

Econometric modelling of bank activities: value-based approach to the problem loans terms' rescheduling

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Abstract. The permanent state of the financial crisis has predictably brought to the forefront such traditional problem of banking as problem loans. This research aims to work out an econometric approach to the solution of the problem of loans terms' rescheduling. For this purpose, we, firstly, treated credit as a bank's investment project with cashflows' chart including initial outflow (principal) and following inflows represented by loan payments. Secondly, we combined the schematic representation of loan's cashflows with NPV formula accustomed to loan's cashflows and it allowed to create the econometric models for three types of loan: classic, annuity, serial. Thirdly, for the case when borrower breaks a loan's payment schedule and it leads to the reduction of loan's NPV and loss of the wealth of bank's shareholders, respectively, we outlined special compensative models of cashflows where default in payment is interpreted by the lender as an additional forced loan. We suggested modifying the loan terms (interest rate or effective period of the loan agreement) for the rest of payment periods. Fourthly, we laid the special compensative models of forced loans' cashflows a top corresponded initial cashflows of loans and this has made it possible to get formulas calculating the modified interest rate and the additional number of loans' payment periods with the aid of backward calculation. As a result, we developed the econometric models of the loan terms' modifications based on the prolongation of the initial credit period and the increasing of the initial interest rate.

1 Introduction

1.1 Research question

Investigating the problem loan management is a continuing concern within modern banking. There is a growing body of literature that recognizes the importance of this problem related to such aspects as the definition and identification of problem loans, detection of reasons and circumstances that lead to the occurrence of problem loans, problem loans' management including loans' portfolio management, mitigation of related risks etcetera.

Most of these studies have been conducted and represented by governmental or supranational bodies charged with financial supervision and regulation (World Bank, IMF, EBRD, and Basel Committee). Leading financial corporations and banks also joined with this process. As a result, it was developed standards, practices and other recommendatory documents related to the management of problem loans at the level of the banking system or bank. Much of these documents are concerned with the necessity to maintain the recommended level of capital adequacy.

In the case of any given loan banks are free to act at its option. The bottom line is that bank has only two actual options to manage the existing problem loan: either to use the right of pledge via forfeiture of the assignable

assets or to reschedule the loan. The first approach is well-known and widely used in practices. The second one can be treated as less harmful to both bank and borrower. In this case, the initial loan terms should be changed in such a way as to save the expected economic effect projected by the bank at the moment of the loan issue. However, the value saving approach that can be used by the bank for handling the problem of problem loans' rescheduling has not yet been characterized in detail and provided with econometric tools. The successful fulfilment of the value saving requirement will enable the bank to prevent the undesired reduction of the credit portfolio's market value. At the same time for the borrower, it could give a handle to save the business and gain time to adapt it to the new loan terms.

1.2 Previous researches and scientific problem

The conceptual framework of this research was based on the wealth maximisation theory [1]. Within the context of banking, this theory got reinterpretation where the wealth of the bank's shareholders directly depends on the credit portfolio's economic performance [2, 3]. A value-based approach was used for the twofold purpose: first to develop the econometric models for the main types of credits to estimate the economic effectiveness of credit for the lender [4], , and second to design compensative models assuming the problem loans terms' rescheduling to grant the lender the planed economic effect [5]. A wide range of

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aspects on problem loans terms' rescheduling is considered in [6, 7]. The methodological basis on econometric models is provided in [8].

For the achievement of the intended outcomes, we proceeded four successive steps.

Firstly, credit was treated as a bank's investment project with its own cashflows' chart including initial outflow (principal) and following inflows in the form of loan payments.

Secondly, the usage of cash-flow diagrams for a schematic representation of loan's cashflows combined with NPV formula accustomed to loan's cashflows allowed to create econometric models for three main types of loan: classic loan, annuity loan and serial loan.

