactions in Indonesia from 2019 to 2021.

The novelty of this research is the influence of Internet-Served Villages/Subdistricts on the Volume of Card-Based Non-Cash Financial Transactions.

To improve posture awareness and offer real-time feedback on appropriate standing or sitting positions, this project intends to construct an intelligent system using computer vision techniques, such as OpenCV [13][14] and OpenPose, in conjunction with the machine learning framework TensorFlow [15][16]. To provide visual cues for optimal alignment, the system employs a visual feedback mechanism where a green line structure is superimposed on the video feed. In addition to identifying the appropriate yoga poses, it also keeps track of how long each pose is held, allowing users to measure their development and gradually extend the amount of time they spend in each pose [17][18]. Our initiative combines these technologies to enhance posture awareness, encourage proper body alignment, and help people maintain their best postures for greater overall well-being [19][20].

To estimate the human pose in real-time and with accuracy, our system combines OpenCV, OpenPose, and TensorFlow. For recording video frames and carrying the necessary image processing operations, OpenCV offers a flexible computer vision framework. To fully comprehend the user's body postures and movements, OpenPose, a commonly used pose estimation framework, gathers detailed pose information. To determine whether a pose is right, clever algorithms can be developed with TensorFlow. The methodology used in our study is examined in this research paper, which also looks at the integration of OpenCV, OpenPose, and TensorFlow for real-time human position estimation in yoga. It digs into the specifics of implementation, covering the system's code, software configuration, and hardware setup. To assess the precision, effectiveness, and efficiency of the posture estimation and feedback system, the study presents the results from tests and user studies.

In conclusion, this research work presents an innovative real-time human pose estimation system designed specifically for yoga practitioners. Our method provides precise and consistent detection of important body joints, enabling thorough analysis of yoga postures by combining cutting-edge computer vision techniques and utilizing the power of deep learning algorithms. The seamless integration of MediaPipe with OpenCV guarantees effective processing and real-time visualization, providing users with immediate feedback and direction. Our system offers a complete solution for self-guided yoga practice and expert instruction with its powerful features, including position comparison with reference data, overlay visualization, and timer functionality. We think that by encouraging perfect alignment, improving performance, and fostering a safe and satisfying yoga experience, our initiative has the potential to revolutionize the way yoga is practiced.

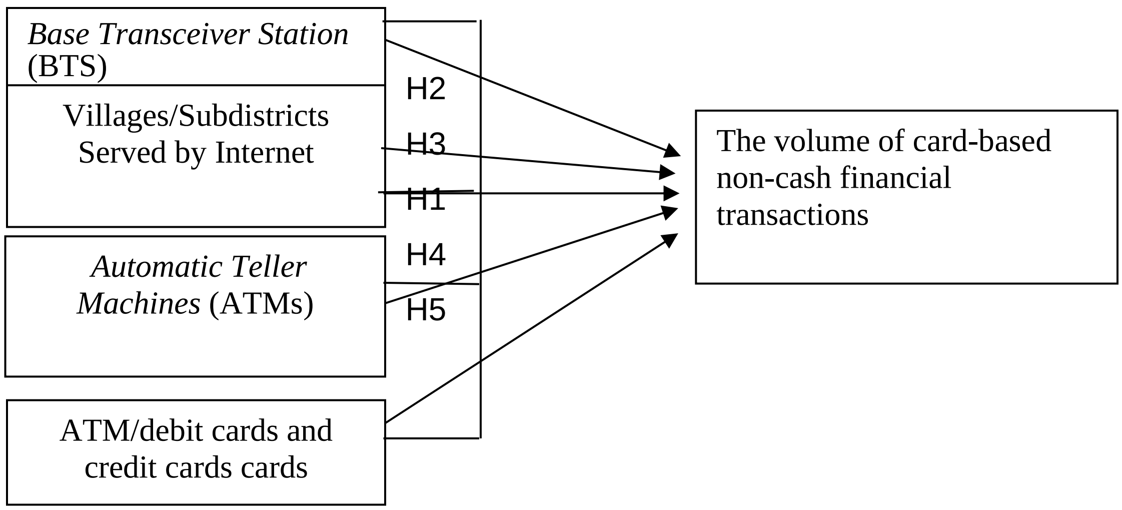
II. RESEARCH METHOD

This research was conducted in 33 provinces in Indonesia and is of a quantitative nature. The data was sourced from secondary data obtained from the Bank Indonesia Office, the Central Bureau of Statistics Office, and the Financial Services Authority Office. This study utilizes longitudinal panel data. According to Ariefianto [16], longitudinal data are panel data that use cross-sectional samples and then observe the behavior of observed variables over time, which remains constant for observation. The sampling of time series data in this study uses purposive sampling techniques.

According to [17] purposive sampling is a non-probability sampling technique based on specific considerations. The specific consideration in this case is the global Covid-19 pandemic condition during the years 2019 to 2021.

The independent variables in this research consist of Base Transceiver Stations (BTS), Villages/Subdistricts Served by Internet, Automatic Teller Machines (ATMs), ATM/debit cards, and credit cards. The dependent variable is the volume of card-based non-cash financial transactions.

The conceptual framework of this research can be seen in the following Figure 1.



Source: Researcher, (2023)

Figure 1. Conceptual framework of the research on the influence of Base Transceiver Station (BTS), Villages/Subdistricts Served by Internet, Automatic Teller Machines (ATMs), ATM/debit cards, and credit cards on the volume of card-based non-cash financial transactions.

