

Doi: 10.53790 /ajmss.v3i4.62

ISSN: 2811-1613

Submitted: 26th July, 2022; Revised: 24th, August, 2022; Accepted: August, 29th 2022

ARTICLE

Borrowers Strategic Loan Default in Central Bank Microfinance Facilities and Incentives to Repay

Salam, N. Gbadebo^{1†}; Alase, A. Gbenga^{1†}; Lamidi, O. Sikiru^{1†}; Joseph, E. Tonuchi^{1,2*†};

¹ Statistics Department, Central Bank of Nigeria, Nigeria.

² Babcock University Ilishan Remo, Nigeria.

† Authors contributed equally

* Corresponding Author: tonuchijoseph@gmail.com

Disclaimer: The contents of this paper are authors' sole responsibility. They do not represent the view of the institution

Abstract

This study examines the incidence of strategic default by borrowers in Central Bank of Nigeria (CBN) microfinance loan facilities and the role of incentives to prevent such opportunistic behaviour. A collective strategic default is a situation where sound borrower feigns inability to repay with an expectation that a large number of other borrowers will not repay their loans, thus reducing the bank's enforcement capacity, and then the effectiveness of the policy. Such opportunistic behaviour of borrowers happens in a framework in which there is no incentives to compel and encourage borrowers to pay back the borrowed funds. Using an extensive form game in a global game theory framework, the study found that without incentives, there is a room for opportunistic behaviour in central government financial intervention programmes. While such programmes are expected to benefit the economy, but incentives, either positive or negative will reduce incidence of strategic default.

Keywords: *borrower strategic default, borrower run, microfinance, game theory, incentives*

Cite as: Salam, G. N., Alase, G. A., Lamidi, S. O, Joseph, T. E. (2022). Borrowers strategic loan default in central bank microfinance facilities and incentives to repay. *Applied Journal of Economics, Management, and Social Sciences*, 3(4), 44-53

1. Introduction

There is evidence of coordinated borrowers' non-repayment of loans (borrowers run) in emerging and developing countries particularly when government institutions are the providers of the loans as in the case of Eastern European countries during their transition, and banking crises in Mexico and East Asia (Ikeda, 2020). In many cases penalties for delaying or non-repayments of loans were usually lower than the cost of borrowing. In another word, the opportunity cost of not repaying the loan is lower than the cost of repaying the loan. This occurred in particular when loans were funded by monetary creation, leading to a massive inaction from both the

lender and borrower and thus devaluation of loan repayments (Agarwal et al, 2021).

Moreover, the delays in the legal procedure to prosecute and prevent opportunistic behaviours among borrowers were often huge in developing countries (Joseph, Peters, Adetoba & Mimiko, 2020). Very often the governments in these countries decide to clear debtor obligations to avoid tough and unpopular social measures particularly if the lender is a government microfinancier institutions, as in Eastern Europe, Russia, and in Africa (Bond and Rai, 2009; Ikeda, 2020). Bond and Rai (2009) argued that the government unwillingness to prosecute and provide institutional framework that enable lenders to

easily prosecute opportunistic behaviour among borrowers as one of the causes of financial crises leading to bank runs. A large part of borrowers faced not only the lack of capability, but also the lack of willingness and incentives to repay their loans.

Thus, in circumstances when financial environment is characterized by inadequate loan recovery laws, inefficient judiciary system, poor disclosure, and accounting rules, where creditor rights are poorly defined or weakly enforced, where development finance is used also for political campaign or gain with weak institution, potentially solvent firms (borrowers) would have a strong incentive to mimic the behaviour of a distressed firms (borrowers) leading to strategic loan default. If the borrowers believe that the incentives of non-repayment of the loan is much higher than the benefits of loan repayment, then there will likely be a coordinated strategic loan default. This can happen where borrowers believe the power of the lender is limited to the decision of not giving additional loan in the event of loan default, rather than taking any legal action against the firm or individuals (Szkup, 2020).

The implication of such behaviour is that the central bank credit initiatives or other developmental institutions credit initiatives will fail to achieve its policy objective as collective strategic default will limit the number of loans available to other firms and individual in the country. Secondly, it will also limit credit creation and effectiveness of the banking sector, which essentially has the tools to enforce the credit agreement. Such behaviour has tendencies to create inflationary pressure in the market as it will encourage excessive liquidity that cannot be easily mopped up by the government.

Essentially, microfinance program is built on the promise of future higher credit, along with a concomitant threat of sanction on loan default. For instance, a borrower who repays today's loan effectively receives a claim to higher future financial access (Bond and Rai, 2009). Thus, borrower repays if the value of this claim exceeds the benefit of defaulting on the loan. However, the expected value of a repaying borrower's claim depends on how likely other borrowers are to repay since that in turn affects the viability of the lender. The study therefore argues that such strategic coordination by borrowers to default on the loan is called "borrowers runs" or 'strategic loan default' and it is common in developing countries where government institutions often involve in the microcredit market to mitigate the problem of adverse selection and moral hazard faced by traditional lenders. Developing countries are characterized by asymmetric information which increases the incidence of adverse selection and moral hazard. The rising incidence of moral hazard and adverse selection in the credit market is touted as one of the hinderance to the market efficiency which has arguably prevented the market from meeting the needs of the SMEs and the so called unbankable.

