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DYNAMIC BEHAVIOUR MODEL: A SUSTAINABLE SMEs DEVELOPMENT

Aspiranti, T., Amaliah, I., Mafruhat, A.Y., Kasim, R.S.R.*

Abstract: Microfinance Institutions (MFIs) are a mainstay in developing countries to overcome poverty problems through Small and Medium-sized Enterprises (SMEs) funding. The various studies that have been done are still very limited on sustainable SMEs funding due to SMEs various obstacles. Microfinance Institutions are the most compatible institutions to fund SMEs because they have complementary characteristics. This study aims to build a sustainable SMEs financing model to develop SMEs and MFIs. The dynamic system is used as a data analysis tool, involving three main actors in the behavior model, namely Third Parties as Funders (TPF), MFIs and SMEs with the data year 2018 scenario. Sensitivity and optimization of SMEs funding policies show that several prerequisites must be met for SMEs financing to be optimal: a) A stable level of Financing to Deposit Ratio (FDR) and sufficient investment capital to make a sustainable circulation of funds. The FDR must be kept above the 60% minimum range. b). The Non-Performing Financing (NPF) level must be maintained at a maximum of 5 percent; FDR must be above 60% to convert savings into financing to be eight months; The share of financing for SMEs is increased by 80 percent.

Keyword: Dynamic System, SMEs, MFIs, Sustainable Development

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Introduction

In developing countries with a dominant number of SMEs, MFIs are relied on helping capitalize SMEs so that SMEs can help the poor get out of poverty (Garrity and Martin, 2018). The sustainability of SMEs as MFIs clients will encourage sustainable MFI institutions as well. The efforts to increase lending to SMEs can enhance SMEs' growth and sustainability (Shihadeh, Naradda and Hannoon, 2019). The factors that most affect the SMEs business environment are the macroeconomic environment, monetary policy, interest rates, regulation of a

* **Tasya Aspiranti,** Dr. SE.,Msi, Indonesia, Bandung Islamic University, Faculty of Economic and Bussiness, Management Department, **Raja Suzana Raja Kasim** Prof. Dr., Malaysia, University of Malaysia Kelantan, Faculty of Enterpreneurship and Bussiness, **Dr. Ima Amaliah,** SE.,M.Si, Indonesia, Bandung Islamic University, Faculty of Economic and Bussiness, Economic Development Department, **Ade Yunita Mafruhat,** SE., M.Soc.Sc, Indonesia, Bandung Islamic University, Faculty of Economic and Bussiness, Economic Development Department
✉ corresponding author: tasya@unisba.ac.id;
✉ rajasuzana@umk.edu.my; ima@unisba.ac.id; ade.yunita.mafruhat@unisba.ac.id

country, and business support (Cepel, Dvorsky, Gregova and Vrbka, 2020). In Indonesia, SMEs contribute to economic growth and employment. MFIs impact increasing GDP, capital accumulation, increasing productivity, reallocation of capital and labor (Raihan, Osmani and Khalily, 2017). MFIs are believed to play a role in poverty alleviation and a sustainable economy (Miled and Rejeb, 2015). Both SMEs and MFIs are considered non-bankable and have no collateral so that they are not compatible with banks that have a conservative principle. Risky SMEs prefer to seek other funding than banks because they prefer experienced borrowers (Belas, Rahman, Rahman and Schonfeld, 2017). A MFIs can improve its performance because it has financial management by common capital sources (Pignatel and Tchuigoua, 2020). This study analyzes a dynamic behavior model for SMEs' sustainable development in Indonesia by involving three actors: third-party fund owners, MFIs and SMEs.

Theoretical Framework

In Muslim majority countries, MFIs contribute to poverty alleviation, increase the economy, improve social conditions, circulation and distribution of welfare, and increase society's intellectual level (Alkhan and Hassan, 2020). MFIs financing in the community affects income, savings, education and transportation expenditure (Hossain and Wadood, 2020). Levine (2005) states that theoretical and empirical studies show that the good function of financial sector will positively impact a country's economic growth. Dynamic economic growth factors also influence a financial institution (Skare and Porada-Rochoń, 2019). However, microcredit faces various challenges, low margins, a limited market and high prices (Dehejia et al., 2012). It suggests that borrowers will be exposed to high risk, given the various challenges of the MFIs (Banerjee et al., 2015). However, MFIs are still unable to solve credit recipients' problems (Ramli et al., 2014). Therefore, Herani (2009) suggested that each member of the MFIs deposits an amount of money as a token of individual ownership. According to Addae-Korankye (2012), microfinance institutions provide financial services for the poor who cannot access the formal financial institution sector such as banks.

