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The Impact of Digital Currency on Demand for Money: Evidence from Indonesia

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ABSTRACT: The purpose of this study is to examine the impact of digital currency transaction variables on the demand for money in Indonesia. The data used are data on the volume of mobile banking transactions, internet banking, interest rates, the level of currency fluctuations, and inflation on the demand for money for the period 2013 to 2022.
Data analysis uses Autoregressive Distributed Lag (ARDL) cointegration method. The results of regression testing can be concluded that the long-term relationship is valid. In addition, using CUSUM and CUSUMQ from the quadratic test, the demand for money in Indonesia is relatively stable using the narrow definition of money, it implies that there haven't been significant and persistent shifts in either the mean or the variance of the narrow money supply.
A stable demand for money suggests that the economic agents in Indonesia, such as households and businesses, are not undergoing substantial changes in their preferences or behaviors related to holding money. This stability can have implications for monetary policy and economic planning, as it indicates a certain level of predictability in the demand for money.
However, it's crucial to keep in mind that economic conditions and factors influencing the demand for money can change over time. Therefore, continuous monitoring and periodic reassessment of the stability of the demand for money are necessary for accurate economic analysis and policy formulation.

KEYWORDS: mobile banking, internet banking, and debit card banking, interest rates, exchange rate, inflation, demand for money

INTRODUCTION

Replacement of electronic money, whether in terms of the influence on money supply and of the influence on the demand for money, is especially important because firstly, fluctuations in money market will cause fluctuations in other macro markets; and secondly, influence of monetary policy will be questioned, considering the money demand reduction under circumstances similar to Keyness liquidity trap. Unlike money published by the central bank, electronic money is internal money. In other words, electronic money is like demand deposit owed by the holder from money publisher [1], [2], [3], [4], [5], [6].

Certainly, spurred by the recent progress in technology-centric payment systems like mobile payments, cryptocurrencies, and blockchain technologies, central banks globally have been actively considering the feasibility of introducing digital versions of traditional fiat currency known as central bank digital currencies (CBDC). So, it is obvious that while reducing the central bank's income from budget of publishing banknotes [7], [8], [9], publishing electronic money increases the money supply. In addition to the above, considering that the electronic money is able be replaced instead of banknote and coin, it will be possible to gradually replace electronic money instead of the central bank's money.

Most people don’t see a difference between cash and digital payments, beyond the obvious fact that paying with cash involves exchanging physical money, whereas digital transactions do not. But there is also a subtler difference. Cash is public money – it is a liability of the central bank and thus perfectly safe. By contrast, digital money originates in the private sector, most commonly in the form of bank deposits. Despite being the liability of a private entity, money issued by banks can always be converted to cash at face value thanks to financial regulation and deposit insurance. This is why people consider it to be safe and useful as a means of payment [10], [11], [12], [13], [14].

The rise of digital platforms as a dominant business model of the information age is challenging the central role of banks in the payment system. Large technology firms and financial startups are bundling payments with digital services, such as online marketplaces, messaging apps and financial services (for example lending and insurance). While banks continue to provide the underlying payment rails for these solutions, they are losing access to the customer interface. Further disruption is potentially looming on the horizon, caused by rapidly developing and complex payment innovations. This includes distributed ledger technology, which provides the basis for stable coins which crypto-assets designed to maintain a stable value that could be used as means of payment. Along with the rapid use of non-cash payment instruments, both card-based (such as ATMs, credit cards and debit cards, whether linked to an account or not) as well as non-cash payments through clearing and Real Time Gross Settlement (RTGS) , an increase in transactions and economic activity. Meanwhile, on the other hand, the increase in economic activity stimulated an increase in the need for non-cash payment instruments.

The increasing increase in non-cash payments indicates that this type of payment is preferred by the public to cash payments, which is partly due to the low transaction costs, the minimum time and effort required, and the absence of time and place constraints for transactions. The increase in non-cash payments was partly driven by developments in information technology and telecommunications.

It is estimated that the volume and value of non-cash payment transactions will continue to increase, in line with the increasing development and use of technology and economic growth. However, so far the magnitude of the impact of the increase in non-cash payments on the economy, in this case GDP and inflation, has not been conclusive. This is also the case with the implications for monetary control carried out by Bank Indonesia. Therefore it is interesting to conduct research on this matter, especially in order to obtain the magnitude of the impact of the increase in non-cash payments that is measurable through appropriate models.