Given the importance of SMEs and the informal sector (arguably the unbankables) to the development of a nation in terms of employment generation, diversification of the economy, and economic growth, Joseph, Obikaonu, Nwolisa, Ariolu, and Aderehunmu (2021) believe that most central governments in developing countries are forced to mitigate the incidence of adverse selection and moral hazard by providing alternative credit facilities to the SMEs and the unbankables on the assumption that they have more information and resources to mitigate the information asymmetry. It is generally believed that moral hazard, coupled with lack of collateral by the poor and small and micro firms is the key reason why credit markets fail (Naveen, 2012). In developing countries, this risk is exacerbated by the lack of sound legal institution and credit scoring mechanisms infrastructure to assess the credit viability of SMEs and the unbankables. Rather than providing a more robust regulatory framework that reduce the incidence of strategic loan default and infrastructure to increase the firms (borrowers) rating based on their activities within the informal sectors, most central banks in developing countries instead resort to providing alterative credit facilities to the un-bankables.

The problem with this approach is that there is a higher probability of collective strategic loan default by the borrowers on the perception that other borrowers are unlikely to pay back the loan with the belief that the borrowed fund is common national wealth. The moral hazard presented by the unbankables is not eliminated merely by government participation in the credit market but are rather intensified. The study therefore argues that without incentives, strategic default (borrowers run) will not be eliminated in the credit market, and if such persist, business, investment, and employment will be negatively impacted (Joseph et al, 2021). High incidence of borrowers' runs can precipitate bank runs and financial crises.

Thus, this study aims to evaluate the role of incentives (positive and negative) in mitigating strategic loan default in government credit facilities window from a global game perspective and ultimately reduce the incidence of moral hazard and adverse selection problem prevalent in the credit market in Nigeria.

2. Literature Review

2.1 Theoretical framework Using Global Game Analysis

Many economic problems are naturally modelled as a game of incomplete information, where a player's payoff depends on his own action, the actions of others, and some unknown economic fundamentals. For example, many accounts of currency attacks, bank runs, strategic default, and liquidity crises give a central role to players' uncertainty about other players' actions. Because other players' actions in such situations are motivated by their

beliefs, the decision maker must take account of the beliefs held by other players (Angeletos & Pavan, 2013). We know from the classic contribution of Harsanyi (1967–1968) that rational behaviour in such environments not only depends on economic agents' beliefs about economic fundamentals, but also depends on beliefs of higher-order – that is players' beliefs about other players' beliefs, and so on.

In principle, optimal strategic behaviour should be analysed in the space of all possible infinite hierarchies of beliefs. However, such analysis is highly complex for players and analysts alike and is likely to prove intractable in general. It is therefore useful to identify strategic environments with incomplete information that are rich enough to capture the important role of higher-order beliefs in economic settings – but simple enough to allow tractable analysis. There are many situations in which interactions between players may give rise to strategic coordination motives. He believes that individual payoff depends not only on an underlying economic fundamental that shapes the aggregate state of the economy which the agents might perceive in different ways, but also on the actions that other players undertake. In these cases, agents must form beliefs about what other agents believe, and different coordination schemes can be sustained and be self-fulfilling in equilibrium (Kashyap, Mahapatro, Tantri, 2021).

For example, with the prospect of a devaluation, a great mass of speculators may launch an attack on a currency if the fundamentals are (or are perceived to be) weak, which in turn would drive the policymaker to devalue for a succinctly strong attack, thereby confirming the ex-ante expectations of the individual agents. Importantly, this may occur even when each individual agent is atomistic and acknowledges that his action alone is insufficient for such an attack to yield aggregate success. However, the coordination-driven correlation in actions may push the final outcome to correspond exactly to the overall prior market expectation (Kashyap et al, 2021).

Thus, many macroeconomic phenomena, ranging from bad debt and currency crises to investment crashes and political instability, can be taken as the outcome of self-fulfilling expectations, higher-order beliefs and information processing in an environment of strategic uncertainty (i.e., uncertainty about the behaviour of other agents) and payoff complementarities (i.e., actions that individually deliver a higher payoff when also chosen by others). It is therefore natural to model such scenarios as games in which players interact in coordination and their payoff depend on their own actions, the actions of others and the economic fundamentals. If such fundamentals are common knowledge, different agents may tacitly coordinate into choosing the same actions in equilibrium.

Other interpretations include bank runs, strategic loan default, asset price crashes, fluctuations in search activity

and episodes of revolution and socio-political distress. For bank runs, Bond and Rai (2009) show that even stable banks may be vulnerable to self-fulfilling panics if there is a systemic mismatch of long-maturity assets and short-maturity liabilities. If one lender believes that other borrowers would not be able to pay back their loans and that the lender will be limited in enforcing the loan agreement if many borrowers are unable to pay back their loans due to distress and insufficient resources to enforce the repayment of the loan, the borrower will naturally decline to abide by the condition of the loan. If other borrowers think like the borrower, then there will be strategic loan default which is capable of creating bank runs and financial crisis. This situation alike can be modelled in a global game framework.