Thirdly, for the case when borrower breaks a loan's payment schedule and it leads to the reduction of loan's NPV it was outlined special compensative models of cashflows where default in payment is considered by the lender as an additional forced loan. We suggested modifying the loan terms (interest rate or effective period of the loan agreement) for the rest of payment periods.

Fourthly, special compensative models of forced loans' cashflows were laid atop corresponded initial cashflows of loans and this combination made it possible to get formulas calculating the modified interest rate and the additional number of loans' payment periods with the aid of backward calculation.

Thus, the chosen problem is of a significant scientific interest nowadays.

2 Main methodological assumptions of the research

2.1 Classic loan

A classic loan is characterized by the regular interest payments and a bullet repayment of the principal's amount at the end of the loan term [9]. Figure 1 illustrates this case.

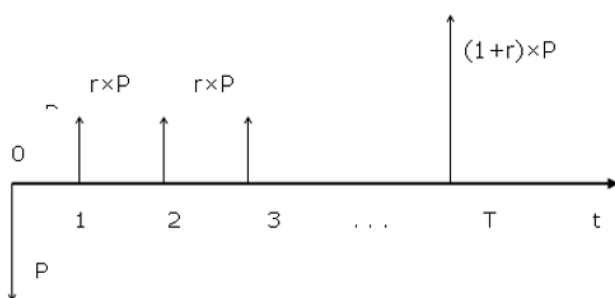


Figure 1. Cash flows' chart for classic loan

The net present value (NPV) of the classic loan is:

$$NPV = -P + r \times P \times \sum_{t=1}^T \frac{1}{(1+WACC)^t} + \frac{P}{(1+WACC)^T} \quad (1)$$

where P is the principal amount, r is the interest per period, T is the term of the loan and $WACC$ is the weighted average cost of capital for the lender.

Table 1 gives the initial loan's terms for the classic loan.

Table 1. Initial terms of the classic loan

Terms of the loan	Value
Principal amount (P)	UAH 10 000,00
Interest rate (r)	13%
Term of the loan (T)	8 years
The weighted average cost of capital for the bank ($WACC$)	8%

We can calculate the expected loan's NPV using formula (1) and it is UAH 2,873.32.

Let's assume that borrower has made payments for the first four years and is failed to pay interest instalment in the fifth period. This situation leads to the reduction of the expected NPV. Of course, we can recalculate the new value for NPV using formula (1) but for descriptive reasons we do it in a tabular form (table 2).

Table 2. Numerical illustration: cash flows and NPV calculation for the classic loan with the missed payment, thousand UAH

Period (t)	Interest rate (r), %	Cash flow (CF_t)	Present value factor $\left[\frac{1}{(1+WACC)^t} \right]$	The present value of cash flow $\left[\frac{CF_t}{(1+WACC)^t} \right]$
0	-	-10	1	-10
1	13	1,3	0.925	1,2
2	13	1,3	0.857	1,11
3	13	1,3	0.793	1,03
4	13	1,3	0.735	0,9
5	13	-	0.68	-
6	13	1,3	0.63	0,82
7	13	1,3	0.58	0,76
8	13	10,3	0.54	6,1
				NPV= 1,98

As we can see the single missed payment decreases loan's NPV by UAH 884.76 (UAH 2,873.32 – UAH 1,988.56).

Taking into account that in this case, we deal with the unsecured loan without opportunity for the lender to get the principal of the loan back, we have two *economically viable* alternatives to offset a loss of the loan's value (NPV): either to increase the interest rate for the rest of periods or to prolong the effective period of the loan agreement.

2.2 Increasing of interest rate

In this case, the statement of the problem is simple.

It is necessary to offset a loss of the loan's value (caused by missed interest payment (figure 2)) using the modified (increased) interest rate for the rest of the loan period.

To solve this problem, it is proposed to formalize the problem by replacement of actual data with disposal variables.