The hypotheses constructed in this research include:

H1: Simultaneously, Base Transceiver Station (BTS), Villages/Subdistricts Served by Internet, Automatic Teller Machines (ATMs), ATM/debit cards, and credit cards have an influence on the volume of card-based non-cash financial transactions.

H2: Base Transceiver Station (BTS) significantly influences the volume of card-based non-cash financial transactions.

H3: Villages/Subdistricts Served by Internet significantly influence the volume of card-based non-cash financial transactions.

H4: Automatic Teller Machines (ATMs) significantly influence the volume of card-based non-cash financial transactions.

H5: ATM/debit cards and credit cards significantly influence the volume of card-based non-cash financial transactions.

The analysis of the research results uses multiple regression model (Gujarati, 2006) as follows:

$VOLit = \beta 0 + \beta 1BTSit + \beta 2DESAit + \beta 3ATMit + \beta 4KARTUit + uit$

Explanation:

VOL = Volume of card-based non-cash financial transactions, consisting of ATM/debit cards and credit cards.

$\beta 0$ = Constant

$\beta 1$, $\beta 2$, $\beta 3$, $\beta 4$ = Coefficients

BTS = Number of Base Transceiver Stations (BTS)

DESA = Number of Villages/Subdistricts Served by Internet

ATM = Number of Automatic Teller Machines (ATMs)

KARTU = Number of ATM/debit cards and credit cards

u = Combined residual of cross-section and time series

i = Provincial data as cross-sectional data at time t

t = Annual time period data as time series data at the observation time.

Data Analysis Method

This research employs descriptive analysis and inferential analysis methods. Descriptive analysis is used to explain the condition of ICT infrastructure access, while inferential analysis is used to estimate or obtain a model capable of explaining the influence of ICT infrastructure on the volume of card-based non-cash financial transactions. The analysis begins with a description of the research variables, followed by model estimation, starting from common effect models, fixed effect models, and random effect models. The next steps include model selection tests to determine the appropriate model and a goodness of fit test. The analysis concludes with hypothesis testing.

The selection of the appropriate model involves using the Chow test to choose between common effect models or fixed effect models, the Lagrange Multiplier test to choose between common effect models or random effect models, and the Hausman test to select between fixed effect models or random effect models. A good model (Goodness of fit test) is determined by the adjusted coefficient of determination (Adjusted R Square), which ranges from 0 to 1. The model is considered better as the Adjusted R Square value approaches 1, indicating that the variation in the dependent variable is highly determined by the values of the independent variables.

Hypothesis testing is conducted using the F-test and t-test. The F-test is used to assess the simultaneous influence of variables such as Base Transceiver Station (BTS), Villages/Subdistricts Served by Internet, Automatic Teller Machines (ATMs), ATM/debit cards, and credit cards on the volume of card-based non-cash financial transactions. Meanwhile, the t-test is used to evaluate the partial influence of variables such as Base Transceiver Station (BTS), Villages/Subdistricts Served by Internet, Automatic Teller Machines (ATMs), ATM/debit cards, and credit cards on the volume of card-based non-cash financial transactions.

III. RESULTS

3.1. Description of Research Variables

BTS (Base Transceiver Station)

Base Transceiver Station (BTS) is a crucial part of Information and Communication Technology (ICT) infrastructure for wireless communication. This is because BTS facilitates wireless communication networks between communication devices and network operators without cables. The main function of BTS is to transmit and receive radio signals to communication devices such as landline phones, mobile phones, and other similar gadgets. These radio signals are then converted into digital signals, which are further transmitted to other terminals to become messages or data. BTS also serves as an internet signal provider for information and/or communication through communication devices.

The number of operating and constructed BTS units in Indonesia from 2019 to 2021 has increased. In 2019, there were 35,062 units, in 2020 there were 37,570 units, and in 2021 there were 39,062 units.

Villages/Subdistricts Served by Internet

The internet is a communication network that connects one electronic medium to another. This communication network transfers data accurately and swiftly through specific frequencies. The internet network functions as a medium for data communication, including non-cash financial transaction operations. The expansion of internet access throughout Indonesia is continuously promoted by the Indonesian government through the "Palapa Ring" program.

The expansion of internet access has resulted in an increasing number of villages and urban areas with internet access in Indonesia. In 2019, there were 42,118 internet-served villages/urban areas, in 2020 there were 47,705, and in 2021 there were 51,764.

Automatic Teller Machines (ATMs)

Automatic Teller Machine (ATM) is a machine that processes financial transactions, replacing human tellers in commercial banks, using ATM/debit cards and credit cards. The operation of Automatic Teller Machine (ATM) involves users accessing their accounts through special plastic cards (ATM cards) encoded with user information on the magnetic strip. This strip contains identification codes that are sent to the bank's central computer via a modem.

The number of operating and constructed Automatic Teller Machines (ATMs) in Indonesia has decreased from 2019 to 2021. In 2019, there were 106,659 machines, in 2020 there were 104,754 machines, and in 2021 there were 82,853 machines.

ATM/Debit Cards and Credit Cards

ATM cards are non-cash card-based payment tools that can be used for cash withdrawals and fund transfers, instantly deducting the cardholder's obligations from their account at the bank or other authorized non-bank financial institutions. Debit cards are used for payments related to economic activities, including purchasing transactions, with the cardholder's obligations being immediately fulfilled by directly deducting from the cardholder's account at the bank or other authorized non-bank financial institutions. ATM cards nowadays also serve as debit cards.