The sustainability of MFIs to alleviate poverty is still very rarely studied and generally took the case in developing countries. Based on the experimental evaluation, it was found that the impact of MFIs on asset ownership and public consumption was still limited (Banerjee, Duflo, Glennerster, Kinnan, 2010; Karlan and Zinman, 2011; Desai, Johnson and Tarozzi 2011). However, in several cases in developing countries, researchers assess that during the 1960-the 1980s, MFIs were still not successful in reducing interest rates on the informal credit market (Hoff and Stiglitz, 1993; 1998; von Pichke, Adams and Donald, 1983). Furthermore, in studies in Bangladesh, Berg, Emran and Shilpi (2013); Mookherjeea and Motta (2016) found the MFIs grew due to a significant increase in interest rates. This phenomenon can be explained as follows: first, the operation scale is not yet economical; the high competition among MFIs (Hoff and Stiglitz, 1998; Jain, 1999). Second, the MFIs focus only on low-risk debtor markets (Bose, 1998). Third, there is collusion among borrowers in the informal credit market due to formal credit brokers (channeled) by money borrowers (Floro and Ray, 1997). Fourth, the MFIs inflexible payment mechanisms lead to an increase in informal credit market share (Jain and Mansuri, 2003). Non-exclusive contracts combined with moral hazard will significantly impact informal borrowers and a high-risk level (Kahn and Mookherjee, 1998; McIntosh and Wydick, 2005). Sustainable and effective MFIs is influenced not only by its type but also by its culture (Seibel, 2005). Financial inclusion MFIs and information technology can alleviate poverty as well as financial stability (Mushtaq and Bruneau, 2019); as an effective instrument in alleviating poverty (Fall, Akim and Wassongma, 2018); accelerating the economic transformation of rural communities through the agricultural sector (Suesse and Wolf, 2020; Fianto, Gan, Hu and Roudaki, 2018).

Methodology

This research uses the dynamic system model. Dynamic system models see behavior instead of matching from point to point. Modeling in this study involves three main actors, namely Third Parties as Fund owners (TPF), Micro Finance Institutions (MFIs), and Small and Medium-sized Enterprises (SMEs). The research takes a case study in Indonesia using the year data 2018 issued by the Financial Services Authority of Republic Indonesia (OJK). The obtained data consist the following information -- The data is in the form of liquid assets managed by MFIs amounting to 12.085 million USD; TPF fund placement in MFIs is amounted to 0.828 million USD; TPF fund for investment in MFIs is amounted to 6% of the total assets owned by MFIs; Portfolio return on TPF fund investment is 7%; profit margin from investing in MFIs is 20%; Percentage of MFIs assets for SMEs is 60%; MFIs financing time for SMEs is six months; loan duration is 12 months; Bank FDR is 50%; Bank Liquidity is 12 months; the period of MFI deposits in SMEs is six months; NPF of MFIs is 10%.

Dynamic Behavior Model Justification

In dynamic systems, the theory used is optimal control (Chiang, 1992). This model has four assumptions: equality constraints, inequality constraints, integral constraints of equality and integral inequality constraints.

Equality constraints

Let there be two control variables in a problem, u1 and u2, and they are required to satisfy the condition

$$g(t, y, u_1, u_2) = c$$

It refers that g functions as the constraint function, and the constant c is the constraint constant. The control problem may then be stated as

$$Maximixe \int_0^T F(t, y, u_1, u_2)dt$$

(1) *and* *limited condition*

$$\dot{y} = f(t, y, u_1, u_2)$$

$$g(t, y, u_1, u_2) = c$$

This is a simple version of the problem with m control variables and q equality constraints, where it is required that q <m. The maximum principle calls for the maximization of the Hamiltonian.

(2) $$H = F(t, y, u_1, u_2) + \lambda(t)f(t, y, u_1, u_2)$$

For every t [0, T]. But this time, H's maximization is subject to the constraint g (t, y, u_1, u2) = c. Accordingly, we form the Lagrangian expressionϵ

(3) $$\mathcal{L} = H + \theta(t)[c - g(t, y, u_1, u_2)]$$

$$= F(t, y, u_1, u_2) + \lambda(t)f(t, y, u_1, u_2) + \theta(t)[c - g(t, y, u_1, u_2)]$$

The Lagrange multiplier is made dynamic as a function of t. It is necessitated that the g constraint must be satisfied at every t in the planning period. Assuming an interior solution for each uj, we require thatθ

(4) $$\frac{\partial \mathcal{L}}{\partial u_j} = \frac{\partial F}{\partial u_j} + \lambda \frac{\partial f}{\partial u_j} - \theta \frac{\partial g}{\partial u_j} = 0, \quad where\ t\ \in\ [0.T]\ (j = 1,2)$$

Simultaneously, we must also set

(5) $$\frac{\partial \mathcal{L}}{\partial \theta} = c -\ g(t, y, u_1, u_2) = 0 \quad for\ all\ t\ \in\ [0.T]$$

It ensures that the constraint will always be in force. Together, (4) and (5) constitute the first-order condition for the constrained maximization of H. It must be supported, of course, by a proper second-order condition or a suitable concavity condition. The rest of the maximum-principles conditions include:

(6) $$\dot{y} = \frac{\partial \mathcal{L}}{\partial \lambda} = \left(\frac{\partial H}{\partial \lambda}\right)$$ (equation of motion for y)

and

(7) $$\dot{\lambda} = \frac{\partial \mathcal{L}}{\partial y} = \left(-\frac{\partial H}{\partial y} + \theta \frac{\partial g}{\partial y}\right)$$ (Equation of motion for λ)

Note that the equation of motion for y, (6), would determine whether we differentiate the Lagrangian function (the augmented Hamiltonian) or the original Hamiltonian function. On the other hand, it would make a difference in the equation of motion forλ , (7), whether we differentiate or H concerning y. The correct choice is Lagrangian expression. It is because, as the constraint in problem (1) specifically prescribes, the y variable impinges upon the range of choice of the control variables, and such effects must be taken into account in determining the path for the costate variable.λ $\mathcal{L}\mathcal{L}\lambda$

While, it is feasible to solve a problem with equality constraints in the manner outlined above, it is usually simpler in actual practice to use substitution to reduce the number of variables we have to deal with. Substitution is, therefore, recommended whenever it is feasible (Hussain et al., 2021).

Inequality Constraints

For simplicity, we shall illustrate this type of problem with two control variables and two inequality constraints:

$$Maximixe \int_0^T F(t, y, u_1, u_2) dt$$

$$and \quad constraint\, function$$

$$\dot{y} = f(t, y, u_1, u_2)$$

$$g^1(t, y, u_1, u_2) \le c_1 \tag{8}$$

$$g^2(t, y, u_1, u_2) \le c_2$$

The Hamiltonian defined in (2) is still valid for the present problem. However, since the Hamiltonian is now to be maximized concerning u1 and u2 subject to the two inequality constraints, we need to invoke the Kuhn Tucker conditions. Besides, for these conditions to be necessary, a constraint qualification must be satisfied. According to a theorem of Arrow, Hurwicz, and Uzawa, any of the following conditions will satisfy the constraint qualification:

(1) All the constraint functions g^i is concave in the control variables u_J [here, concave in (u1, u2)].
(2) All the constraint function g^i is convex in the control variables u1. Besides, there exists a point in the control region u0 U [here, u 0 ∈is a point ($u_1$0, $u_2$0)] such that, when evaluated at u0, all Constraints g^i are strictly <ci (that is, the constraint set has a nonempty interior).
(3) The gi functions satisfy the rank condition: Considering those constraints that turn out to be effective or binding (satisfied as strict equalities), form

the partial derivative matrix. $\left(\partial g^1 / \partial u_j\right)$(Where e indicates "effective constraints only"), and evaluate the partial derivatives at the optimal values of the y and u variables. The rank condition is that the rank of this matrix is equal to the number of effective constraints.

We now augment the Hamiltonian into a Lagrangian function:

(9) $\mathcal{L} = F(t, y, u_1, u_2) + \lambda(t) f(t, y, u_1, u_2) + \theta_1(t)[c_1 -$ $g1t,y,u1,u2+\theta 2(t)c2-g2t,y,u1,u2$

The essence may become more transparent if we suppress all the arguments and write $\mathcal{L}$.

(10) $$\mathcal{L} = F + \lambda f + \theta_1(c_1 - g^1) + \theta_2(c_2 - g^2)$$

The first-order condition for maximizing calls for, assuming interior solutions, $\mathcal{L}$

(11) $$\frac{\partial \mathcal{L}}{\partial u_j} = 0$$

as well as

(12) $$\frac{\partial \mathcal{L}}{\partial \theta_i} = c_1 - g^1 \geq 0 \qquad \theta_i \geq 0$$

$$\theta_i \frac{\partial \mathcal{L}}{\partial \theta_i} = 0$$

$$(i = 1{,}2\ and = 1{,}2\ ) \quad for\ all\ t\ \in\ [0.T]$$

Condition (12) differs from (5) because the constraints in the present problem are inequalities. $\frac{\partial \mathcal{L}}{\partial \theta_i} \geq 0$ condition merely restates the ith, constraint, and the complementary-slackness condition $\theta_i \frac{\partial \mathcal{L}}{\partial \theta_i} = 0$ ensures that those terms in (9) involving θ_i will vanish in the solution, so that the value of $\mathcal{L}$ will be identical with that of H $= F + \lambda f$ after maximization.