2.2 Empirical Literature

A lot has been written on global games with interest on strategic coordination by borrowers particularly as it relates to microfinancing and bank runs that resulted in financial crisis. For instance, Ikeda (2020) examined bank runs, strategic default, prudential guideline in global games. Using a strategic global game theory, the author modelled the role of noisy information for studying liquidity and shows that bank runs are inevitable. Risk shifting induces excessive leverage and insufficient liquidity, causing an inefficiently high crisis probability. Imposing one requirement only causes risk migration: banks respond by taking more risk in another area, which warrants joint requirements. The design of the optimal joint requirements depends crucially on the model's general equilibrium effect and incentives become the key mediator.

Agarwal et al (2021) examined how microcredit programmes by the state can guarantee SMEs access to commercial bank loan, using global strategic game with loan-level data from Rwanda. The authors found that a large-scale microcredit expansion programme together with a credit bureau accessible to all lenders can enable unbanked borrowers to build a credit history, facilitating their transition to commercial banks. Specifically, data revealed that the programme improved access to credit and reduced poverty. A sizable share of first-time borrowers switched to commercial banks, which cream-skim less risky borrowers and grant them larger, cheaper, and longer-maturity loans. Switchers have lower default risk than non-switchers and are not riskier than other bank borrowers. Switchers also obtain better loan terms from banks compared with first-time bank borrowers without a credit history.

Kashyap et al (2021) examined the optimal bank regulation in the presence of bank run risk. The study modified the earlier Diamond and Dybvig (1983) model to account for the possibility of banks raising equity funding while offering liquidity services to depositors, make loans that are risky, and invest in safe liquid assets. The bank

and its borrowers are subject to limited liability. Their model also accounts for situation where when firms are profitable, banks monitor borrowers to ensure that they repay loans. Depositors may choose to run based on conjectures about the resources that are available for people withdrawing early and beliefs about banks' monitoring. The study found that banks opt for a more deposit-intensive capital structure than a social planner would choose. The privately chosen asset portfolio can be more or less lending-intensive, while the scale of intermediation can also be higher or lower depending on a planner's preferences between liquidity provision and credit extension. To correct these three distortions, they argue that a package of three regulations is warranted.

You et al (2021) investigated three game players in strategic default case of peer to peer (P2P) lending platforms in China. The study using evolutionary game model (EGM) of three players developed an interaction among regulatory authorities, P2P lending platforms, and borrowers. Then, the asymptotic of the equilibrium and evolutionary stability strategies of the EGM are analysed. Results indicate that either the P2P lending platforms or borrowers will choose "noncompliant operation" or "default" strategies from a short-term perspective, and the strict supervision of the P2P lending platform in the short term is necessary for the sustainable operation of the platform. When supervision is intensified in the early stage and regulatory pressure becomes a normal state, P2P lending platforms and borrowers will actively select "compliant operation" and "repayment" strategies even if there is a lack of regulation in the future. Meanwhile, the behavioural strategies of P2P lending participants can be changed to conform to the sustainability of P2P lending by reducing the costs of strict supervision and increasing the damage caused by general supervision, reward and punishment coefficient for P2P lending platforms, repayment incentives of borrowers, and defaulting opportunity costs.

Pang, Yang, Li and Cao (2020) examined a two-party static game between market supervisory organization and P2P lending platform. Considering 4-game modes with both "strong supervision" and "weak supervision" of market supervisory organization and "compliance management" and "noncompliance management" of P2P lending platform, the paper establishes a static game model between P2P lending platform and market supervisory organization and solves the market equilibrium solutions. Based on income, cost, disguised cost, and P2P lending platform and income, cost, and reward of market supervisory organization, it discusses conditional strategies that P2P lending platform selects "compliance management" or "noncompliance management" and that market supervisory organization selects "strong supervision" or "weak supervision", respectively. Furthermore, the relevant influencing factors are analysed, and come from 18 P2P lending platforms in

Guangdong Province of China. The conclusions were in agreement with the actual market.

Lee and Neuhann (2020) examined a global game with intervention trap. The authors use a dynamic model of collateralized lending with asymmetric information in which (i) an asset class can be used as collateral only if average quality is sufficiently high, and (ii) quality improves if borrowers exert hidden effort but slowly declines otherwise. Equilibrium asset quality is sensitive to initial conditions and self-fulfilling beliefs are sensitive to future quality. Under the most favorable beliefs, quality grows only if initial quality is sufficiently high, and small shocks may trigger persistent lending freezes. Even when equilibrium effort is inefficient, optimal policy under limited commitment can induce harmful intervention traps with falling quality and rising subsidies.

Barahona, Dobbin and Ho (2021) examined how schools respond to financial incentives using global game strategic form. Governments can penalize institutions with high dropout or loan default rates, and these institutions can respond by increasing quality or changing the selection of students. The study therefore developed an equilibrium model to illustrate the trade-off faced by policymakers. The study found that using the predictions of the model using a 2017 reform in Brazil, schools are made to pay a fee for students receiving federal student loans that dropped out or defaulted. Consistent with the predictions of the model, it was also discovered that schools are more reliant on government aid to reduce dropout rates, primarily by increasing quality. **Hibbeln and Osterkamp (2020)** examined bank behaviour in the global game with scrutinization. Using OLS, propensity score matching, and instrumental variable regressions, the study examines why retention deals perform better. Analysing monitoring effort and the workout process, it was discovered that the probability of rating updates or collateral revaluations is higher, and the rating quality is better. Retention loans have a lower probability of becoming non-performing, a lower delinquency amount, and a shorter time in arrears. Moreover, non-performing and defaulted retention loans are more likely to recover. It was also observed that total losses are lower for deals with retention, which are driven by lower default rates, lower exposures at default, and higher recovery rates.