Credit cards are non-cash card-based payment tools used for making payments related to economic activities, including purchasing transactions and/or cash withdrawals. The cardholder's payment obligations are initially fulfilled by the acquirer or issuer, and the cardholder is obligated to make payments at the agreed-upon time, either through lump-sum payments (charge cards) or installment payments.

The number of ATM/debit cards in Indonesia has increased from 2019 to 2021. In 2019, there were 182.43 million cards, in 2020 there were 213.66 million cards, and in 2021 there were 226.24 million cards. In contrast, the number of credit cards decreased from 2019 to 2021. In 2019, there were 17.41 million cards, in 2020 it decreased to 16.84 million cards, and in 2021 it further decreased to 16.43 million cards. Although the number of credit cards decreased from 2019 to 2021, when combined with the number of ATM/debit cards, the total number of card-based payment tools, or Card-Based Payment Tools (APMK), in Indonesia has increased. In 2019, the total number of ATM/debit and credit cards in Indonesia was 199.83 million, in 2020 it was 230.50 million, and in 2021 it was 242.67 million cards.

Volume and Value of Card-Based Non-Cash Financial Transactions

Transaction volume represents the frequency or execution of transactions carried out by cardholder customers, while transaction value represents the monetary value resulting from cash withdrawal, transfers, and purchases using cards. ATM/debit card transactions consist of cash transactions through Automatic Teller Machines (ATMs), shopping transactions through Electronic Data Captured (EDC) machines, intrabank transactions, and interbank transfer transactions through ATMs. On the other hand, credit card transactions include cash transactions through Automatic Teller Machines (ATMs) both domestically and internationally, as well as shopping transactions through Electronic Data Captured (EDC) machines, both domestically and internationally.

The volume of card-based non-cash financial transactions in Indonesia from 2019 to 2021 fluctuated. Fluctuations occurred in all types of transaction instruments, including both ATM/debit cards and credit cards. The volume of ATM/debit card transactions reached 7,026.85 million transactions in 2019, decreased to 6,655.63 million transactions in 2020, and increased again to 7,218.27 million transactions in 2021. Credit card transaction volume in 2019 was 347.60 million transactions, decreased to 273.28 million transactions in 2020, and increased again to 279.58 million transactions in 2021. Overall, the volume of ATM/debit card and credit card transactions in Indonesia reached 7,374.45 million transactions in 2019, decreased to 6,928.91 million transactions in 2020, and increased again to 7,497.85 million transactions in 2021.

When looking at the transaction values, non-cash financial transactions based on cards in Indonesia from 2019 to 2021 also experienced fluctuations. The value of non-cash financial transactions based on cards in Indonesia in 2019 reached 7,817,506.65 billion Rupiah, decreased to 7,155,778.84 billion Rupiah in 2020, and increased again to 7,921,700.74 billion Rupiah in 2021.

3.2. Model Estimation

Common Effect Model

Estimating the common effect model assumes that the intercept and slope of the regression model for each individual (province) are the same [18], [19]. The results of the common effect model estimation in this study can be seen in the following Table 1.

Table 1. Results of Common Effect Model Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	39.57883	16.40739	2.412256	0.0178
BTS?	-6.561074	2.809751	-2.335109	0.0219
DESA?	-6.919666	1.723744	-4.014323	0.0001
ATM?	1.706624	0.866404	1.969778	0.0521
KARTU?	4.989407	0.180593	27.62788	0.0000
R-squared	0.961496	Mean dependent var		23468.54
Adjusted R-squared	0.960153	S.D. dependent var		51248.64
S.E. of regression	10230.12	Akaike info criterion		21.34749
Sum squared resid	9.00E+09	Schwarz criterion		21.45859
Log likelihood	-956.6369	Hannan-Quinn criter.		21.39229
Durbin-Watson stat	1.894455			

Source: Processed data, 2023

Fixed Effect Model

The assumption of a constant intercept in the panel data regression model for each individual (province) and time is considered less realistic, so a model that can better capture these differences is needed. Gujarati [20] introduced the fixed effect model to detect whether there are differences in the intercepts in a panel data regression model. The results of the fixed effect model estimation can be seen in the following Table 2.

Table 2. Results of Fixed Effect Model Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	18,469.19	14143.36	1.305856	0.1969
BTS?	17,61040	11.90431	1.479330	0.1447
DESA?	3,101406	3.740010	0.829251	0.4105
ATM?	-0,877603	0.256891	-3.416243	0.0012
KARTU?	-2,564972	0.296176	-8.660289	0.0000
Fixed Effects (Cross)				
_BALI—C	-8,661.032			
_BANTEN--C	12,220.25			
_BENGKULU--C	-22,095.29			
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.996659	Mean dependent var		23468.54
Adjusted R-squared	0.994691	S.D. dependent var		51248.64

S.E. of regression	3734.162	Akaike info criterion	19.56953
Sum squared resid	7.81E+08	Schwarz criterion	20.51390
Log likelihood	-846.6289	Hannan-Quinn criter.	19.95036
F-statistic	506.2923	Durbin-Watson stat	3.327174
Prob(F-statistic)	0.000000		

Source: Processed data, 2023

Table 2 shows that the intercept between individuals (provinces) turns out to be different from the average intercept for all individuals. This difference is exemplified by the difference in intercepts for Bali Province reaching 18,469.19 – 8,661.03 = 9,808.16. The intercept difference for Banten Province reached 18,469.19 + 12,220.25 = 30,689.44 and the intercept difference for Bengkulu Province reached 18,469.19 -22,095.29 = -3,626.10.