Note that, unlike in nonlinear programming, we have in (11) the first-order conditions $\frac{\partial \mathcal{L}}{\partial u_j} = 0$, not $\frac{\partial \mathcal{L}}{\partial u_j} \leq 0$. This is because the ui variables are not restricted to nonnegative values in problem (8)) if the latter problem contains additional non-negativity restrictions.

$$u_j(t) \geq 0$$

Then, by the Khun-Tucker conditions, we should replace $\frac{\partial \mathcal{L}}{\partial u_j} = 0$ conditions in (11) with

(13) $$\frac{\partial \mathcal{L}}{\partial u_j} \leq 0 \qquad u_j(t) \geq 0 \qquad u_j \frac{\partial \mathcal{L}}{\partial u_j} = 0$$

It should be pointed out that the symbol in$\mathcal{L}$ (13) denotes the same Lagrangian as defined in (9), without separate $\theta(t)$ type of multiplier terms appended on account of the additional constraints $u_j(t) \geq 0$. This procedure is directly comparable to that used in nonlinear programming.
Other maximum-principle conditions include the equations of motion for y and A. These are the same as in (6) and (7):

(14) $$\dot{y} = \frac{\partial \mathcal{L}}{\partial \lambda} \qquad dan \qquad \dot{\lambda} = \frac{\partial \mathcal{L}}{\partial y}$$

Wherever appropriate, of course, transversality conditions must be added, too.
Equality Integral Constraint
We shall illustrate the solution method with a problem that contains the original state variable, one control variable, and one integral constraint:

$$Maximize \int_0^T F(t,y,u)dt$$

(15) $$refer\ to \quad \dot{y} = f(t,y,u)$$

$$\int_0^T G(t,y,u)\,dt = k \qquad (k\ given)$$

$$and \qquad y(0) = y_0 \qquad y(T) \qquad (y_0, T\ \ given)$$

The approach to be used here is to introduce a new state variable Γ(t) into the problem such that a condition can replace the integral constraint in terms of Γ(t). To this end, let us define

(16) $$\Gamma(t) = -\int_0^t G(t,y,u)\,dt$$

It can be noted that the upper limit of integration is the variable t, not the terminal time T. The derivative of this variable is

(17) $$\dot{\Gamma} = -\,G(t,y,u)$$ (Equation for) Γ

and the initial and terminal values ofΓ(t) in the planning period are

(18) $$\Gamma(0) = -\int_0^0 G(t,y,u)\,dt = 0$$

and

$$\Gamma(T) = -\int_0^T G(t,y,u)\,dt = -k \tag{19}$$

From (19), it is clear that we can replace the given integral constraint with a terminal condition on the Γ variable. By incorporating Γ into the problem as a new state variable, we can restate (15) as

$$\begin{aligned} &Maximize \int_0^T F(t,y,u)dt \\ &Subject\ to\ \ \dot{y} = f(t,y,u) \\ &\dot{\Gamma} = -G(t,y,u) \\ &y(0) = y_0 \qquad y(T) \qquad (y_0, T\ \ given) \\ &\text{and} \quad \Gamma(0) = 0 \qquad \Gamma(T) \ = -k \qquad (k\ \ given) \end{aligned} \tag{20}$$

This new problem is an unconstrained problem with two state variables, y and Γ. While the y variable has a vertical terminal line; the new Γ variable has a fixed terminal point. Since this problem is now unconstrained, we can work with the Hamiltonian without first expanding it into a Lagrangian function.
Defining the Hamiltonian as

$$H = F(t,y,u) + \lambda f(t,y,u) - \mu G(t,y,u) \tag{21}$$

we have the following conditions from the maximum principle:

$$\begin{aligned} &\operatorname*{Max}_u H \qquad && while\ t \in [0.T] \\ &\dot{y} = \frac{\partial H}{\partial \lambda} && \text{(Equation of y rate)} \\ &\dot{\lambda} = \frac{\partial H}{\partial y} && \text{(Equation of } \lambda \text{ rate)} \\ &\dot{\Gamma} = \frac{\partial H}{\partial \mu} && \text{(Equation of } \Gamma \text{ rate)} \\ &\dot{\mu} = \frac{\partial H}{\partial \Gamma} && \text{(Equation of } \mu \text{ rate)} \\ &\lambda(T) = 0 && \text{(transversality condition)} \end{aligned} \tag{22}$$

What distinguishes (22) from the conditions for the usual unconstrained problem is the presence of the pair of equations of motion for Γ and μ. Since the Γ variable is an artifact whose mission is only to guide us to add the $-\mu G(t,y,u)$. To the Hamiltonian mission, that has already been accomplished and whose time path is of no direct interest, we can safely omit its equation of motion from (22) at no loss.

On the other hand, the equation of motion for μ does impart a significant piece of information. Since the Γ variable does not appear in the Hamiltonian, it follows that:

$$\dot{\mu} = -\frac{\partial H}{\partial \Gamma} = 0 \qquad \Rightarrow \mu(t) = constant \tag{23}$$

It validates our earlier assertion that the costate variable associated with the integral constraint is constant over time. However, as long as we remember that the μ multiplier is a constant, we may omit its equation of motion from (22) as well.