Szkup (2020) examines multiplier effect and comparative statics in global games of regime change. The study revealed that the effect of a change in any parameter of a global game model of regime change can be decomposed into a direct effect, which captures the effect of a change in parameters when agents' beliefs are held constant, and a multiplier effect, which captures the role of adjustments in agents' beliefs. The study also characterizes conditions under which the multiplier effect is strong and relate it to the strength of strategic

complementarities and the publicity multiplier, as emphasized in an earlier work.

Brihaye et al (2019) examined positive and negative incentives in microfinance institution using the global game framework. It was discovered that incentives (positive or negative) increase “on-time” repayments. Second, the client is more likely to repay his loan with the encouragement of a bonus scheme rather than under the pressure of a sanction, regardless of the amount. The study further concludes that positive incentives are more effective as compared to negative incentives.

In summary, this study has reviewed several models explaining different strategic approaches to microfinancing either in a two-player situation – the microfinance and the borrowers, or a three-player situation – the microfinance, the borrowers, and the regulatory agencies. The study has also reviewed different situations and scenarios in which strategic default by borrowers can be possible and how this can be prevented from the global game perspective. Thus, the present study will contribute to the body of literature by developing a model that involves a lender, in this case the central government through its agencies, and borrowers who have tendencies to strategically plan to default.

3. The Model

When it comes to microfinancing, several authors have modelled the strategic relationship between microfinance and borrowers and have suggested different circumstances where the risk of microfinancing can be minimized. The study presents a case of two players, the central government microfinance institution (lender) and the potential borrowers (clients), and where the relationship between the players ends after two periods.

This assumption is simplistic but is made to reflect the role of Nigeria Incentive-Based Risk Sharing system for Agricultural Lending (NIRSAL) as microfinancier and to also reiterate the fact that NIRSAL operation model is not purely built on progressive lending but rather act as mechanism for special intervention. The Central Bank microfinance institution (thereafter referred to as NIRSAL) can grant loan or not to the borrowers (thereafter referred to as client). If it does so, then the client uses the money for a project and earn a naira wealth (₦W) and chooses either to repay the loan or not to repay it.

To encourage repayment of loan, the study presented a case of where NIRSAL introduces several incentives into the game designed to encourage the clients to pay back the loan and prevent strategic default. The incentives could be either positive or negative. The study will examine two situations/variants – the incentivized and non-incentivized game. We look at how the game will be played (how each of the actors will behave) when there are no incentives from NIRSAL and when NIRSAL introduces some incentives to encourage clients’ repayment of loans. We assume that positive incentives from NIRSAL in form of standing in for the ‘certified clients’ in any commercial/microfinance bank loan, reducing the client interest rate payment on future loans, or giving the client a higher loan in the next round, or giving clients grants in the future will encourage the clients to pay back their loans on time. On the other hand, NIRSAL can use some negative incentives to discourage strategic default. For instance, if clients fail to pay loans, NIRSAL can pull out its sanction measures in form of placing embargo on the clients to accessing other NIRSAL microfinance loan windows, prosecution, and publicizing client’s profile publicly. The idea is to see how the incentives measure will encourage clients’ repayment of loans and prevent strategic default which might hinder NIRSAL objective of increasing SMEs access to loan.

• **Basic Assumption**

- NIRSAL plays at node N1, N2, and N3
- Clients (SMEs) plays at C1 to C3
- Both Players have two strategies
- NIRSAL can Give loan (L) or Not (NL)
- Client can Pay (P) or Not (DP)

