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The Application of Logistic Regression to Measure the Impact of Covid-19 Pandemic on Household Credit Financing

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ABSTRAK

Penyebaran Covid-19 berdampak langsung pada sektor ekonomi. Dampak Covid-19 terhadap sektor ekonomi dapat dilihat dari Non Performing Loan (NPL). Pembiayaan kredit berpengaruh terhadap Stabilitas Sistem Keuangan. Selanjutnya, rumah tangga menjadi sektor yang paling terdampak Covid-19, karena pendapatan rumah tangga diperoleh dari sektor lain yang juga terkena dampak penyebaran Covid-19. Dampak ini dapat dilihat dari sisi pendapatan, tabungan/aset, dan konsumsi. Penelitian ini bertujuan untuk menganalisis dampak Covid-19 yang diukur dari variabel pendapatan, tabungan/aset, dan konsumsi terhadap pembiayaan kredit rumah tangga menggunakan Model Regresi Logistik. Hasil pemodelan menunjukkan bahwa variabel konsumsi dan tabungan tidak berpengaruh signifikan terhadap pembiayaan kredit rumah tangga, sedangkan variabel pendapatan berpengaruh signifikan dan mampu memprediksi 15,5% terhadap variabilitas pembiayaan kredit rumah tangga. Selanjutnya berdasarkan nilai odds ratio model diperoleh informasi bahwa pengaruh penurunan pendapatan rumah tangga selama pandemi Covid-19 berpengaruh 1 kali terhadap nilai odds ratio pembiayaan kredit rumah tangga. Secara keseluruhan, model mampu memprediksi data dengan benar sebesar 81,4%.

Kata Kunci: regresi logistic, pandemic covid-19, ekonomi, pembiayaan kredit rumah tangga

ABSTRACT

The spread of the Covid-19 outbreak has a direct impact on the economic sector. The impact of Covid-19 on the economic sector can be seen from Non-Performing Loans (NPL). Credit financing affects the Financial System Stability. Furthermore, households are the sector most affected by Covid-19, because household income is obtained from other sectors that are also affected by the spread of Covid-19. This impact can be seen in terms of income, savings/assets, and consumption. This study aims to analyze the impact of Covid-19 as measured by the variables of income, savings/assets, and consumption on household credit financing using the Logistic Regression Model. The modelling results show that the consumption and savings variables do not have a significant effect on household credit financing, while the income variables have a significant effect and are able to predict 15.5% of the variability of household credit financing. Furthermore, based on the odds ratio value of the model, information is obtained that the effect of decreased household income during the Covid-19 pandemic affected one time on the value of the odds ratio for household credit financing. Overall, the model was able to predict the data correctly by 81.4%.

Keywords: logistic regression, covid-19 pandemic, economics, household credit financing

INTRODUCTION

Covid-19 (Coronavirus Disease 2019) is a public health emergency of international concern. The Covid-19 virus is the fifth pandemic after the 1918 flu pandemic [1]. The first report of this case on December 1, 2019, was found in Wuhan, China [2]. The symptoms of a patient exposed to this virus, such as fever, malaise, dry cough, and dyspnea, were diagnosed as viral pneumonia [3]. Patients who had a history of severe disease constitute about 15% of cases [4]. Until now, there is no specific, effective, and proven pharmacological treatment [5].

Covid-19 is a global problem that has a direct impact on Indonesia. All sectors have been affected by the widespread Covid-19 outbreak, including the economic sector. Various policies have been made by the Government

of Indonesia, such as social distancing or physical distancing, large-scale social restrictions (PSBB), imposition of curfews, etc. Some regions also apply lockdown policies locally. This has hampered economic activity. On the other hand, various efforts have been made by the government of Indonesia to ensure that the economy continues to run, such as making changes to the budget and providing fiscal stimulus [6].

In an interconnected and integrated world, the impact of Covid-19 is a death threat and a serious threat to people who cannot work due to various policies made by the government. Not to mention the panic of consumers and producers in facing Covid-19, changing their usual consumption patterns and creating market anomalies [7].