Results and Discussion

Results of Power SIM data processing software: MFIs provide loans with social security to SMEs. SMEs will use funds lent by MFIs to buy assets to develop SMEs businesses. In this simulation, before injecting funds from TPF and soft loans to MFIs, MFIs already had initial funds. MFIs will flexibly repay loans from TPF over the long term. TPF is a third-party funder in the form of government programs in developing countries. It can also be a Corporate Social Responsibility fund for the development of the real sector. The impact of CSR activities on business performance also contributes significantly to SMEs' financial performance (Bahta, Yun, Islam and Bikanyi, 2020).
Figure 1 depicts the results of dynamic behavior simulation in SMEs development.

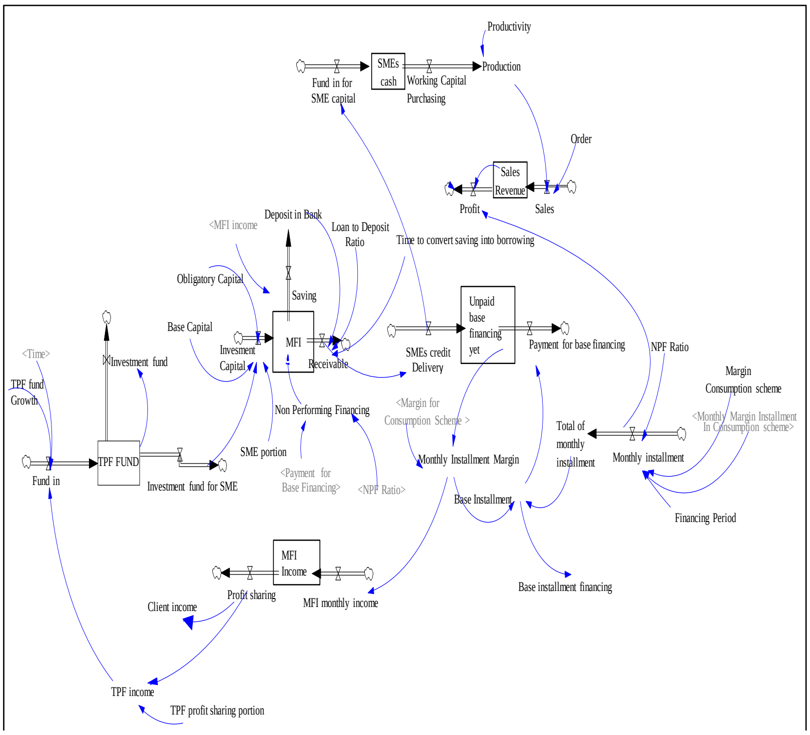

Figure 1: The flow of fund among three actors: Third-Party Fund, MFIs, and SMEs

The higher the value of MFIs FDR is more liquid the MFIs, and it will impact the greater the banks' ability to channel their funds to SMEs. A company is in good financial condition and without problems if it has no liquidity problems or short-term liabilities. The payment of its short-term obligations depends not on the receivables to be received (Kropsz, 2010).

Simulation Change in Time Deposit

A time deposit is an MFIs deposit with a certain period to utilize TPF fund before it is lent to SMEs. The baseline of the research is 12 months of time deposit. Then, we do the simulation with 6, 8, 10 months of time deposit. The model's simulation will impact MFI asset liquidity, investment fund, profit, bank deposit and SMEs financing delivery. Figure 2 shows the simulation results: In the movement of liquid assets, at six months of time deposit, liquid assets' movement tends to be stable, but there are fewer liquid assets that can be used.