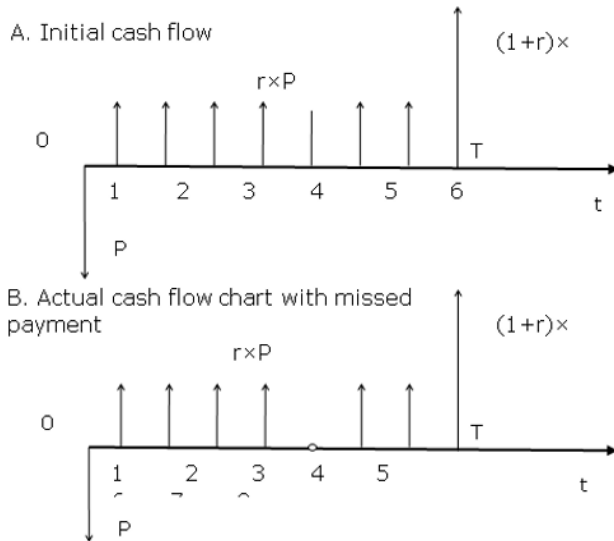


Figure 2. Cash flows charts

The comparison of this cash flow charts shows the absence of one payment (figure 2).

The missed payment ($P \times r$) can be treated by bank both as cash outflow and as a forced extraordinary loan at this period marked as T' .

In our case the principal amount of this forced credit can be compensated by annuity payment (marked as A) for the rest of periods ($[T'; T]$) (figure 3).

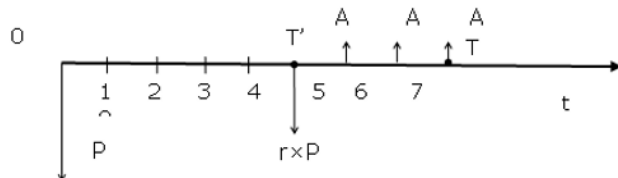


Figure 3. Cash flow for the rest of periods

The amount of this additional annuity payment can be derivable from the equation:

$$r \times P = A \times \left[\frac{1}{WACC} - \frac{1}{WACC \times (1 + WACC)^{T-T'}} \right] \quad (2)$$

The additional annuity payment is:

$$A = \frac{r \times P}{\frac{1}{WACC} - \frac{1}{WACC \times (1 + WACC)^{T-T'}}} \quad (3)$$

The amount of this additional annuity payment can be added to the original loan's interest payment.

This is shown within the figure 4.

In this particular case, the amount of an additional annuity payment that is to be added to the initial interest payment is UAH 504.44.

The modified interest rate (r') for the rest of periods ($[T'; T]$) after the missed interest payment at the period T'

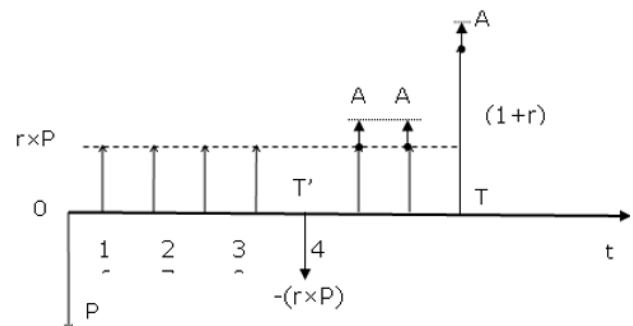


Figure 4. Cash flow for the modified payment

is:

$$r'_{[T';T]} = \frac{A + r \times P}{P} = \frac{A}{P} + r \quad (4)$$

On substituting (3) into (4) we get the primary case

$$r'_{[T';T]} = \frac{\frac{r \times P}{\frac{1}{WACC} - \frac{1}{WACC \times (1 + WACC)^{T-T'}}}}{P} + r \quad (5)$$

and these after simplification:

$$r'_{[T';T]} = r \times \left[\frac{WACC}{1 - \frac{1}{1+WACC}^{T-T'}} + 1 \right] \quad (6)$$

In the case under consideration, the modified interest rate (r') for the rest of periods ([5; 8]) after the missed interest payment at the period 5 is 18.04% and checking calculation is represented in table 3.