Maria Nicola divides several sectors affected by Covid-19. The main sectors affected are agriculture, oil, and gas, while the other sector is the manufacturing industry. The other sectors that are also affected are the education sector, the financial sector, the health and pharmaceutical sector, the tourism, service and aviation sector, the housing development sector, the sports industry sector, the information, technology and media sector, and the food sector [8]. Thus, almost no one has escaped the impact of the Covid-19 pandemic. The affected sectors, of course, also have an impact on the employees who work in them.

The impact of Covid-19 on the economic, financial, and banking sectors can be seen from the non-performing loans (NPL) of banks, which experienced a slight increase as of February 2020 [9]. The increase in NPLs coincided with the spread of Covid-19 to many countries [10]. The Financial System Stability Committee said the three initial sectors that experienced a decline in credit were the hotel, transportation, and restaurant sectors. NPL itself was recorded to have increased from 2.53% to 2.77%. Wimboh Santosa, Chairman of the OJK Board of Commissioners, in his presentation, revealed that the increase in non-performing loans was contributed by the transportation, processing, trade, and household sectors [11]. Households are certainly the sector most affected by Covid-19 because generally, household income is obtained from other sectors affected by the spread of Covid-19. Therefore, if various sectors experience losses, even up to the closure, households will also experience negative impacts in line with this.

The government has issued a government regulation (Perpu No. 1/2020) concerning State Financial Policy and Financial System Stability for Handling the Covid-19 Pandemic and in the Context of Facing Threats that Endanger the National Economic and Financial System Stability. This policy is like a cool breeze for credit banks or conventional banks that carry out credit activities to the public. This credit relaxation means providing leeway on time and regulations related to loan interest payments [12]. In addition, this policy is considered to maintain NPL (Non-Performing Loans) and NPF (Non-Performing Finance) from exceeding 5%. It is just that in practice, the relaxation of credit and financing is not given to all debtors, so in the end, not all people can feel it [13].

Previously, the Financial Services Authority provided two stimuli. First, relax the credit asset quality assessment for a loan ceiling of up to Rp 10 billion. Second, the loan restructuring arrangement for loans over Rp 10 billion [14]. So what about the credit made by the community? The community is the party most directly affected by Covid-19. Workers in the informal and private sectors in particular face various situations of uncertainty, including credit payments.

Credit financing itself affects Financial System Stability. A stable Financial System condition is supported by solid capital, increased liquidity, well-maintained financial markets, and maintained credit risk and decreased banking efficiency [15]. Previous research states that the relationship between credit financing and Financial System Stability shows a positive and negative relationship and has specific impacts [16]. The banking sector is a sector that is a mainstay to support the rate of economic growth in Indonesia. However, the number of debtors affected by Covid-19 due to layoffs decreased income, and other causes affecting the payment of obligations to banks caused the Financial System Stability system to be disrupted [17].

One of the factors driving consumption development is credit. The trend of increasing credit for consumer goods continues to increase every year [18]. However, the increase due to uncontrolled consumption credit can cause adverse effects that lead to default, increased non-performing loans (NPL), and disrupted financial system stability. Especially during the Covid-19 pandemic, it is estimated that public consumption will decline due to the spread of the Covid-19 virus and policies issued by the government.

Credit itself is an actor capable of improving the people's economy, while for banks, credit is one of the main sources of income. Savings/deposits/community investment itself is a fundamental funding source for any bank in channelling credit financing to the public. The more funding sources that banks receive in the form of savings/deposits/ other investments, the greater the opportunity for banks to channel back to the public in financing loans [19]. The community itself during the Covid-19 pandemic was reported to save more often; even the savings rate grew positively [20]. This is a good source of capital, of course, for the banking world, but on the other hand, banks are currently faced with a tighter distribution system, considering that the Covid-19 pandemic still creates various uncertainties that impact people's ability to pay their financing obligations.