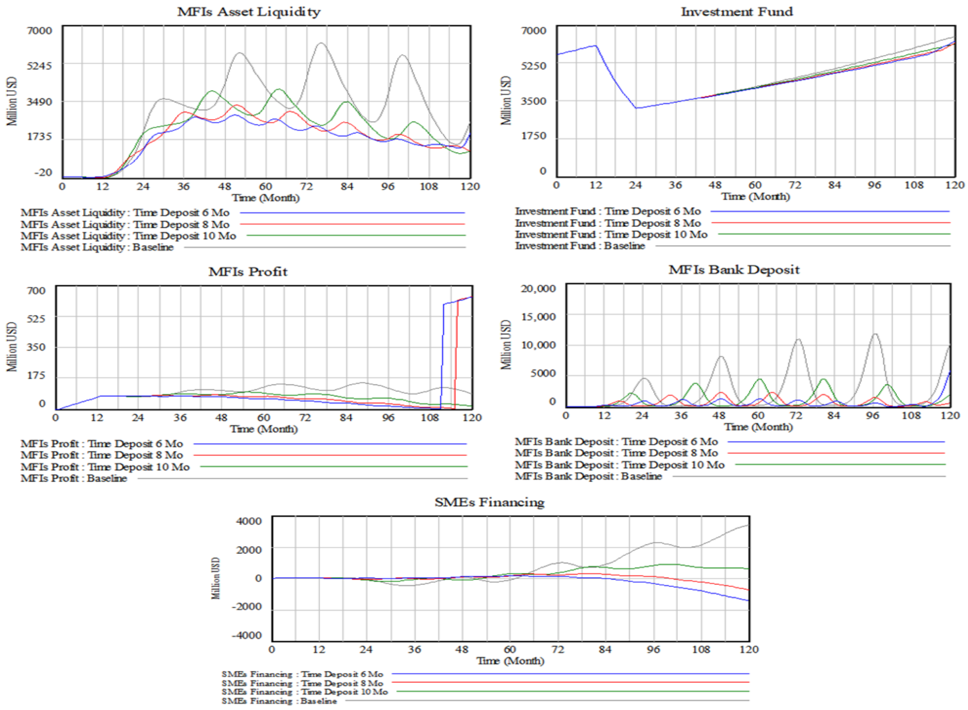

Figure 2: Simulation Results of Change in Time Deposit

Furthermore, at the eight months of time deposit, the fluctuation in the addition of liquid assets began to increase, and the peak of the fluctuation in the addition of liquid assets is in the ten months of time deposit. The time deposit has a change from the simulation of third-party funds, but it is not significant. The longer the time deposit is higher the profit. From an MFI's profit side, the longer the time deposit is higher the profit rate with the greater the fluctuation rate. At the time deposit period of 6 and 8 months, the MFI's profit was close to 0. After the eight months of time deposit, the MFI's profit increased. At the ten months of time deposit, the growth rate of SMEs financing tended to stabilize. 10-months of time deposit had a higher rate of profit fluctuation. From the simulation of the amount of SMEs financing, it was identified that the growth rate of SME financing tended to be negative at the time deposit period of 6 and 8 months. At the ten months of time deposit, the growth rate of SMEs financing tends to stabilize. The ten months of time deposit has a higher rate of profit fluctuation. From the simulation of the amount of SME financing, it was identified that the SMEs growth rate tended to be negative at the time deposit period of 6 and 8 months. The 10-months of time deposit have a higher rate of profit fluctuation. At the ten months of time deposit, the growth rate of SMEs financing tends to stabilize. Based on the SMEs financing simulation, it is identified that SMEs' growth rate tends to be negative at the time deposit period of 6 and 8 months. At the time deposit period of 10 months, the growth rate of SMEs financing tends to stabilize.

Simulation of Change in Financing to Deposit Ratio

The FDR ratio at baseline is 50 percent (assuming the minimum FDR of Bank Indonesia). Figure 3 shows a simulation of assets liquidity, investment funds, profit, Bank deposits, and MFIs financing delivery at the FDR levels of 60% and 70%. In the short term until the 70th months, SMEs financing is in the negative value.

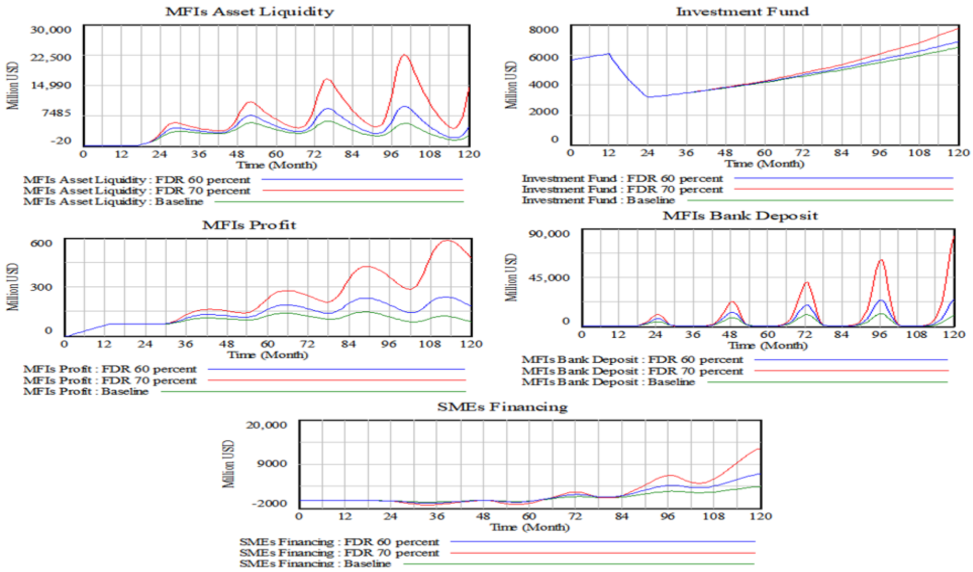

Figure 3: Simulation Results of FDR Change of 60 and 70 percent

The negative value of SMEs financing indicates the risk of SMEs receivables not being paid off. In the short term, SMEs financing carries the risk of large unpaid receivables because MFIs assets and TPF funds are still limited. In the long term, at the FDR levels of 60% and 70% trend of the assets' liquidity, investment funds, profits, Bank deposits, and SMEs financing delivery tends to increase. FDR level of 70% has a better impact on increasing all five variables than 60%. All of the FDR levels in the long term shows that the higher the FDR level is higher the impact on increasing the five variables. It means that in the long term, FDR has a positive impact on asset liquidity, investment funds, profits, bank deposits, and SMEs financing. This finding is in line with the previous study results that MFIs' participation in financing SMEs increases overall savings (total bank deposits) and credit allocation (loans to the private sector) in the economy and microcredit (Abrar, Hasan and Kabir, 2020; Aragón, Karaivanov and Krishnaswamy, 2020).