Random Effect Model

Using dummy variables to detect differences in intercepts among individuals (provinces) in the fixed effect causes a reduction in parameter efficiency due to the reduction in degrees of freedom. This issue is addressed by using error term variables. The estimation of the random effect model is used to detect whether there are differences in random error variables among individuals but still over time. The random effect values indicate the extent of the difference in random error components of individuals from the average intercept value of all individuals. The results of the random effect model estimation can be seen in the following Table 3.

Table 3. Results of Random Effect Model Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4962.377	2207.373	2.248092	0.0272
BTS?	-10.80544	4.077947	-2.649726	0.0096
DESA?	-3.708429	2.027360	-1.829191	0.0709
ATM?	2.062246	1.002818	2.056451	0.0428
KARTU?	4.365920	0.264330	16.51691	0.0000
Random Effects (Cross)				
_BALI--C	-6674.078			
_BANTEN--C	-16060.61			
_BENGKULU--C	-1470.208			

Source: Processed Data, 2023

It is shown in Table 3 that the random error components of individuals differ from the average intercept (C) value of all individuals. This difference is exemplified by the difference in random error components for Bali province compared to the average intercept, which is -6674.07. The difference for Banten province is -16060.61, and for Bengkulu province, it is -1470.208.

3.3. Selection of the Appropriate Model and Goodness of Fit Test

Chow Test

Widarjono [19] states that the Chow Test is a test to choose between the common effect model or the fixed effect model. The hypotheses formed in the Chow Test are as follows: H0: Common Effect Model Ha: Fixed Effect Model If the P-value is less than 5% or 0.05, then Ha is accepted, and Ho is rejected. Conversely, if the P-value is greater than 5% or 0.05, then Ho is accepted [19].

Table 4. Chow Test Results

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	8.132884	(32,62)	0.0000
Cross-section Chi-square	163.171831	32	0.0000

Source: Processed Data, 2023

Table 4 shows that the Probability (Prob) of Cross-section F is 0.0000. This value is smaller than 5% or 0.05. This means that Ha (the alternative hypothesis) is accepted, and Ho (the null hypothesis) is rejected, implying that the common effect model is rejected, and the fixed effect model is accepted, indicating that the panel data regression model contains differences in intercepts.

Lagrange Multiplier Test

The Lagrange Multiplier Test is used to select between the random effect model and the common effect model. The hypotheses formulated in the Lagrange Multiplier Test are as follows: Ho: Common Effect Model Ha: Random Effect Model If the Probability (Prob) of Both Breusch-Pagan is less than 5% or 0.05, then Ha is accepted, and Ho is rejected. Conversely, if the Probability (Prob) of Both Breusch-Pagan is greater than 5% or 0.05, then Ho is accepted [19].

Table 5. Lagrange Multiplier Test Results

Lagrange Multiplier Tests for Random Effects
Null hypotheses: No effects
Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided
(all others) alternatives

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	1.547698	0,437203	1.984901
	(0.2135)	(0.5086)	(0.1589)

Source: Processed Data, 2023

Table 5 shows that the Probability (Prob) of Both Breusch-Pagan is 0.1589. This value is greater than 5% or 0.05. This means that Ho (the null hypothesis) is accepted, and Ha (the alternative hypothesis) is rejected, indicating that the common effect model is accepted. Therefore, the common effect model is more appropriate than the random effect model for estimating panel data, even though there are differences in the random error component affecting the average intercept (C) of all individuals (provinces).

Hausman Test

According to Gujarati [20], the Hausman Test is used to choose between the fixed effect model and the random effect model. The hypotheses formulated in the Hausman Test are as follows: Ho: Random Effect Model Ha: Fixed Effect Model If the P-value is less than 5% or 0.05, then Ha is accepted, and Ho is rejected. Conversely, if the P-value is greater than 5% or 0.05, then Ho is accepted [18].

Table 6. Hausman Test Results

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	127.076171	4	0.0000

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
BTS	0.185753	-0.098601	0.013074	0.0129
DESA	-0.007955	-0.050659	0.002455	0.3887
ATM	-0.009810	0.020780	0.000011	0.0000
KARTU	-25.462536	46.218277	45.192673	0.0000

Sumber Source: Processed Data, 2023

Based on the Hausman test results in Table 6, a Probability (Prob) of Cross-section random value of 0.0000 is obtained. This value is less than 5% or 0.05. Therefore, Ha (the alternative hypothesis) is accepted, and Ho (the null hypothesis) is rejected. It indicates that the fixed effect model is accepted, implying that there are differences in the intercepts of the panel data regression model.

The results of the goodness-of-fit tests, including the Chow test, Lagrange Multiplier test, and Hausman test, all conclude that this study is more appropriate to use the fixed effect model. The adjusted R-squared value of the fixed effect model in this study is 0.99469. This value indicates that approximately 99.46 percent of the variation in the volume of card-based non-cash financial transactions in Indonesia is determined by Base Transceiver Station (BTS), Villages/Subdistricts Served by Internet, Automatic Teller Machines (ATMs), ATM/debit cards, and credit cards, while the remaining 0.54 percent is influenced by other variables outside this model.