Amajihono, in his research, stated that the spread of Covid-19 in Indonesia had an impact on preventing consumers from paying their obligations to banks. In addition, recipients of People's Business Credit (KUR) are also affected by Covid-19, debtors are not even able to pay off their obligations on time due to conditions that force them to not default [21].

Muliaman D. Hadad, Wimboh Santoso, and Armida Alisjahbana in the joint research conducted, revealed that household income (the head of the family) has a positive and significant effect on available credit payments. This study also describes that the better a household's income, the easier it is to provide credit [18].

The graph of household income allocation for consumption, savings, and instalments for 2017-2019 can be seen in Figure 1. The allocation of household income for instalments is the smallest compared to the allocation for consumption and savings. In 2020, with the Covid-19 pandemic, which causes people's incomes to decline, it was feared that the allocation of household income for instalments would be smaller or even cut to cover consumption. Pakpahan predicts consumer spending by one third will decrease due to Covid-19. Consumption and purchasing power of the people themselves tend to decline because the reduced income is not there. In the Micro, Small and Medium Enterprises (MSMEs) sector, there was a 56% decline in sales and 22% problems in credit financing [22]. This means that Covid-19 has a serious impact on the MSME sector in terms of sales and debtor obligations to creditors.

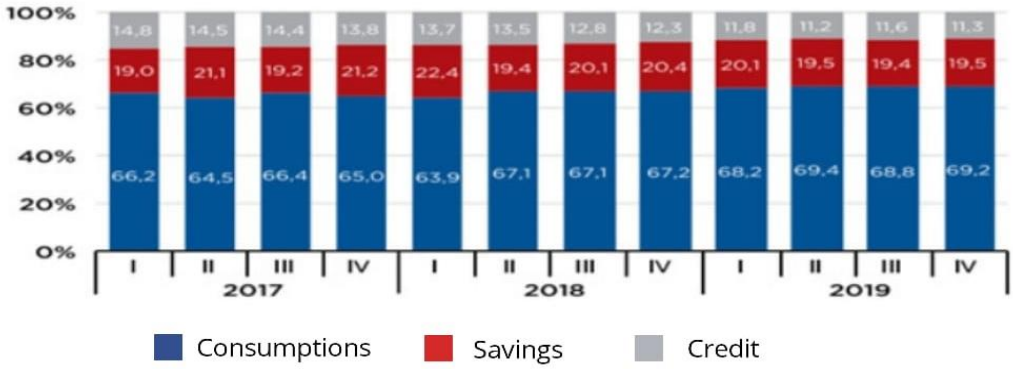

Figure 1. Allocation of Household Income (adapted from Bank Indonesia)

Banks and other financial institutions are vulnerable when the economy is in a downturn because it is likely that loans will not go well [23]. Lagoarde-Segot and Leoni developed a theory that the banking industry will collapse because the expected prevalence of a major pandemic increases; this is related to debtor liabilities that will change from the initial scheme due to the pandemic [24]. Skoufias further said that most of the loans from microfinance institutions given to the poor would be affected by shocks during the epidemic, all group members will certainly be stressed by the aggregate shocks [25].

Olaniyi revealed that the decreasing community activity, then the income automatically decreases and affects the expenditure and payment of the community's obligations [26]. Employees who are dismissed, the high rate of layoffs, various company sectors that go bankrupt automatically impact daily workers, the MSME sector, and other sectors. Based on the Ministry of Manpower's data, as a result of Covid-19, there were 1,943,916 people from 114,340 companies that were laid off. In detail, 1,500,156 workers in the formal sector were dismissed and laid off (77%) from 83,546 companies, while the informal sector was 443,760 people (23%) from 30,794 companies [27]. This situation affects community purchasing power and community inability to pay their obligations towards credit financing [28].

Hadiwardoyo, in his study, said that Covid-19 had several impacts on the individual sector and society, such as the loss of salaries, benefits, or income for business actors / the informal sector. Individuals or households with credit payment obligations will be subject to fines/interest due to being late or unable to pay credit obligations. Even worse, individuals/communities can create new debts to meet current needs or pay off existing debts. Individuals/communities also experience immaterial losses because the performance of compliance with payments has decreased in Bank Indonesia's records. Individuals/communities must also provide extra funds for family members affected by emergencies [29].