Table 3. Numerical illustration: cash flows and NPV calculation for the classic loan with the missed payment and modified interest rate, thousand UAH

Period (t)	Interest rate (r), %	Cash flow (CF _t)	Present value factor $\left[\frac{1}{(1+WACC)^t} \right]$	The present value of cash flow $\left[\frac{CF_t}{(1+WACC)^t} \right]$
0	-	-10	1	-10
1	13	1,3	0,925	1,2
2	13	1,3	0,857	1,11
3	13	1,3	0,793	1,03
4	13	1,3	0,735	0,9
5	13	-	0,68	-
6	18,04	1,8	0,63	1,13
7	18,04	1,8	0,58	1,05
8	18,04	11,8	0,54	6,377
				NPV = 2,873

2.3 Prolongation of the effective period of the loan agreement

An alternative solution to the problem is to prolong the effective period of the loan agreement.

Consequently, it is necessary to compensate for the loss loan's NPV (UAH 884.76) caused by the missed interest payment at the 5th period.

The simplest solution is to use the step-by-step prolongation procedure by adding one after one payment periods until the loan's NPV reach the target value (UAH 2,873.32).

This approach represented in table 4.

As table 4 shows that it is possible to compensate the loss loan's NPV caused by the missed interest payment on the basis of adding four new payment periods and the new loan term is meant to be almost 12 years.

The above method can be treated as a one based on empirical judgments but not on value-based computational approach.

It needs a great number of iterations to get the result and does not provide the problem's solution in a formalized manner.

In the furtherance of this goal, the first thing we have to do is to chart additional cash flows that can arise out of the loan's prolongation (figure 5).

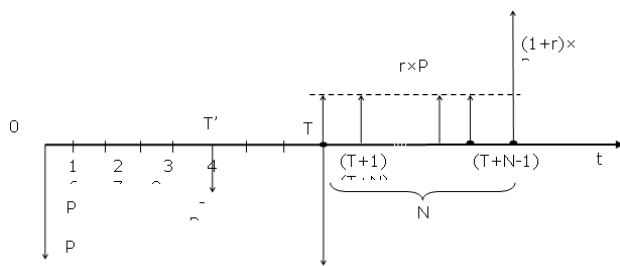


Figure 5. Cash flow for the forced loan in the case of loan prolongation

This chart depicts only those cash flows which first, occurred as a result of failure to pay on the due date (outflows): an interest payment on period T' (in this case $T' = 5$) and absence of repayment of principal P on a loan at period T . Secondly, it shows additional interest payments ($r \times P$) over the time of N additional payment periods added to the initial effective period of the loan agreement and repayment of principal (P) at the end ($T + N$).

The loss of the loan's original NPV due to the missed interest payment is:

$$NPV_{loss} = \frac{r \times P}{(1 + WACC)^{T'}} + \frac{P}{(1 + WACC)^T} \quad (7)$$

NPV of additional cash flows over the time of N additional payment periods is:

$$NPV_{CFadd} = r \times P \times \left[\sum_{t=T+1}^{T+N} \frac{1}{(1 + WACC)^t} \right] + \frac{P}{(1 + WACC)^{T+N}} \quad (8)$$

Taking into account that interest payments are annuities, formula (7) may be expressed as follows:

$$NPV_{CFadd} = \frac{1}{(1 + WACC)^T} \times \left[\frac{1}{(1 + WACC)^T} - \frac{P}{(1 + WACC)^{T+N}} \right] + \frac{P}{(1 + WACC)^{T+N}} \quad (9)$$

Now it is possible to equate the loss of the loan's original NPV due to the missed interest payment (6) with NPV of additional cash flows over the time of N additional payment periods:

$$NPV_{loss} = NPV_{CFadd} \quad (10)$$

or

$$\frac{r \times P}{(1 + WACC)^T} + \frac{P}{(1 + WACC)^T} = \frac{r \times P}{WACC * (1 + WACC)^T} \times \left[1 - \frac{1}{(1 + WACC)^N} \right] + \frac{P}{(1 + WACC)^T} \times \frac{1}{(1 + WACC)^N} \quad (11)$$

The deduced equation (10) contains the only one unknown variable we need – the number of additional payment periods (N):

$$N = \frac{\ln \left(\frac{WACC - r}{WACC * (r * (1 + WACC)^{T-T'} + 1) - r} \right)}{\ln(1 + WACC)} \quad (12)$$

In the case under consideration the number of additional payment periods $N = 3.95$.