Based on the review above, the objective of this research is to find out and obtain empirical evidence about:

1. The influence of mobile banking transactions on the demand for money (M1) in Indonesia both in the long and short term?
2. The influence of internet banking transactions on the demand for money (M1) in Indonesia both in the long and short term?
3. The influence of debit card banking transactions on the demand for money (M1) in Indonesia both in the long and short term?
4. The influence of interest rates on the demand for money (M1) in Indonesia both in the long and short term?

LITERATURE REVIEW

Money and Digital Currency

According to Mankiw economists [15]argue that all wealth is not only refers to the amount of money one has but money is only one type of wealth. Money is used to make transactions and acts as a stock of assets when making transactions. According to economists, a person is said to be rich if he has a large stock of assets in the form of money. Unlike Mankiw's opinion, according to Frederic S. Mishkin (Mishkin, 2008), there is a special meaning of money for economists. Money has different forms, both money in currency, checking accounts, and other forms held by the community. In contrast to the notion that the richer a person holds more money, economists argue that money is divided into assets that are used to make transactions. Another difference in opinion is that there is a definition of money that is the same as income while economists argue that money also has the meaning of money in circulation and is used in general to process payment transactions for goods or services that will be received by the public.

Money is the num´eraire of the economy and, more importantly, it is the medium exchange used to meet future payments. In mature monetary economies, money has two main features [17], [18], [19], [20]: (1) money has no intrinsic value, and (2) it is universally accepted for trading good and services. Conventional wisdom says that “money is what money does”. That is, money is a unit of account, a means of payment and a store of value. Another economist pronounces “They are money because people accept them as money. For this to happen, money must do three things. First, money must serve as a medium of exchange. The alternative is bartering, but that is complicated and inefficient [11], [21], [22], [23]

Second, money must serve as a store of value. Finally, money must serve as a unit of account. Hicks explained the different roles that money plays in a single-period theory and in a continuation theory [23], [24]. Money is a flow of means of payment that is naturally created during the economic process (especially but not exclusively the production process) and used for the circulation of commodities. Furthermore, in a world of uncertainty, money is also a stock, a store of wealth held to meet unforeseeable payments. Money is a social convention where one party accepts it as payment bin the expectation that others will do so too. Money denominated in a particular currency (money in a traditional sense) includes money in a physical format (notes and coins, usually with legal tender status) and different types of electronic representations of money, such as central bank money (deposits in the central bank that can be used for payments) or commercial bank money [20], [23], [25].

Money in Modern Era

Over the ages, various forms of private money have come and gone. Some have lasted longer than others, but they have given way to central bank money. Financial innovations have allowed people to conduct economic transactions far beyond the constraints imposed by physical currency [1], [9]. Recent innovations have allowed users to move away from paperbased exchange systems (such as checks) to electronic systems (such as swiping debit cards through a point-of-sale card reader) to using near-field communication (NFC) technology to enable radio communication through mobile-computing platforms (such as via applications on smartphones) [1], [5]. As with the 13th-century bills of exchange, these innovations are convenient mechanisms that allow users to use traditional currencies more efficiently. Unlike VCs, they do not constitute new currencies.

The reasons for this resilience of central bank money are of particular interest given current debates about digital currencies - cryptocurrencies and how far they will supplant central bank money. Central Bank Digital Currency is money that is characterized by two features: (1) like banknotes in circulation, CBDC is a claim on the central bank; (2) in contrast to banknotes, it is digital. The importance of common knowledge is especially relevant in monetary economics in the age of distributed ledger technology (DLT) and Bitcoin, as one interpretation of money is as a score-keeping device on the history of past transactions [4], [7], [26].

Digital currency definition according to the international institutions: European Central Bank (2012): “a virtual currency is a type of unregulated, digital money, which is issued and usually controlled by its developers, and used and accepted among the members of a specific virtual community.” “Virtual currency is a digital representation of value that can be digitally traded and functions as (1) a medium of exchange; and/or (2) a unit of account; and/or (3) a store of value, but does not have legal tender status (i.e., when tendered to a creditor, is a valid and legal offer of payment) in any jurisdiction. Committee on Payments and Market Infrastructures (CPMI): “digital currency” as any electronic form of money, or medium of exchange that features a distributed ledger and a decentralized payment system. “Digital currency is an asset stored in electronic form that can serve essentially the same function as physical currency, namely, facilitating payments transactions. Central bank digital currency refers to money that meets the following criteria [4], [6], [7], [27], [28]:

The central bank issues it in digital form.