The World Bank itself predicts that Covid-19 will stop the businesses of nearly 24 million people in East Asia and the Pacific, and an estimated 922 million people live in poverty worldwide [30]. Given that the vital aspects of the economy, namely supply, demand, and supply chain, have been disrupted, the impact of the crisis will be felt equally to all levels of society. Moreover, the impact in the real sector will then spread to the distressed financial sector because a large number of investees will experience payment difficulties to their investors [31].

The Covid-19 pandemic is estimated to have hit MSMEs, consisting of 1,785 cooperatives and 163,713 micro, small and medium enterprises). Most of the cooperatives affected by Covid-19 are engaged in daily needs, while the MSME sector that is most affected is food and beverages. This, of course, directly impacts the community regarding the income they receive, the investments they carry out, the consumption of daily necessities, and their credit financing obligations [32].

The decline in people's income impacts the level of consumption, thereby affecting the contraction of economic growth. The middle to lower class society is a group that is heavily involved in consumptive debt. The income obtained from middle to lower class families is only enough to meet the needs of daily life. Other needs that are not daily expenses, such as a place to live and a vehicle, are usually met by borrowing from individuals and bank and non-bank financial institutions. The government has issued Law Number 2 of 2020, which instructs banking institutions to provide concessions to debtors. The enactment of this legal umbrella has an impact on commercial bank regulations,

both systemic and non-systemic, experiencing financial difficulties. The government has also taken a policy to restructure credit or financing for debtors experiencing difficulties due to the Covid-19 pandemic. These steps indirectly explain that the Covid-19 pandemic affects credit financing made by the community [33].

Warjiyo, in his study, said that the payment of customer obligations for credit financing is closely related to the health of the bank, which leads to the Financial Stability System. In the context of banking operations, monetary transmission channels through bank credit are essential, especially funding for actual sector activities through bank credit distribution. However, in practice, banks also face problems in this regard, such as capital (CAR), the amount of bad credit (NPL) and the Loan to Deposit Ratio (LDR) [34].

This study aims to see how the impact of the Covid-19 pandemic on household credit financing obligations. The smoothness of credit payments itself impacts bank NPL and NPF multi-finance companies, which all boil down to Financial System Stability. In this study, the impact of the Covid-19 pandemic was measured through variables of income, savings/assets, and consumption. Furthermore, these variables are analyzed using the Logistic Regression model to determine which variables significantly affect household credit financing.

METHOD

The research method used in this research is the quantitative research method, where this method is used to examine a specific population or sample using random sampling techniques and to test the predetermined hypothesis using statistical data analysis [35]. The data used in this study are primary data and secondary data. Primary data is survey results to the public using Google Form, while secondary data comes from books, journals, articles, websites, and various other literature.

Primary data collected were 97 data containing information on income, savings/assets, the level of consumption of respondents during the Covid-19 pandemic, and the effect of the Covid-19 pandemic on household credit financing from respondents. The variables used are credit financing as the dependent variable and income, savings, and consumption as the independent variable. These variables are described as follows:

- Credit Financing = household credit financing (affected, not affected),
- Income = income during the Covid-19 pandemic (decreased, fixed / increased),
- Savings = savings / assets during the Covid-19 pandemic (reduced, fixed / increased),
- Consumption = consumption during the Covid-19 pandemic (reduced, fixed / increased).