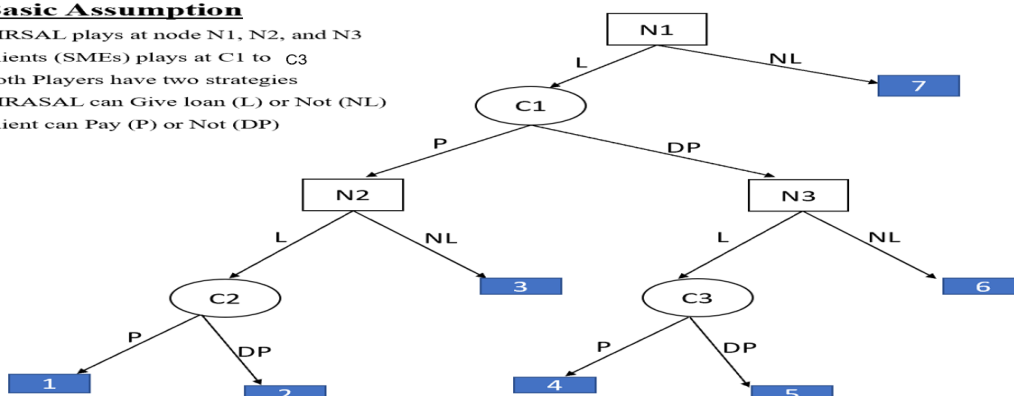


Figure 1: Extensive form of the Game between NIRSAL and Client the player

Source: Author Schematization

The study followed the example of Brihaye et al (2019) and use a two-case period where we consider a repeated game scenario, and each player played twice, and the relationship end for the purpose of simplification. The intuition is that NIRSAL loans often target the unbankable where a successful relationship with NIRSAL will improve their business and move them to bankable clients which could then easily get higher loan from NIRSAL or the commercial banks through NIRSAL referrer. A successful relationship with NIRSAL provides the SMEs with a good credit history that could easily be accessed by the traditional financial institution thereby making it easy for the lenders to access the firms credit worthiness and increase access to credit in the market. Figure 1 represents this situation as an extensive-form game. It models the temporal structure of all the possible interactions between two players: NIRSAL (which makes choices at square nodes labelled N1, N2, and N3) and the client (who makes choices at circle nodes labelled C1, C2, and C3). The letters on the arrows linking the nodes illustrate the possible choices of the NIRSAL and the client. NIRSAL plays first at node N1 and chooses to grant a loan (action L) or not to grant the client loan (action NL). If NIRSAL chooses to grant a loan, then the client chooses (at node C1).

The client can decide to repay the loan (action P), or not to repay it (action DP). If the borrower pays back the loan, NIRSAL at node (N2) can decide to grant another loan or not. Most literature that modelled progressive lending like Brihaye et al (2019) automatically grants the client another higher loan when they pay back (whether it paid back on time or late). The present study assumed a modified progressive learning where clients who repay their last loan does not receive another higher loan intermittently, but request for another loan are discussed and agreed. This is premised on assumption that the client sometimes could have been forced through sanction to pay the loan in which case NIRSAL might not want to grant the client another loan since he or she is viewed as a bad debtor. Similarly, if NIRSAL grant the client loan the second time, the client might decide to pay or not to pay back the loan at node C2 and C3.

The shaded nodes numbered 1 to 7, represent the end of the relationship between the client and NIRSAL and correspond to 7 possible final situations, and a possible pay-off for each of the players depending on their choice of action/strategies. This is called the players payoff and is summarized in Table 1. Depending on the case in question, NIRSAL and the client get a certain amount, which we call the payoff. For example, if NIRSAL grants no loan (DP) at node N1, the two players payoffs are both zero. Quite naturally, we assume that both players, NIRSAL and client are rational agents who want to maximize their own payoff and act accordingly. If the client repays a loan, we must distinguish, in the model, the payoffs in this case from those in the case where the client failed to pay back the loan and the client made a gain from

his cheating in the game while NIRSAL will make a loss. To determine the payoffs in all cases, we introduce some notation in Table 1. Note that the study does not fix apriori the value of each of the notation, including the positive and negative incentives to have the freedom to clearly illustrate the dynamics of the relationship and possible consequences for every action taken. Secondly, placing an arbitrary value will not allow the study to modify the value as NIRSAL or regulator introduces varieties of incentives in the game to prevent borrowers run. Nevertheless, we show further that the incentives do not have to be high for the client to repay the loan, since other factors as institutional framework (legal system, political environment) can make a difference.

The study considers two variants of the two-period model of Figure 1: the basic variant, denoted by M0; the variant in which the NIRSAL uses incentives (positive and negative simultaneously) denoted as M1. According to the notation in Table 1, in the basic variant, if NIRSAL grants the client a loan Z_1 and the client repays it, then NIRSAL receives interest plus the capital, given as ρZ_1 , while the client receives his project income minus the amount s/he repays, which can be written as $\mu Z_1 - (1 + \rho)Z_1$. However, if NIRSAL grants the client a loan Z_1 and the client fails to repay the loan, then NIRSAL loses its fund ($-Z_1$), while the client get it as bonus from his cheat (Z_1) and his/her payoff becomes μZ_1 .

However, to check opportunistic behaviour in the game, particularly a cooperative strategic default in the game as common in most government special loan intervention, NIRSAL could decide to introduce incentives, positive and negative - the only two at the NIRSAL's disposal, as discussed earlier. For instance, if NIRSAL grants loan to a client and the client repays the loan, the client receives a positive incentive from NIRSAL in the form of standing in for the client in any commercial bank loan, reducing the client interest rate payment on loan when paying back the loan, or giving the client a higher loan in the next round, among others. Thus, the client pay-off becomes $\mu Z_1 - (1 + \rho)Z_1 + PI$, while NIRSAL pay-off becomes $\rho Z_1 - PI$ where PI represent positive incentives. On the other hand, NIRSAL can use negative incentives to discourage strategic default. For instance, if the client fails to pay the loan, NIRSAL can pull out its sanction measures in the form of embargo on the client's account until the loan is repaid, prosecution of client based on the extant law, and embargo on further loan(s) to the client. Example is the case when NIRSAL grants the client loan and the client refuses to pay back the loan, the client pay-off will be given as the client project income plus the borrowed fund and the interest he/she would have paid on the fund, minus the cost of the sanction in his business and cost of the gain he/she would have received had he/she paid.

$$\mu Z_1 + (1 + \rho)Z_1 - (PI + S_c(NI)) \quad (1)$$

Whereas the NIRSAL payoff will be given as the cost of the positive incentive given to client for repayment of loan minus the amount granted as loan plus interest on loan repayment.