Anyone has the right to hold it. It is not a privilege reserved to e.g. credit institutions.

It is the same currency as banknotes and central bank deposits. The conversion rate of Bank notes and zero-interest bearing digital cash would always be one-to-one, and at least some economic entities, e.g. banks, could convert it freely into other types of central bank money.

It can be used as a payment instrument in retail payments.

When two parties engage in a transaction, there is no third party – at least not a private one - that verifies or executes the payment as a central counterparty. The same principle applies to banknote payments.

RESEARCH METHOD

Research Design

There are several common techniques use to estimate cointegrating relationship on money demand. There is an estimation based on residual approach such as Engle & Granger, (2015) and a maximum likelihood base such as Soren & Katarina, (1990). Those methods required all the variable has the same order of integration. When the variable contains different order of integration, the estimation cannot be accurate. To solve this problem, [31]proposed an Autoregressive Distributed Lag (ARDL) cointegration method. ARDL cointegration method does not require the variables to have the same order of integration. Other advantages of ARDL are: 1) it takes sufficient lags to capture data generating process in general to a specific modeling; 2) it generatesa dynamic error correction model through a simple transformation.

The Model and Tool Analysis

Dynamic equation is based on an auto regression model, which can be showed for a model Auto Regressive Distributed Lag, ARDL (p, q, q2,…, qk), as follows:

$$\alpha(L,p)Y_t = \sum_{i=1}^{k} \beta_i(L,q_i)X_{it} + \delta' W_t + U_t$$

i = 1, 2 … k

Where:

Wt : a vector of certain (non-random) variables such as the intercept, the trend variable, dummy variables or endogenous variables with constant lags.

Pt : the lags used for dependent variable

Qt : the lags used for independent variables

Xt : the independent variable;

Yt : the dependent variable

L : the lag operator which is defined as follows:

LjYt = Yt− j

In above equation, the following relations are satisfied:

$$\alpha(L,p) = 1 - \alpha_1 L - \alpha_2 L^2 - \ldots - \alpha_p L^p$$

$$\beta_i(L,q_1) = 1 - \beta_{i1} - \beta_{i2} L^2 - \ldots - \beta_{iq} L_{qi}$$

Estimation of long-run relationship can be done in two stages with the auto regressive distributed lag (ARDL) method. In the first stage, long-run relationship between the study variables is tested in the above manner:

If the total estimated coefficients related to the lags of dependent variable (αi) is smaller than 1, dynamic pattern tends to long-run equilibrium. So, to test co integration, it is necessary to test the following hypothesis:

Quantity of T statistic required for the above test is calculated as follows

$$H \quad \geq 0$$
$$H^t = \frac{\sum_{i=1}^{p} \hat{\alpha} - 1}{\sum_{i=1}^{p} S\hat{\alpha}_i} \leq 0$$

Where, S indicates standard deviation of dependent variable lags coefficients. If the absolute value of the obtained t statistic is greater than the absolute value of critical values null hypothesis will be rejected, and a long-run relationship will be accepted. If the long-run relationship between model variables is proved, the estimation and analysis of long-run coefficients and inference about their value can be done in the second stage. Long-run coefficients of explanatory variables are calculated according to the following equation:

$$\hat{\theta}_i = \frac{\hat{\beta}_{i0} + \hat{\beta}_{i1} + \hat{\beta}_{i2} + \ldots + \hat{\beta}_{i\hat{q}_i}}{1 - \hat{\alpha}_1 - \hat{\alpha}_2 - \ldots - \hat{\alpha}_{\hat{p}}}$$

Where, P and q , for i = 1, 2, 3, ..., k are values selected P and q , based on one of the criteria to determine lag. One important goal concerning the auto regressive distributed lag model is to determine the optimal lags. If the suitable lags are considered for this model, estimators of ordinary least squares are compatible in the short run parameters; and estimations obtained from the autoregressive pattern with distribution lag in long run are ultra-compatible.