Simulation of Change in NPF Value

The NPL simulation at the MFI is at another base of 10%. The NPL will be simulated at 2.5%, 5% and 7.5% levels. In this simulation, the baseline or initial simulation is used 10 percent.

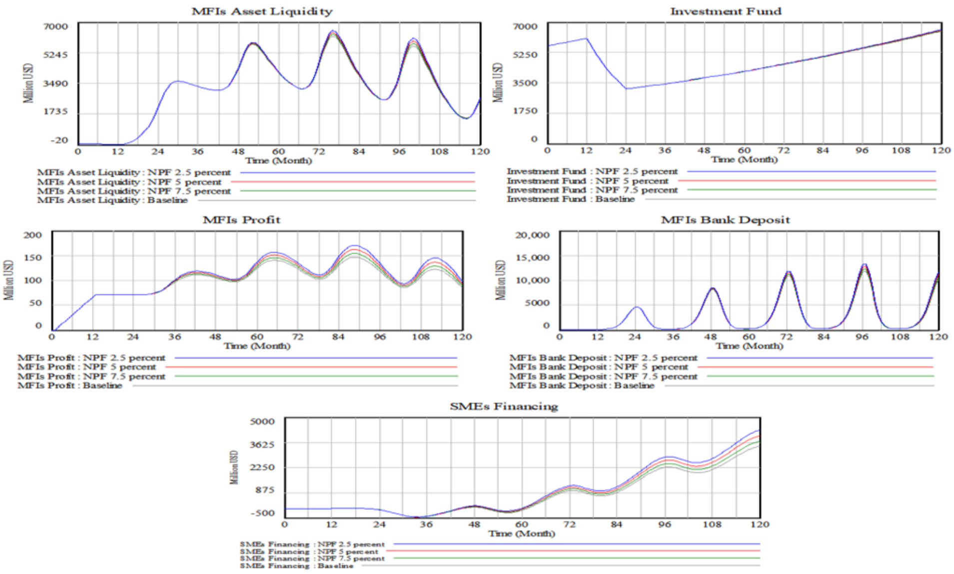

Figure 4: Simulation Results of Change in the NPF value

The rate of growth with reduced NPF does not have an exponential impact. The simulation in Figure 4 shows that MFIs asset liquidity, investment funds, profit, bank deposit, and SMEs financing has the same value at all NPF levels. It indicates that NPF has no impact on MFIs asset liquidity, investment funds, profit, bank deposit and SMEs financing.

Simulation of Optimal Financing Improvement Policies

Simulation of optimal financing improvement policies can be shown in Figure 5. On the base line, SMEs financing is 60%. After a simulation of SMEs financing to 80%, it has caused lending to be more volatile and tends to increase until the 120th month, and it can be stated that the MFI's profit rate is better. The MFI's liquid asset placements are increasing, but placements and withdrawals attract more funds each month. The effect is that the profits from third party funds will be higher. SMEs financing to 80% in the long term will have a sustainable positive impact on MFIs asset liquidity, fund investment, bank deposit and SMEs financing.