Thus, the lender must prolong the effective period of the loan agreement up to 11.95 years to compensate the loan's loss of NPV (UAH 884.76) caused by the missed interest payment at the 5th period on the assumption that interest rate on this loan stays fixed.

2.4 Annuity loan case

An annuity loan is characterized by the instalment in all periods being of an equal amount CF_{ann} . Period by period the loan is settled and because the loan outstanding thereby is being reduced, the interest will period by period become less and the repayments equally higher. Figure 6 illustrates this case.

The expected net present value of the annuity loan is:

$$NPV = -P + CF_{ann} \times \sum_{t=1}^T \frac{1}{1 + WACC)^t}, \quad (13)$$

where CF_{ann} is equal in all periodic instalments.

Table 5 gives the initial loan's terms for the annuity loan.

We can calculate the expected loan's NPV using formula (12) and it is 2,873.32.

Let's assume that borrower has made payments for the first four years and is failed to pay an instalment at the

Table 4. Numerical illustration: cash flows and NPV calculation for the classic loan with the missed payment and prolongation of the loan's effective period of the agreement (step-by-step prolongation procedure), thousands UAH

Period (<i>t</i>)	Additional period (<i>t</i> + 1)	Cash flow (<i>CF_t</i>)	Present value factor $\left[\frac{1}{(1+WACC)^t}\right]$	The present value of cash flow $\left[\frac{CF_t}{(1+WACC)^t}\right]$	Cumulated NPV $\left[-K + \sum_{t=1}^{T+N} \frac{CF_t}{(1+WACC)^t}\right]$
0		-10	1	-10	-10
1		1,3	0,92	1,2	-8,79
2		1,3	0,85	1,1	-7,68
3		1,3	0,79	1,03	-6,64
4		1,3	0,73	0,9	-5,69
5		0	0,68	0	-5,69
6		1,3	0,63	0,8	-4,87
7		1,3	0,58	0,75	-4,11
8		1,3	0,54	0,7	-3,41
9	1	1,3	0,5	0,65	-2,76
10	2	1,3	0,46	0,6	-2,16
11	3	1,3	0,42	0,55	-1,6
12	4	11,3	0,39	4,487	2,883
					NPV = 2,883

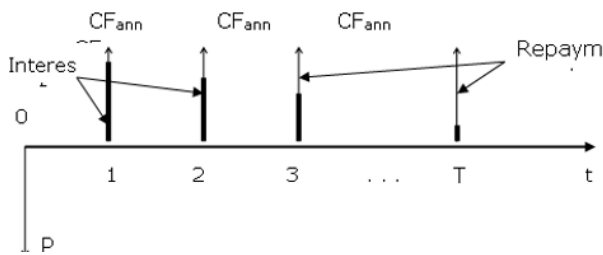


Figure 6. Cash flow for the annuity loan

Table 5. Initial terms of the annuity loan

Terms of the loan	Value
Principal amount (<i>P</i>)	UAH 10
Installment per period (<i>CF_{ann}</i>)	UAH 2,24
Term of the loan (<i>T</i>)	8
The weighted average cost of capital for the bank (<i>WACC</i>)	8%

5th period. This situation leads to the reduction of the expected NPV. We could recalculate the new value for NPV using formula (12) but for descriptive reasons we did it in a tabular form (table 6).