Considering The Rinaldi model in the time-series method, the following model is recommended for estimating the money demand function in Indonesia:

M1t = α0 + α1MBt + α2IBt + α3DCt + α4ERt + α5IRt + α6Pt + εt

Where:

M1t : Real volume of coins and banknotes handled by the people, M1/P MBt : number of transactions using m-banking

IBt : number of transactions using i-banking

DCt : number of transaction using debit cards Pt: inflation rate IRt : short-run interest rate of bank deposits (3 month)

ERt : exchange rate Pt: inflation rate

εt : disturbance component

As stated in Pesaran and Pesaran (1997), the ARDL procedure contains two steps. First, the existence of the longrun relation between the variables in the system is tested. In other words, the null hypothesis of no cointegration or no long-run relationship defined by H0 : λ1 = λ2 = λ3 = λt = 0 is tested against its alternative H1 : λ1≠ 0, λ2 ≠ 0, λ3 ≠ 0, λt ≠ 0 by computing the F-statistics. The distribution of this F-statistics is nonstandard irrespective of whether the variables in the system are I(0) or I(1). The critical values of the F- statistics. They provide two sets of critical values in which one set is computed with the assumption that all the variables in the ARDL model are I(1), and another with the assumption that they are I(0). For each application, the two sets provide the bands covering all the possible classifications of the variables into I(0) or I(1), or even fractionally integrated ones. If the computed F-statistics is higher than the appropriate upper bound of the critical value, the null hypothesis of no cointegration is rejected; if it is below the appropriate lower bound, the null hypothesis cannot be rejected, and if it lies within the lower and upper bounds, the result is inconclusive.

When the results of F-statistics in the first step support the evidence of the existence of cointegration between variables, we move to the second step of ARDL approach. In this step, the lag orders of the variables are choose using Akaike Information Criteria (AIC) or Schwarz Bayesian Criteria (SBC). The step of selecting the lag orders of variables is very important because the appropriate lag selection enables us to identify the true dynamics of the models. To check the performance of the estimated model, we also present the diagnostic tests associated with the model that examine the serial correlation, functional form, and heteroscedasticity. Additionally, in this paper the stability tests, namely, CUSUM (Cumulative Sum) and CUSUMSQ (CUSUM of Squares) of recursive residuals, are also conducted.

Estimation Data and Sample

We use monthly data from Banking Statistics published by Financial Service Authority (OJK) for our analysis. The sample period is from 2013:01 to 2022:12. This sample period is chosen due to the availability of the data of all variables in the model. The demand of money balances is proxied by the monetary aggregate, M1, which consists of Indonesian Rupiah (IDR) in circulation outside banks and Rupiah denominated demand deposits in banking system. The seasonally adjusted data of M1 are available from IFS. These data are converted into real balances by using Consumer Price Index (CPI). The major obstacle for the case of Indonesia is how to choose the scale variable.

To overcome this, we adopt the method of quadratic interpolation to generate the annual data of real GDP into its monthly value. This method is often used by many researchers for empirical studies of money demand function in developing countries. The nominal exchange rate (period average) data are defined as the amount of Cambodian Riel per unit of US dollar.

FINDINGS

Descriptive Statistics

Table 1

Descriptive Statistics

	DC	ER	IB	IR	M1	MB	P
Mean	16702.29	12004.61	1465505.	5.586783	1020535.	203011.9	96.88698
Median	2822.500	12967.50	1291138.	5.453280	958478.5	125942.0	98.78206
Maximum	73701.00	15227.00	3186964.	8.310000	1513520.	726558.0	115.2201
Minimum	367.0000	8508.000	636723.0	3.340000	571337.2	34230.00	77.49773
Std. Dev.	22481.18	2042.405	583768.7	1.098563	273944.7	179283.0	11.71125
Skewness	1.158204	-0.440590	0.913986	0.482704	0.177085	1.266868	-0.157002
Kurtosis	2.863040	1.674248	3.117506	2.333501	1.822372	3.748821	1.649519
Jarque-Bera	23.78156	11.19226	14.81918	6.078358	6.679079	30.83076	8.490584
Probability	0.000007	0.003712	0.000605	0.047874	0.035453	0.000000	0.014332
Sum	1770443.	1272489.	1.55E+08	592.1990	1.08E+08	2151962	10270.02
Sum Sq. Dev.	5.31E+10	4.38E+08	3.58E+13	126.7183	7.88E+12	3.37E+12	14401.10
Observations	106	106	106	106	106	106	106

Stationarity Test

From the test results, it was found that most of the variables in the study were in a stationary position at the first difference level, and all variables were stationary at the second difference level. The stationarity of each variable can be determined by comparing the ADF Test Statistics values.