The regression equation for the fixed effect model, as shown in Table 2, is as follows:

Y = 18,469.19 + 17.61BTS + 3.10DESA - 0.88ATM - 2.56KARTU

This equation can be interpreted as follows:

1. The constant value of 18,469.19 indicates that when the variables Base Transceiver Station (BTS), Villages/Subdistricts Served by Internet, Automatic Teller Machines (ATMs), ATM/debit cards, and credit cards are constant (zero), the growth of the volume of card-based non-cash financial transactions in Indonesia reaches 18,469.19 million transactions.
2. The regression coefficient value of Base Transceiver Station (BTS) is 17.61, meaning that for each increase of 1 unit in Base Transceiver Station (BTS), the volume of card-based non-cash financial transactions in Indonesia will increase by 17.61 million transactions.
3. The regression coefficient value of Villages/Subdistricts Served by Internet is 3.10, indicating that for each increase of 1 internet-served village, the volume of card-based non-cash financial transactions in Indonesia will increase by 3.10 million transactions.
4. The regression coefficient value of Automatic Teller Machines (ATMs) is -0.88, suggesting that for each increase of 1 ATM machine, the volume of card-based non-cash financial transactions in Indonesia will decrease by 0.88 million transactions.
5. The regression coefficient value of ATM/debit cards and credit cards is -2.56, meaning that for each increase of 1 unit of ATM/debit cards and credit cards, the volume of card-based non-cash financial transactions in Indonesia will decrease by 2.56 million transactions.

3.4. Hypothesis Testing

Simultaneous Test (F Test)

Based on Table 2, the Probability (Prob) value for the F-statistic is 0.000000. This value is less than 5% or 0.05. Therefore, hypothesis H1 is accepted, indicating that Base Transceiver Station (BTS), Villages/Subdistricts Served by Internet, Automatic Teller Machines (ATMs), ATM/debit cards, and credit cards collectively influence the volume of card-based non-cash financial transactions in Indonesia.

Partial Test (t-test)

The results of the partial tests can be seen from the Prob values for each independent variable in Table 2. These values imply the following:

1. The Prob value for Base Transceiver Station (BTS) is 0.1447. This value is greater than 5% or 0.05. Thus, hypothesis H2 is rejected, indicating that the influence of Base Transceiver Station (BTS) on the volume of card-based non-cash financial transactions in Indonesia is not significant.
2. The Prob value for Villages/Subdistricts Served by Internet is 0.4105. This value is greater than 5% or 0.05. Therefore, hypothesis H3 is rejected, indicating that the influence of internet-served villages on the volume of card-based non-cash financial transactions in Indonesia is not significant.
3. The Prob value for Automatic Teller Machines (ATMs) is 0.0012. This value is less than 5% or 0.05. Hence, hypothesis H4 is accepted, suggesting that the influence of ATM machines on the volume of card-based non-cash financial transactions in Indonesia is significant.
4. The Prob value for ATM/debit cards and credit cards is 0.0000. This value is less than 5% or 0.05. Thus, hypothesis H5 is accepted, indicating that the influence of ATM/debit cards and credit cards on the volume of card-based non-cash financial transactions in Indonesia is significant.

IV. DISCUSSION

The results of the F test show that simultaneously Base Transceiver Station (BTS), Villages/Subdistricts Served by Internet, Automatic Teller Machines (ATMs), ATM/debit cards and credit cards influence the volume of card-based non-cash financial transactions in Indonesia. This influence is strengthened by the results of the goodness of fit test that variations in the value of the volume of card-based non-cash financial transactions in Indonesia are determined by Base Transceiver Station (BTS), Villages/Subdistricts Served by Internet, Automatic Teller Machines (ATMs), cards ATM/debit and credit cards.

These results show that Information and Communication Technology (ICT) plays a very important role in the implementation of card-based non-cash transactions in Indonesia. Bank Indonesia (2022) reports that Information and Communication Technology (ICT) has facilitated ATM/debit card and credit card transactions in Indonesia in 2019 as many as 7,374.45 million transactions, but in 2020 it decreased to 6,928.91 million transactions, but increased again to 7,497.85 million transactions in 2021. The role of Information and Communication Technology (ICT) in non-cash financial transactions can also be seen in the transaction value which is quite fantastic. The transaction value in 2019 reached 7,817,506.65 billion Rupiah, in 2020 it decreased to 7,155,778.84 billion Rupiah, but in 2021 it increased again to 7,921,700.74 billion Rupiah.

Influence of Base Transceiver Station (BTS)

The main task of BTS is to send and receive radio signals to communication devices such as landlines, cellular phones and other types of gadgets, then the radio signals will be converted into digital signals which are then sent to other terminals into messages or data (Susanti and Rahardjo, 2017) [21].

The availability of the number and location of BTS placement affects the capacity and quality of the network received by users of cellular telephone or internet services. The more BTS, the easier and faster internet access will be [22] who researched 1800 MHz GSM Network Analysis in sectors that use frequency reuse on the quality of DKI Jakarta BTS services at PT. Telkomsel Indonesia, TBK concluded that Rx Level or network strength level influences the C/I or signal value as an indicator of the quality of the 1800 MHz GSM network.

However, the t test results show that the influence of the Base Transceiver Station (BTS) on the volume of card-based non-cash financial transactions in Indonesia is not significant. This happens because it turns out that most banks that carry out card-based non-cash transactions in Indonesia do not use internet connections from BTS, but internet connections from satellites and fiber optics (Rianto, 2017), even Bank Rakyat Indonesia uses its own satellite, namely BRISat (Primadhyta , 2017). Apart from using satellites, banks also use metro Ethernet or cable modems to strengthen their internet connections.