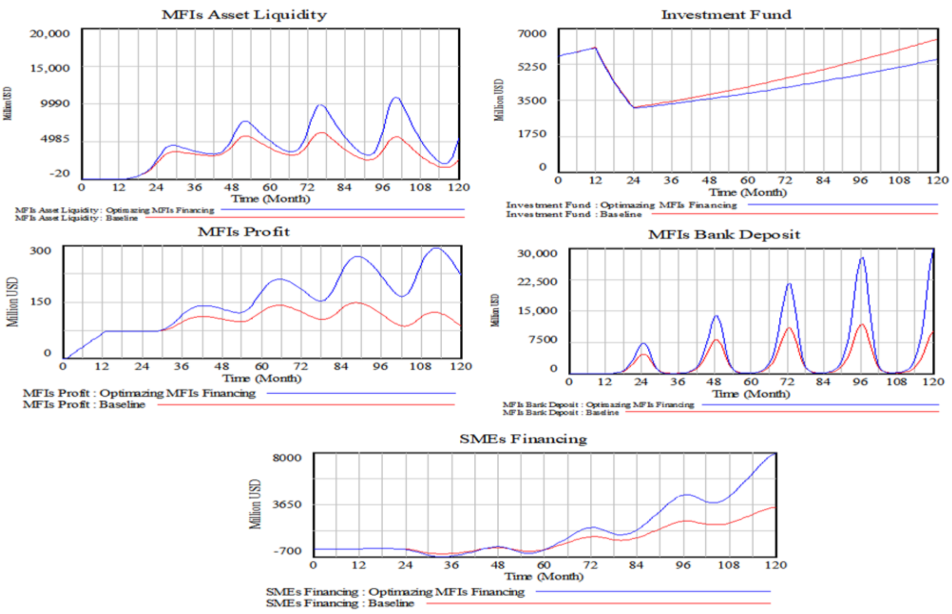

Figure 5: Simulation Results of Policy Optimization

Asset liquidity continues to increase sustainably in the long term as MFIs have no difficulty financing their operating liabilities. It is due to financial support from third parties as well as ongoing payments from SMEs. Investment in third party funds continues to increase in the long term due to the sustainability of funding for MFIs and SMEs. Profit, Bank deposits and SMEs financing continue to increase sustainably in the long term due to continuous operational processes with both TPFs and SMEs.

Conclusion

The results of the sensitivity simulation and optimization of the SMEs funding policy require several prerequisites for financing to the SMEs to be optimal: a) A stable FDR level and sufficient investment capital to carry out a sustainable fund circulation. The FDR must be kept at the 60% minimum range. b). The NPF level must be maintained at a maximum of 5 percent; FDR must be above 60% to convert savings into financing to be eight months; The share of financing for SMEs is increased by 80 percent. This research needs to be strengthened by including the real volatility value of the NPF and variable inflation as macro variables so that the short and long term impacts of the NPF, FDR, time deposit simulations on MFIs asset liquidity, investment funds, profit, bank deposit and SMEs become more accurate. Further research on sustainable SMEs financing needs to be continued by including elements of real volatility value of the NPF and inflation rate.

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MODEL DYNAMICZNEGO ZACHOWANIA: ZRÓWNOWAŻONY ROZWÓJ MŚP

Streszczenie: Instytucje mikrofinansowe (MIF) są w krajach rozwijających się podstawą przezwyciężania problemów ubóstwa dzięki finansowaniu małych i średnich przedsiębiorstw (MŚP). Różne przeprowadzone badania są nadal bardzo ograniczone w zakresie zrównoważonego finansowania MŚP ze względu na różne przeszkody w MŚP. Instytucje mikrofinansowe są instytucjami najbardziej kompatybilnymi z finansowaniem MŚP, ponieważ mają uzupełniające się cechy. Niniejsze badanie ma na celu zbudowanie trwałego modelu finansowania MŚP w celu rozwoju MŚP i MIF. System dynamiczny jest używany jako narzędzie do analizy danych, z udziałem trzech głównych aktorów modelu zachowania, a mianowicie stron trzecich jako podmiotów finansujących (TPF), MIF i MŚP w scenariuszu z 2018 r. Wrażliwość i optymalizacja polityki finansowania MŚP pokazują, że aby finansowanie MŚP było optymalne, musi być spełnionych kilka warunków wstępnych: a) Stabilny poziom wskaźnika finansowania do depozytu (FDR) i wystarczający kapitał inwestycyjny, aby zapewnić zrównoważony obieg środków. FDR należy utrzymywać powyżej 60% zakresu minimalnego. b). Poziom finansowania zagrożonego (NPF) musi być utrzymany na maksymalnie 5 procentach; FDR musi przekraczać 60%, aby przekształcić oszczędności w finansowanie na osiem miesięcy; Udział finansowania MŚP wzrasta o 80 procent.

Słowo kluczowe: dynamiczny system, MŚP, MFI, zrównoważony rozwój.

动态行为模型:可持续的中小企业发展

摘要:小额信贷机构(MFIs)是发展中国家通过中小型企业(SMEs)资金来解决贫困问题的支柱。由于中小企业的种种障碍,已经进行的各种研究仍然很少涉及可持续中小企业的资金。小额信贷机构是为中小企业提供资金的最兼容机构,因为它们具有互补性。这项研究旨在建立可持续的中小企业融资模式,以发展中小企业和小额信贷机构。该动态系统用作数据分析工具,涉及行为模型中的三个主要参与者,即第三方(作为资金提供者(TPF),小额信贷机构和中小型企业)的数据年份为 2018 年。中小企业融资政策的敏感性和优化表明,要使中小企业融资达到最佳,必须满足几个先决条件:a)稳定的融资存贷比(FDR)水平和充足的投资资本,以使资金可持续流通。
FDR 必须保持在最小范围的 60%以上 b)。不良融资(NPF)的水平必须维持在最高 5%;FDR 必须高于 60%,才能将储蓄转化为融资,期限为八个月;中小企业的融资份额增加了 80%。

关键字:动态系统,中小企业,小额信贷机构,可持续发展