$$PI - (Z_1 + (1 + \rho)Z_1) \tag{2}$$

The study has described the possible payoffs of NIRSAL and client after the first loan. In order to give NIRSAL and client payoffs after the second loan, the study use a discount factor $0 < \delta < 1$ to obtain the present value of the money received tomorrow. For example, case 1, corresponding to shaded node 1 in Figure 1, represents the situation where the NIRSAL grants the client loans twice and the client repays the loan in both cases. In the basic variant, this implies that the NIRSAL gets ρZ_1 in the first interaction and $\delta\rho Z_2$ in the second interaction as given in (3)

$$\rho Z_1 + \delta\rho Z_2 \tag{3}$$

While the client gets:

$$\mu Z_1 - (1 + \rho)Z_1 + \delta(\mu Z_2 - (1 + \rho)Z_2) \tag{4}$$

Where $Z_2 > Z_1$, if we assume progressive lending.

To determine the Sub Nash Perfect Equilibrium for both players, the study applied the backward induction on each game for both variants when there are no incentives and when there are. This process starts at the end of the game (nodes C2 and C3) which are the only two unique subgames in the model and goes back up to the top (node N1) to determine optimal strategies for the players. The idea is that at each step, the player in question chooses the action(s) that maximize(s) his or her payoff, given the reasonable choices made by the other player in the previous steps.

Table 1: Summary of the Players pay-off with or without incentives

No Incentives			With Incentives	
S/N	Client Payoff	NIRSAL Payoff	Client Payoff	NIRSAL Payoff
1	$\mu Z_1 - (1 + \rho)Z_1 + \delta(\mu Z_2 - (1 + \rho)Z_2)$	$\rho Z_1 + \delta\rho Z_2$	$\mu Z_1 - (1 + \rho)Z_1 + PI + \delta(\mu Z_2 - (1 + \rho)Z_2 + PI)$	$\rho Z_1 - PI + \delta(\rho Z_2 - PI)$
2	$\mu Z_1 - (1 + \rho)Z_1 + \delta(\mu Z_2)$	$\rho Z_1 + \delta(-Z_2)$	$\mu Z_1 - (1 + \rho)Z_1 + P1 + \delta(\mu Z_2 + (1 + \rho)Z_2 - (PI + Sc(NI)))$	$\rho Z_1 - PI + \delta(PI - (Z_2 + (1 + \rho)Z_2))$
3	$\mu Z_1 - (1 + \rho)Z_1$	ρZ_1	$\mu Z_1 - (1 + \rho)Z_1 + PI$	$\rho Z_1 - PI$
4	$\mu Z_1 + \delta(\mu Z_1 - (1 + \rho)Z_1)$	$-Z_1 + \delta\rho Z_2$	$\mu Z_1 + (1 + \rho)Z_1 - (PI + Sc(NI)) + \delta(\mu Z_2 - (1 + \rho)Z_2 + PI)$	$PI - (Z_1 + (1 + \rho)Z_1) + \delta(\rho Z_2 - PI)$
5	$\mu Z_1 + \delta(\mu Z_2)$	$-Z_1 + \delta(-Z_2)$	$\mu Z_1 + (1 + \rho)Z_1 - (PI + Sc(NI)) + \delta(\mu Z_2 + (1 + \rho)Z_2 - (PI + Sc(NI)))$	$PI - (Z_1 + (1 + \rho)Z_1) + \delta(PI - (Z_2 + (1 + \rho)Z_2))$
6	μZ_1	$-Z_1$	$\mu Z_1 + (1 + \rho)Z_1 - (PI + Sc(NI))$	$PI - (Z_1 + (1 + \rho)Z_1)$
7	0	0	0	0

Source: Author

3.2 Determining the Optimal Sub Nash Perfect Equilibrium of the Players

Case 1: No Incentives

Solving by backward induction, we will first consider the pay-off of the client who played last at node C2 and C3. From the node C2 and C3 in both cases, the client would want to choose the option of not pay at case 2 and 5 where he chooses not to pay, given that $-(1 + \rho)Z_1 < 0$ and $\mu Z_1 + \delta(\mu Z_2) > 0$. Which means from the client perspective case 1, 3 and 4 is not a feasible option for him/her but would prefer the pay-off of 2 and 5. The implication is that following same reasoning about the choice of player two (client), NIRSAL would prefer case 3 and 6 where she will not grant loan again, given that NIRSAL cannot choose case 1 and 4, given the choice of player 2 (the client).

NIRSAL will choose the pay-off of case 3 over 6 as long as $(\rho Z_1) > -Z_2$, which is the case.

Given that NIRSAL, through backward induction, has chosen case 3 in node N2 and case 6 in node N3, the client will compare his/her pay-off at both nodes to decide his/her strategy in C1. The client will likely choose node 6 where he has a pay-off of μZ_1 . Notice that the client pay-off in node 3 is $\mu Z_1 - (1 + \rho)Z_1$ which is less than his/her pay-off at node 6 (μZ_1). In order words, (that is $\mu Z_1 - (1 + \rho)Z_1 < \mu Z_1$).