A communications satellite is an artificial satellite installed in outer space for the purpose of telecommunications using radio at microwave frequencies. Satellites play the role of receiving and transmitting information and communication signals throughout the world or across continents that are not connected by terrestrial communication technology networks (fiber optics and terrestrial radio). Optical fiber is a transmission line or a type of cable made of glass or plastic which is very smooth and smaller than a strand of hair, and can be used to transmit light signals from one place to another. The light source used is usually a laser or LED. This type of fiber optic cable is also often used in middle to high class network installations. Optical Fiber can be used by Automatic Teller Machine (ATM) and/or Electronic Data Captured (EDC) networks and cause internet signal usage from BTS to be reduced.

The Metro Ethernet network used by banks as an internet connection is a Metropolitan-area Network (MAN) network based on the Ethernet standard which has a wider reach. Metro Ethernet is short for metropolitan-area Ethernet. In simple terms, Metro Ethernet can be understood as an Ethernet technology with a wider scope (https://blog.lintasarta.net/article/metro-ethernet-pengertian-dan-apa-cepatnya). This network uses an internet connection from a direct satellite and does not depend on BTS.

Influence of Villages/Subdistricts Served by Internet

The results of the t test show that the influence of villages/sub-districts served by the internet on the volume of card-based non-cash financial transactions in Indonesia is not significant. This is because the internet network in Indonesia does not yet reach all villages/districts. Indonesian Internet Service Providers Association, (2018) in [23] stated that the development of internet facilities and infrastructure built by the Indonesian Government which was packaged in the Palapa Ring program until 2019 had not yet reached all regions of Indonesia, so that some areas could not yet be reached by the internet network, especially in Eastern Indonesia. Apart from that, the relationship between villages/sub-districts served by the internet is not significant with the volume of card-based non-cash financial transactions because 72.41 percent of the largest internet penetration is in urban areas, while in rural areas it is only 27.59 percent [23]. This is a sign that some rural areas in Indonesia are not yet able to enjoy communication network and internet facilities, so that villages/sub-districts served by the internet do not have a significant effect on the volume of card-based non-cash financial transactions in Indonesia in this research.

Influence of Automatic Teller Machines (ATMs)

The t-test results indicate that the influence of Automatic Teller Machines (ATMs) on the volume of card-based non-cash financial transactions in Indonesia is significant. This aligns with the research conducted by [24], which found that the quantity of ATMs increases customer interest in using banking service quality dimensions. ATMs provide convenience for non-cash transactions, and the more customers use ATMs, the higher the transaction volume.

However, the coefficient value of Automatic Teller Machine (ATMs) in this study is negative. This suggests that an increase in the number of ATMs will decrease non-cash card-based financial transaction volumes. This decline is due to the Indonesian government implementing Large-Scale Social Restrictions (PSBB) during 2019-2021 to prevent the spread of Covid-19, declared a global pandemic by the World Health Organization (WHO). The PSBB policy included measures such as avoiding crowds, working from home, and maintaining social distance.

In addition to government policies limiting social interactions in public places, the decrease in the volume of card-based non-cash financial transactions is also attributed to Automatic Teller Machines (ATMs) that were malfunctioning and were not removed from the total number of ATMs during the research period. Malfunctioning ATMs cannot process transactions, leading to a reduction in transaction volumes.

Influence of ATM/Debit Cards and Credit Cards

The t-test results show that the influence of ATM/debit cards and credit cards on the volume of card-based non-cash financial transactions in Indonesia is significant. This is because cards serve as instruments for non-cash financial transactions. This finding is consistent with research conducted by Wijaya et al. (2021) [25], which concluded that e-money and electronic transaction volume have a positive and significant impact on the money supply (M1) in Indonesia. More electronic transactions result in higher non-cash card-based transaction volumes.

However, the coefficient values for ATM/debit cards and credit cards are negative in this study. This indicates that an increase in the number of ATM/debit cards and credit cards will decrease the volume of card-based non-cash financial transactions. This is attributed to the global Covid-19 pandemic that affected the world, including Indonesia, from 2019 to 2021. This pandemic led the Indonesian government to implement Large-Scale Social Restrictions (PSBB) in public places to curb the spread of Covid-19, reducing non-cash financial transactions. Some countries even enforced lockdowns due to the global Covid-19 pandemic, as seen in New Zealand. According to [26], young households' consumption during lockdowns in New Zealand was more unstable compared to older households with resources to insure themselves against employment shocks. This situation shows that the global Covid-19 pandemic also affected financial transactions, including non-cash card-based transactions.

Additionally, the decrease in the volume of card-based non-cash financial transactions can be attributed to the emergence of digital cash in Indonesia's economy, which has shifted the role of prepaid cards as transaction instruments. Digital cash, as described by Soekarni et al., [27], and [28].

1. Involves storing the value of money in a personal computer or device (e.g., a mobile phone) connected to the bank's network.

2. Transactions and payments are made through communication networks (internet, web, or telephone) as a means of transferring value/payment.

3. Virtual payment transaction services.

Digital cash offers advantages over cards (prepaid cards), as it eliminates the need for cards to store balance, with balances stored in users' devices connected to the bank's network, simplifying value transfer/payment without requiring ATM machines.

Apart from government policies limiting social interactions in public places and the presence of digital cash, the decrease in non-cash card-based financial transaction volumes can also be attributed to the fact that malfunctioning ATM/debit cards and credit cards were not excluded from the total number of cards during the research period. Malfunctioning cards cannot be used as transaction instruments, resulting in a decrease in transaction volumes.