As we can see the single missed payment decreases the loan's NPV by UAH 1524.61 (UAH 2873.32 – UAH 1348.71). Considering that in this case, we deal with the unsecured loan without opportunity for the lender to get the principal of the loan back, we have two economically viable options to compensate the loss of the loan's value: either to increase the instalment for the rest of periods or to prolong the effective period of the loan agreement.

Table 6. Numerical illustration: cash flows and NPV calculation for the annuity loan with the missed payment, thousands UAH

Period (<i>t</i>)	Cash flow (<i>CF_t</i>)	Present value factor $\left[\frac{1}{(1+WACC)^t}\right]$	The present value of cash flow $\left[\frac{CF_t}{(1+WACC)^t}\right]$
0	-10	1	-10
1	2,24	0,925	2,07
2	2,24	0,857	1,92
3	2,24	0,793	1,78
4	2,24	0,735	1,65
5	0	0,680	0
6	2,24	0,630	1,41
7	2,24	0,583	1,3
8	2,24	0,540	1,21
			NPV = 1348,71

2.5 Increasing of instalments

In this case, the statement of task is simple. There is a need to compensate a loss of the loan's NPV (caused by missed instalment) using the increased value of instalment.

To solve this problem, it is proposed to formalize the problem by replacement of actual data with disposal variables.

The comparison of cash flow charts (figure 7) shows the absence of one payment (instalment). The missed payment (*CF_{ann}*) can be treated by bank both as a cash outflow and (in our case) as a *forced* extraordinary loan at this period marked as *T'* in the case when the lender is ready to increase the instalment.

Similarly, with the classic loan's approach it is possible to derive an equation of the additional annuity payment (*A*) for the rest of periods (*T'*; *T*):

$$CF_{ann} = A \left[\frac{1}{WACC} - \frac{1}{WACC \times (1 + WACC)^{T-T'}} \right] \quad (14)$$

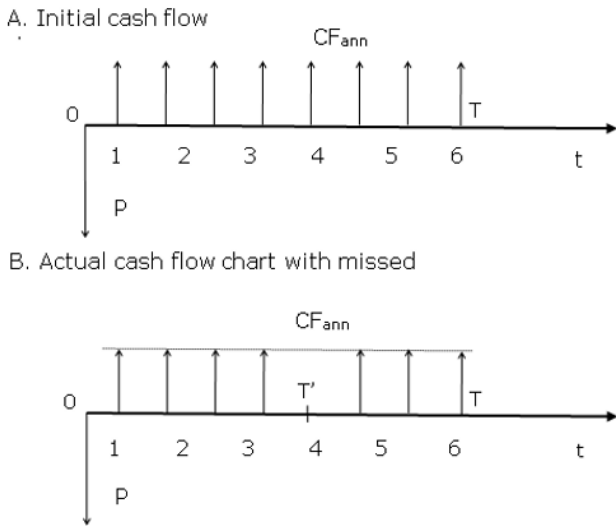


Figure 7. Cash flows

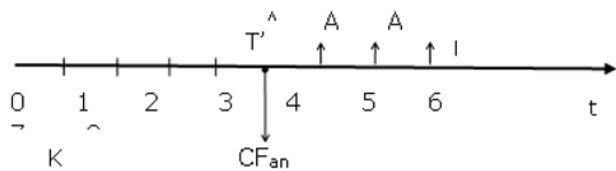


Figure 8. Cash flow for the forced loan to compensate the loss of the loans' NPV caused by missed instalments

The additional annuity payment is:

$$A = CF_{ann} \times \left[\frac{WACC}{1 - \frac{1}{(1+WACC)^{T-T'}}} \right] \quad (15)$$

The amount of this additional annuity payment (A) can be added to the original loan's instalment (figure 9).