The analytical method used is logistic regression with a logit model. Logistic regression is a statistical model used to analyze relationships between independent variables and dependent variables that are categorical/qualitative [36]. In logistic regression, the dependent variable can be categorical data with two possibilities (dichotomy) or many possibilities, either sequential or not [37]. Mathematically, logistic regression with a logit model can be written as follows:

$$\pi(Credit\ Financing)_i = \frac{e^{\beta_0+\beta_1 Income+\beta_2 Savings+\ \beta_p Consumption}}{1+\ e^{\beta_0+\beta_1 Income+\beta_2 Savings+\ \beta_p Consumption}} \quad (1)$$

where $\pi(Credit\ Financing)_i$ is the logit model of the i-th model, $i = 1,2,\dots,i$, β_j is the j-th constant, and $j = 1,2,3$. The goodness of the logistic model (goodness of fit) can be seen through the Pseudo- R^2 criteria which are formulated as follows [38]:

$$Pseudo - R^2 = 1 - \frac{I(\hat{\beta})}{I(\bar{y})} \quad (2)$$

where $I(\hat{\beta})$ is the log likelihood value of the observed logit model and $I(\bar{y})$ is the logit model with constant only. In addition, the goodness of logistic model (goodness of fit) can also be seen through the corcondance rate which can provide a descriptive percentage of data in classifying the data appropriately into each response category [36]. The possible classifications that can occur are as follows.

Table 1. *Corcondace Rate*

Variable	**Indicator**		**Total**
	Corcondance	***Incorcondance***	
Affected Household Credit Financing	a	b	a+b
Not-Affected Household Credit Financing	c	d	c+d
Total	a+c	b+d	a+b+c+d

By using Table (1), corcondance rate can be calculated as follows:

$$Corcondance\ rate = \frac{a+d}{a+b+c+d} \quad (3)$$

Furthermore, selecting the best model can also be done by looking at the Akaike Information Criterion (AIC) value which can be formulated as follows [39]:

$$AIC = 2k - 2\ln(\hat{L}) \quad (4)$$

where k is the number of parameters and $\hat{L}$ is the maximum values of the likelihood function of the model.

RESULTS AND DISCUSSION

The analysis begins with estimating the model and selecting a significant independent variable. The first model is $Credit\ Financing \sim Income + Savings + Consumptions$ and the estimation results can be seen in Table 2.

Table 2. Model 1 ($Credit\ Financing \sim Income + Savings + Consumptions$)

Variables	Estimate	Standard Error	Z- value	Pr(>|z|)
(Intercept)	3.6006	0.8185	4.399	1.09×10^{-5}
Income	-0.9526	0.3310	-2.878	0.00401
Savings	-0.3181	0.2891	-1.100	0.27129
Consumptions	-0.2308	0.3780	-0.610	0.54158

In Table 2, the p-value of the consumption variable is 0.54158, so by using α = 0.05, the consumption variable is not significant and must be eliminated from the model. Furthermore, the model is re-estimated with the second model $Credit\ Financing \sim Income + Savings$ and the estimation results can be seen in Table 3.

Table 3. Model 2 ($Credit\ Financing \sim Income + Savings$)

Variables	Estimate	Standard Error	Z- value	Pr(>|z|)
(Intercept)	3.3316	0.6708	4.966	$6.82e^{-07}$
Income	-1.0357	0.3042	-3.404	0.000663
Savings	-0.3086	0.2875	-1.073	0.28149

In Table 3, the p-value of the savings variable is 028149, so using α = 0.05, the savings varibale is not significant and must be eliminated from the model. Furthermore, the model is re-estimated with the third model, namely $Credit\ Financing \sim Income$. The estimation results can be seen in Table 4.

Table 4. Model 3 ($Credit\ Financing \sim Income$)

Variables	Estimate	Standard Error	Z- value	Pr(>|z|)
(Intercept)	2.9584	0.5441	5.437	5.4×10^{-8}
Income	-1.1368	0.2913	-3.903	9.51×10^{-5}

In Table 4, the p-value of the income variable is $9.51e^{-05}$, so using α = 0.05, the income variable is significant. Based on equation (1), the logit model is obtained as follows:

$$\pi(Pembiayaan\ Kredit)_i = \frac{e^{5.4x10^{-8}+9.51x10^{-5}Income}}{1+e^{5.4x10^{-8}+9.51x10^{-5}Income}} \quad (5)$$