V. CONCLUSION

Based on the results and discussions, this research concludes as follows, information and Communication Technology (ICT) infrastructure to support digitization, especially non-cash card-based financial transactions, has developed well in Indonesia, although some areas require improvement. This is evident from the growth of several infrastructure components. Infrastructure that experienced growth during the period from 2019 to 2021 includes Base Transceiver Stations (BTS), villages/sub-districts served by the internet, and ATM/debit cards. Conversely, infrastructure that declined during this period includes Automatic Teller Machines (ATMs) and credit cards. ICT infrastructure access has successfully facilitated non-cash card-based financial transactions in Indonesia.

TwoThe variables representing ICT infrastructure access, including Base Transceiver Stations (BTS), villages/sub-districts served by the internet, Automatic Teller Machines (ATMs), and ATM/debit cards and credit cards, collectively have a significant influence on the volume of card-based non-cash financial transactions in Indonesia. However, when analyzed individually:

a. Base Transceiver Stations (BTS) do not have a significant influence on the volume of card-based non-cash financial transactions. This is due to the fact that most banks conducting non-cash card-based transactions do not use BTS for internet connectivity; instead, they rely on internet connections through fiber optics, metro Ethernet, or cable modems.

b. Villages/sub-districts served by the internet do not have a significant influence on the volume of card-based non-cash financial transactions. This is because the infrastructure development in the Palapa Ring program has not yet covered all regions of Indonesia, preventing some areas from having internet access. Furthermore, the inpact between villages/sub-districts served by the internet on non-cash card-based financial transaction volumes is not significant, mainly because 72.41 percent of the highest internet penetration is in urban areas, while rural areas account for only 27.59 percent.

c. Automatic Teller Machines (ATMs) have a significant influence on the volume of card-based non-cash financial transactions. This is because non-cash card-based transactions are processed through Automatic Teller Machines (ATMs).

d. ATM/debit cards and credit cards have a significant influence on the volume of card-based non-cash financial transactions. This is because non-cash card-based transactions use ATM/debit cards and credit cards, which store monetary value.

Recommendations

The Indonesian government should enhance the signal strength of Base Transceiver Stations (BTS) to enable their use as internet connections for banking transactions, especially as non-cash financial transactions transition from prepaid cash cards to digital cash as a means of financial transaction.

The Indonesian government and relevant stakeholders should work to expand internet connectivity into villages, allowing non-cash card-based financial transactions to reach even the remotest areas.

The Indonesian government should encourage providers to increase and evenly distribute Automatic Teller Machines (ATMs) to villages that currently lack them, provided that the Information and Communication Technology (ICT) infrastructure is sufficient.

The Indonesian government and Bank Indonesia should promote the use of ATM/debit cards and credit cards as payment instruments and educate the public about the security of their deposits against cybercrimes.

Future researchers are encouraged to extend the research period (time series data) to broaden the scope of research regarding the influence of Base Transceiver Stations (BTS), Automatic Teller Machines (ATMs), Automatic Teller Machines (ATMs), ATM/debit cards, and credit cards on the volume of card-based non-cash financial transactions in Indonesia.

REFERENCES

1. Untari, R., Priyarsono, D.S., & Novianti, T. (2019). Impact of Information and Communication Technology (ICT) Infrastructure on Economic Growth and Income Inequality in Indonesia. *International Journal of Scientific Research in Science Engineering and Technology*, 109-116. http://dx.doi.org/10.32628/IJSRSET196130
2. Sarangi, A.K., & Pradhan, R.P. (2020). ICT infrastructure and economic growth: a critical assessment and some policy implications. *Decision*, 47, 363–383. https://doi.org/10.1007/s40622-020-00263-5
3. Alshubiri F, Jamil SA, & Elheddad M. (2019). The impact of ICT on financial development: Empirical evidence from the Gulf Cooperation Council countries. *International Journal of Engineering Business Management*;11. doi:10.1177/1847979019870670
4. Asongu, S. A., Nwachukwu, J. C., & Tchamyou, V. S. (2016). Information asymmetry and financial development dynamics in Africa. *Review of Development Finance*, *6*(2), 126-138. https://hdl.handle.net/10520/EJC-831373a19
5. Wasiaturrahman, W., Wahyuningtyas, Y.T., Ajija, S.R. (2019). Non-Cash Payment and Demand for Real Money in Indonesia. *Journal of Economics Business and Accountancy Ventura*, 22(1), 1-8. http://dx.doi.org/10.14414/jebav.v22i1.1575
6. Safitri, D. (2022). Human Behavior Affects the Implementation of Non-Cash Transaction. Proceedings, The 3rd International Conference in Social Science University of Merdeka Malang, November 4-5, 3(1), 231-235. https://jurnal.unmer.ac.id/index.php/iconiss
7. The World Bank. (2021). Ensuring a More Inclusive Future for Indonesia through Digital Technologies. https://www.worldbank.org/en/news/press-release/2021/07/28. Access 9/20/2023
8. Pradhan, R.P., Mallik, G., & Bagchi, T.P. (2018). Information communication technology (ICT) infrastructure and economic growth: A causality evinced by cross-country panel data. *IIMB Management Review*, 30(1), 91-103. https://doi.org/10.1016/j.iimb.2018.01.001
9. Bankole, F. O., Osei-Bryson, K., & Brown, I. (2013). The impact of information and communication technology infrastructure and complementary factors on Intra-African trade. *Information Technology for Development*, 21(1), 12-28 http://dx.doi.org/10.1080/02681102.2013.832128
10. Rahman, I.K., & Bohlin, E. (2014). Decomposition analysis of the telecommunications sector in Indonesia: What does the cellular era shed light on?, Telecommunications Policy, 38(3), 248-263. https://doi.org/10.1016/j.telpol.2013.10.006
11. Shahiduzzaman, M., & Alam, K. (2014). The Long-run Impact of Information and Communication Technology on Economic Output: The Case of Australia. *Telecommunications Policy*, 38(7), 623– 633. https://doi.org/10.1016/j.telpol.2014.02.003
12. Dinati, F.N.I., Santosa, F.RE., & Nasihien, R.D. (2021). The Impact of Tower Base Transceiver Station (BTS) Infrastructure Development on the Resident Environment. *International Journal of Engineering, Science & InformationTechnology (IJESTY)*, 1(2), 7-12. http://dx.doi.org/10.52088/ijesty.v1i2.48
13. Satria, D., Alanda, A., Erianda, A., & Prayama, D. (2018). Network Security Assessment Using Internal Network Penetration Testing Methodology," JOIV Int. J. Informatics Vis. http://dx.doi.org/10.30630/joiv.2.4-2.190
14. Sampaio, R. R., De Barros Pereira, H. B., & Rosa, C. P. (2012). Mapping information and knowledge flow: IT governance from the perspective of social networks," Gest. e Prod. http://dx.doi.org/10.1590/S0104-530X2012000200011
15. Zendrato, N., & Zarlis, M. (2020). Analysis of Mamdani Method to Increase the Level of the Advantages of Infrastructure Development for Optimal Network," in IOP Conference Series: Materials Science and Engineering, 2020, http://dx.doi.org/10.1088/1757-899X/769/1/012053
16. Ariefianto, M.D. (2012). *Ekonometrika Esensi dan Aplikasi dengan Menggunakan Eviews*. Jakarta: Erlangga. https://lib.ui.ac.id/detail.jsp?id=20393857