Table 2. Uji Augmented Divker-Fuller

No.	Variabel	Uji Augmented Dickey-Fuller					
		Level			First different		
		t-stat	signifikansi	keterangan	t-stat	signifikansi	keterangan
1	M1	0.061157	0.9610	Non stasionary	-2.282794	0.1797	Non stasionary
2	MB	7.259693	1.0000	Non stasionary	-1.495267	0.5321	Non stasionary

3	DC	1.501327	0.9992	Non stasionary	-12.75701	0.0000	Stasionary
4	IB	1.241424	0.9983	Non stasionary	-13.27508	0.0000	Stasionary
5	IR	-1.864713	0.3477	Non stasionary	-12.94504	0.0000	Stasionary
6	ER	-1.157289	0.6906	Non stasionary	-11.34447	0.0000	Stasionary
7	P	-0.635760	0.8569	Non stasionary	-9.357427	0.0000	Stasionary

Test critical values:	1% level	-3.502238
	5% level	-2.892879
	10% level	-2.583553

Results of the data stationarity test using the method Augmented Dickey-Fuller (ADF) at the level level shows that the probability of all variables are > 0.05 so they are not stationary at level level. If there is data that is not stationary at level level, it is necessary to carry out a stationarity test at the next stage, namely level first difference. On testing first difference also uses the ADF method. The above are also the results of the stationarity test at level first difference. Based on these two stationarity tests, it means that the research variables have met the first requirement for ARDL testing, namely that all variables must be stationary at level or first difference and may not use data that is stationary at a level second difference. But the estimation still operates and valid to do so with different stationery.

Conduct long-term, longitudinal studies to track the evolution of mobile banking adoption patterns over extended periods. Examine how these patterns correlate with inflation and interest rate trends, providing a more comprehensive understanding of the sustained impact on the demand for digital money. Explore the regulatory challenges and opportunities associated with the intersection of mobile banking, inflation, and interest rates. Investigate the implications of cross-sector collaboration between financial institutions, technology firms, and regulatory bodies in shaping the landscape of mobile transactions amid economic fluctuations.

Explore the potential integration of blockchain technology and decentralized finance (DeFi) into the mobile banking ecosystem. Investigate how these emerging technologies can address inflation concerns, provide alternative interest rate mechanisms, and impact the demand for traditional forms of money in mobile transactions. Investigate the resilience of mobile banking systems in the face of economic shocks. Analyze how well these systems can adapt to sudden changes in inflation and interest rates and assess their role in stabilizing financial transactions during periods of economic uncertainty.

CONCLUSIONS

In this study, the demand for money in Indonesia has been estimated using ARDL approach to cointegration analysis. The ARDL method does not generally require knowledge of the order of integration of variables. The results of the long run regression, reveal that Mobile Banking MB, Exchange rate ER and inflation P are associated with Money Demand M1 with different sign, where only MB has positive impact. The negative effect of inflation rate on M1 supports our theoretical expectation that as the inflation rate rises, the demand for money falls. This indicates that people prefer to substitute physical assets for money balances. The negative effect of exchange rate on M1 indicates that depreciation of domestic money decreases the demand for money, opposing the wealth effect argument. The other independent variable such internet Banking IB, Debit Card DC and interest rate are not having impact on money demand in the long run.

Following recent trends in cointegration analysis, this paper demonstrates that cointegration does not imply stability. By incorporating CUSUM and CUSUMSQ tests into cointegration analysis, it is revealed that while M1 money demand is stable, M2 is not. Thus, it may be concluded that M1 is a better monetary aggregate in terms of formulating monetary policy and central banks control.

This research analyses the stability of money demand in Indonesia. The data used covers the period 2013:1 to 2022:12. Additionally, models autoregressive distributed lag (ARDL) is used to test the long-term relationship between the M1 monetary aggregate and its determinants. The results of regression testing can be concluded that the long-term relationship is valid. In addition, using CUSUM and CUSUMQ from the quadratic test, the demand for money in Indonesia is relatively stable using the narrow definition of money (M1).

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