To this end, the client will choose case 6 pay-off at node C1. Player 1, NIRSAL, will then make the final decision of choosing between case 6 and case 7, where no loan happened. NIRSAL pay-off at case 6 is given as $-Z_1 < 0$, which means that he will likely not want to give loan in the first instance and chooses case 7. And when loan does not happen, everyone loses including businesses, household, government, and the economy at large. To mitigate such a scenario, let consider the case where incentives are introduced in the game to check opportunistic behaviour by the borrowers.

Case 1: With Incentives

Following the reasoning when we solved for the case of no incentives, Player 2 (the client) will start by choosing its pay-off in cases 2 and 5. Of course, he will prefer not to pay depending on the incentives – the cost of not paying the loan. In situation where the client knows that the cost (consequences) of not paying the loan outweigh the benefits of running with NIRSAL loan (borrower run), he will unlikely choose cases 2 and 5, except for a case of emergency. However, if he feels the benefits of not paying outweigh the cost associated with not paying, he will likely run away with NIRSAL loan. This is more likely in situation where cooperative strategic default is possible. But for this example and following the rational used for the first case analysis, the client will choose case 2 as long as $\mu Z_2 + (1 + \rho)Z_2 < (PI + Sc(NI))$ which is the case when there is high chances of sanction, negative effect on loan defaulters, and will also choose case 5 as long as $\mu Z_1 + (1 + \rho)Z_1 > (PI + Sc(NI))$ and $\mu Z_2 + (1 + \rho)Z_2 > (PI + Sc(NI))$. If we assume this is the case, player 2 will choose either case 2 or case 5. This is possible when the incentives employed by the bank is not adequate, otherwise s/he will choose cases 1 and 4.

Player 1 (NIRSAL) will consider case 3 and case 6. The bank will choose case 3 as long as $\rho Z_1 > PI$. This cannot be easily seen if this is the case except one understands what makes PI, that is the positive incentive. In most cases a government financial institution might be looking for people with integrity and genuine business ideas to sponsor and the positive incentives might likely be higher than the initial loan and in this case, the government might choose case 6 over case 3. If we assume that NIRSAL chooses case 3, then the decision of the client at C1 will be to compare his/her pay-off at cases 3 and 6. If $\mu Z_1 + (1 + \rho)Z_1 - (PI + Sc(NI)) < \mu Z_1 - (1 + \rho)Z_1 + PI$, then the sub-Nash perfect equilibrium will be the pay-off at case 3. This will largely be determined by the size and collection of both positive and negative incentives at the disposal of NIRSAL to enforce non-payment of loan or prevent opportunistic behaviour from borrowers.

4. Conclusion

The study has discussed the incidence of strategic loan default or borrower runs in typical government microfinance scheme using game theory. To achieve the

objective, the study developed a game theory model with hypothetical two players – the government microfinance (NIRSAL) and the client (borrowers). Two models of possible relation between players were discussed, the first being the case where the relationship between both players (NIRSAL and client) are not regulated by any incentives and the second being the case where a number of incentives were introduced in the game by NIRSAL.

The findings revealed that in the first variant of the model (no incentives), the game Sub-Nash equilibrium results in a situation where NIRSAL is unwilling to grant loan to the client, because if it does, the client will not pay back and it will incur loss because of possible incidence of strategic loan default. There is a situation where clients feel obliged not to pay their loans because they feel others would not pay and possibly no significant consequence for not paying the loan. This is a common scenario in Nigeria and other developing countries, and this makes it difficult for the government to succeed in most intervention programmes that involve government agencies directly giving loan to the public. As revealed in the case of no incentive, if all players are rational, government will be discouraged from embarking on intervention programmes. This absence of government intervention will then constitute an obstacle to Nigeria's industrial development as well as poverty alleviation policies in the country.

The study also looked at an alternative model where incentives are introduced in the model. Both positive and negative incentives are introduced to regulate and reduce opportunistic behaviour among the borrowers, reduce moral hazard, and to ensure there is no incidence of cooperative strategic default of bank loans. As revealed in this case, we could see that incentives regulate the choice of borrowers from day one. It could be seen that the more the collection and size of the incentives are, the more likely opportunistic behaviour is mitigated from taking place.

The study concludes that incentives is key to the success of the different intervention programmes being rolled out by the central bank micro finance bank without which the borrowers runs (strategic default) will be prevalent. Such incidence can create inflationary pressure on the economy as the government tries to push more money into the economy by providing more credit facilities to other clients without mopping the earlier loans. Secondly, it could stiffen the economy as the bank struggles to raise more funds to give other SMEs and businesses due to no or low payment of loans by existing borrowers. Thirdly, such incidence could lead to bad credit history for most businesses and informal sector participants, which ultimately makes it difficult for such individuals to access loans from the conventional window (deposit money banks). Lastly, the developmental objectives of resolving the financial constraints of most businesses and informal sector participants will be defeated. This finding is consistent with the findings of

Bond and Rai (2009) and **Brihaye et al (2019)** who believed that poor regulatory incentives in developing countries encourage borrowers' runs, which is inimical to proper functioning of the credit market. This could be attributed to one of the reasons hindering most intervention programmes in Nigeria as argued by **Tonuchi and Andrew (2019)**.