17. Hardani., Ustiawaty, J., Andriani, H., & Istiqomah, R.R. (2020). Buku Metode Penelitian Kualitatif & Kuantitatif. Yogyakarta: CV. Pustaka Ilmu Group. https://www.researchgate.net/publication/340021548_Buku_Metode_Penelitian_Kualitatif_Kuantitatif/citation/download?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIn19
18. Widarjono, A. (2018). *Ekonometrika Pengantar dan Aplikasinya*, Edisi Kelima. Yogyakarta: UPP STIM YKN.
19. Widarjono, A. (2009). *Ekonometrika Pengantar dan Aplikasinya*, Edisi Ketiga. Yogyakarta: Ekonesia.
20. Gujarati, D.N. (2012). *Dasar-dasar ekonometrika buku 2 edisi 5*. Jakarta: Salemba Empat
21. Susanti & Rahardjo, N. (2017). *Evaluasi Cakupan Sinyal BTS Secara Spasial di Sebagian Kabupaten Buleleng Provinsi Bali*. https://media.neliti.com Access, 12 Oct 2023.
22. Ariska, C., Djatmiko, W., & Diamah, A. (2018). Analisis Jaringan GSM 1800 MHz pada sektor yang menggunakan *frequency reuse* terhadap kualitas pelayanan BTS DKI Jakarta di PT. Telkomsel Indonesia, TBK. *Jurnal Pendidikan Vokasional Teknik Elektronika,* 1(2), 20-24. http://journal.unj.ac.id/unj/index.php/jvote/article
23. Adiningsih, S., Lakollo, E.M., Nariswari, S., Ardiansyah, S.R., Islam, M., & Rahmawaty, U.F.R. (2019). *Transformasi Ekonomi Berbasis Digital di Indonesia*. Jakarta: PT. Gramedia Pustaka Utama.
24. Ramadani, L.A., Azizoma, R., & Arifin, Z. (2021). Pengaruh Dimensi Banking Service Quality (BSQ) Terhadap Minat Nasabah Bank Syariah. *Iqtishaduna*, 12(2). 264-272. https://journal.uinmataram.ac.id/index.php/iqtishaduna/article/view/4329
25. Wijaya, A.Y., Mukhlis, I., & Seprillina, L. (2021). Pengaruh E-Money terhadap permintaan uang pada sebelum dan sesudah Covid-19. *Jurnal Ekonomi, Bisnis dan Pendidikan*, 1(2), 135-145. https://doi.org/10.20885/JKEK.vol1.iss2.art5
26. Graham, J., & Ozbilgin, M. (2021) Age, industry, and unemployment risk during a pandemic lockdown. *Journal of Dinamic Economis and Control* 133, 104233., 1-25. https://doi.org/10.1016/j.jedc.2021.104233
27. Soekarni, M., Hastutu, F., & Bimantoro, S. (2021). *Studi empiris dampak perkembangan teknologi informasi pada kegiatan B@ank Sentral*. Pusat Pendidikan dan Studi Kebanksentralan Bank Indonesia. Jakarta
28. Zai, A.Z., Ismail, K., Syahputra, D.S., & Pitri, A. (2021). Dampak Perkembangan Teknologi Informasi Dan Komunikasi Terhadap Budaya. http://dx.doi.org/10.13140/RG.2.2.31426.81605