Then, from equation (5), the odds ratio for model 3 is obtained as follows:

$$\frac{\pi(Pembiayaan\ Kredit)_i}{1-\pi(Pembiayaan\ Kredit)_i} = e^{5.4x10^{-8}+9.51x10^{-5}Pendapatan} \quad (6)$$

Equation (5) can be interpreted as a comparison of credit financing probability affected by Covid-19 pandemic against credit financing probability not affected by Covid-19 pandemic with income input variables during Covid-19 pandemic. Equation (6) can be interpreted that the decline in people's income during Covid-19 pandemic has an effect as much as exp(9.51×10^{-5})= 1.000095 times the value of the odds ratio for affected household credit financing. The goodness of fit of the model 3 using Pseudo-R^2 formula in equation (2) is as follows:

$$Pseudo - R^2 = 1 - \frac{loglikelihood\ (Credit\ Financing \sim Income)}{loglikelihood\ (Credit\ Financing \sim 1)} = 0.155 \quad (7)$$

Based om equation (7), the values of Pseudo-R^2 equals 0.155. It means that the income variable in model 3 is able to predict 15,5% of the variability of household loan financing. In addition, the model goodness of fit can also be seen using the corcondance rate and based on the formula in equation (3) and the estimation results of model 3 in Table 5, the calculation of the corcondane rate is as follows:

$$Corcondance\ rate = \frac{11+68}{11+11+7+68} = 0.814 = 81{,}4\% \quad (8)$$

The calculation result in equation (8) is 81,4%. It means that model 3 can predict the data correctly as much as 81,4%.

Table 5. *Corcondace Rate*

Variable	Indicator		Total
	Corcondance	***Incorcondance***	
Affected Household Credit Financing	11	11	22
Not-Affected Household Credit Financing	7	68	75
Total	18	79	97

AIC value (Table 6) shows that model 3 has the smallest AIC value of 91.823 so that model 3 is better than model 1 or model 2. This is in accordance with the results of the estimation model that the income variable is significant, while consumption and savings are not significant (model 1 and model 2).

Table 6. AIC Value

Model	AIC
Model 1	94.345
Model 2	92.708
Model 3	91.823

CONCLUSION

The consumption and savings variables do not have a significant effect on household credit financing. At the beginning of the Covid-19 pandemic, public consumption was reported to have decreased, even sales of various retailers dropped drastically. However, recently there has been a movement of consumption where people have changed their consumption patterns from conventional shopping to online shopping. Nowadays, people even keep more stock of goods at home as inventory to avoid unnecessary activities outside the home. On the other hand, the current government continues to maintain the stability of public consumption with various policies issued such as Social Assistance for the household sector, the sector for workers who have an income of less than five million rupiah, and other policies. So this is in line with the study results that consumption does not have a significant effect on people's obligations in paying credit financing. In line with consumption, the results of this study also show that public savings also do not have a significant effect on household credit financing. In the report on collecting bank funds, it is even stated that public savings grew positively amid Covid-19. It happens because many people divert their funds to savings in case of the current uncertain situation.

Based on the Pseudo-R2 value, the income variable can predict 15.5% of the variability of household loan financing. Based on the odds ratio value, information is obtained that the decreasing income of the community during the Covid-19 pandemic affects one time on the value of the odds ratio for household credit financing affected. Furthermore, the model formed was able to predict the data correctly by 81.4%.

For further research, the prediction of model variability can be increased by adding variables that hypothetically significantly affect household credit financings, such as occupational variables, age variables, and other variables. In addition, this study has a limited number of research respondents, so that further research can be increased by increasing the number of research respondents, and it would be better if the identity of the respondents were validated.

The model's estimation result follows the conditions in the field, namely that income has a significant effect on the community's obligation to pay credit financing. Therefore, the researcher recommends that the government continue to provide assistance and policies that protect the community, especially those who work in the informal sector and are affected by layoffs. This policy on the macro side concerns policies towards industries that are directly affected by Covid-19. Nevertheless, this policy is expected to ensure that the public will have income, the economy will continue to run, and in the end, the people will be able to pay credit for financing, which will lead to good financial system stability.

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