5. Recommendation and Policy Implication

Incentives are the key to preventing strategic loan default in government intervention programmes. Several positive and negative incentives could be introduced to discourage opportunistic behaviour in the credit market. Example of positive incentives could include NIRSAL standing in for certified clients in any deposit money bank loan, reducing the client interest rate payment on loan when paying back the loan, or giving the client a higher loan in the next round. Certified here entails client with great credit history or who have successfully repaid the borrowed funds without the bank pulling any of its sanction tools. Similarly, negative (harsh) incentives could also be introduced in the form of embargo on client account until the loan repayment, prosecution of client based on the extant law, and public ban on client from accessing loan elsewhere in the financial system.

Similarly, the incidence of moral hazard or adverse selection can be totally minimized when NIRSAL adopt a systemic and objective screening process to evaluate borrowers before releasing funds. Objective screening measure will ensure that only businesses with clear vision and growth trajectory that will contribute to the economy growth process are only funded. Similarly, objective screening process will ensure that borrowers totally understand the terms and condition of the borrowed funds as evidence suggests that most borrowers in government backed credit scheme rarely understand the condition of the loans when accessing such loan. This understanding will limit the incidence of moral hazard.

Competing Interests

Authors declare no competing interest

References

- Agarwal, S., Thomas, K., Camelia, M., Andrea, F., Presbitero, and André F, S. (2021). Serving the Underserved: Microcredit as a Pathway to Commercial Banks," Finance and Economics Discussion Series 2021-041. Washington: Board of Governors of the Federal Reserve System, <https://doi.org/10.17016/FEDS.2021.041>.
- Angeletos, G.-M., Pavan, A. (2013). Selection-free predictions in global games with endogenous information and multiple equilibria. *Theoretical Economics*, 8, 883–938
- Barahona, N., Dobbin, C., Ho, H. (2021). Skin in the Game: Colleges' Financial Incentives and Student Outcomes. Occasional Paper. Retrieved from <https://Theb.stanford.edu/~sotero/papers/skinningame.pdf>
- Bond, P., & Rai, A. S. (2009). Borrower runs. *Journal of Development Economics*, 88(2), 185–191.
- Brihaye, T., De Pril, J, Labie, M, Périlleux, A. (2019). Positive versus negative incentives for loan repayment in microfinance: A game theory approach. *Rev Dev Econ*. 23, 577– 597. <https://doi.org/10.1111/rode.12563>
- Harrison, R. and Jara-Moroni, P. (2021). Global games with strategic substitutes. *International Economic Review*, 62, 141-173. <https://doi.org/10.1111/iere.12481>
- Hibbeln, M. T., Osterkamp, W. (2020). The impact of skin in the game on bank behavior in the securitization market. Retrieved from <http://dx.doi.org/10.2139/ssrn.3528090>
- Ikeda, D. (2020). Bank runs, prudential tools and social welfare in a global game general equilibrium model. Bank of England Working Paper No. 732 (revised in October 2020), Available at SSRN: <http://dx.doi.org/10.2139/ssrn.3192939>
- Joseph, T. E. Peter, I., Adetoba, O. O., Mimiko, D. O. (2020). How large is the size of nigeria's informal economy? a mimic approach. *International Journal of Economics, Commerce and Management*, 8(7), 204-228
- Joseph, T., Obikaonu, P., Ariolu, C., Nwolisa, C., & Aderohunmu, A. (2021). SMEs Intervention Programmes in Nigeria: Evaluating Challenges Facing Implementation. *Applied Journal of Economics, Management and Social Sciences*, 2(1), 16–25. <https://doi.org/10.53790/ajmss.v2i1.10>
- Kashyap, N., Mahapatro, S., Tantri, P. L. (2021). Preventing Borrower Runs: The Prompt Corrective Action Approach. Available at SSRN: <https://ssrn.com/abstract=3933476> or <http://dx.doi.org/10.2139/ssrn.3933476>
- Lee, M. J., Neuhann, D. (2020). A Dynamic Theory of Collateral Quality and Long-term Interventions. A federal Reserve Occasional paper Series retrieved from http://sites.utexas.edu/danielneuhann/files/2022/02/C_Qual_revision.pdf
- Pang, S., Yang, J., Li, R., & Cao, J. (2020). Static Game Models and Applications Based on Market Supervision and Compliance Management of P2P Platform. *Mathematical Problems in Engineering*, 2020, 1–17. <https://doi.org/10.1155/2020/8869132> <https://doi.org/10.1155/2020/8869132>
- Szkup, M. (2020). Multiplier effect and comparative statics in global games of regime change. *Theoretical Economics*, 15: 625-667. <https://doi.org/10.3982/TE3074>
- Tonuchi, E. J. and Onyebuchi, N. A. (2019). Economic diversification in Nigeria: the role of agriculture and manufacturing sector. *International Journal of Research in Electronics and Computer Engineering*7(4): 916–926

Trautmann, S. T., & Vlahu, R. (2013). Strategic loan defaults and coordination: An experimental analysis. *Journal of Banking & Finance*, 37(3), 747–760

You, G., Guo, H., Dagestani, A. A., Deng, S. (2021). Evolutionary game analysis of three players on behavioural strategy of p2p lending participants: a sustainable operations perspective. *Special issue- Complexity in Businesses and Economics 2021*.