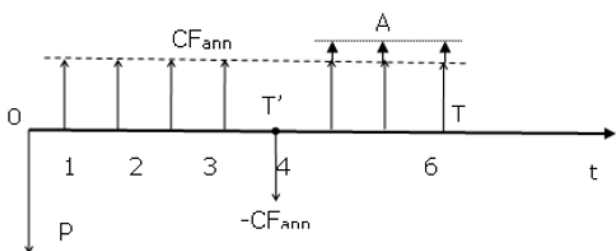


Figure 9. Cash flow for the modified annuity

In the case under consideration (table 5), the additional annuity payment for the rest of periods (15'; 8) after the missed instalment (2,240.15) at the period 5 is 869.25.

Checking calculation is represented in table 7.

Table 7. Numerical illustration: cash flows and NPV's calculation for the annuity loan with the missed payment and modified instalment, thousand UAH

Period (t)	Cash flow (CF _t)	Compensatory cash flow (A)	Summary cash flow (CF' _t = CF _t + A)	Present value factor $\left[\frac{1}{(1+WACC)^t} \right]$	The present value of cash flow $\left[\frac{CF_t}{(1+WACC)^t} \right]$
0	-10	-	-10	1	-10
1	2,24	-	2,24	0,92	2,07
2	2,24	-	2,24	0,85	1,92
3	2,24	-	2,24	0,79	1,78
4	2,24	-	2,24	0,73	1,64
5	-	-	-	0,68	0,00
6	2,24	0,86	3,1	0,63	1,95
7	2,24	0,86	3,1	0,58	1,81
8	2,24	0,86	3,1	0,54	1,67

NPV = 2,873.32

2.6 Prolongation of the effective period of the loan agreement

Let's assume that borrower has made payments for the first four years and is failed to pay an instalment at the 5th period. This situation leads to the reduction of the loan's expected NPV (table 6). The cash flow model of the compensatory *forced* loan is displayed graphically in figure 10.

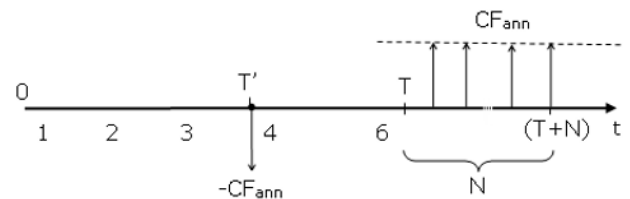


Figure 10. Cash flow for the forced loan to compensate the loss of the loans' CF caused by missed instalments via prolongation

This chart depicts only those cash flows which first, occurred as a result of failure to pay on the due date (outflow): an instalment payment ($-CF_{ann}$) on period T' (in this case $T' = 5$). Secondly, it shows additional instalment payments (CF_{ann}) over the time of N additional payment periods added to the initial effective period of the loan agreement $T + N$.

The loss of the loan's original NPV due to the missed instalment is:

$$NPV_{loss} = \frac{CF_{ann}}{(1 + WACC)^T} \quad (16)$$

NPV of additional cash flows (instalments) over the time of N additional payment periods ($[T + 1; T + N]$) is:

$$NPV_{CFadd} = \frac{CF_{ann}}{WACC \times (1 + WACC)^T} \times \left[1 - \frac{1}{(1 + WACC)^N} \right] \quad (17)$$

Now it is possible to equate the loss of the loan's original NPV due to the missed payment (15) with NPV of additional cash flows (instalments) over the time of N additional payment periods (16):

$$NPV_{loss} = NPV_{CF_{add}} \quad (18)$$

or

$$\frac{CF_{ann}}{(1+WACC)^{T'}} = \frac{CF_{ann}}{WACC \times (1+WACC)^T} \times \left[1 - \frac{1}{(1+WACC)^N} \right] \quad (19)$$

After simplification

$$\frac{1}{(1+WACC)^N} = 1 - WACC \times (1+WACC)^{T-T'} \quad (20)$$

The deduced equation (19) contains the only one unknown variable we need – the number of the additional payment periods (N):

$$N = \frac{\ln\left(\frac{1}{1-WACC \times (1+WACC)^{T-T'}}\right)}{\ln(1+WACC)} \quad (21)$$

This formula shows that the number of additional payment periods (N) depends only on the original term of the loan (T), lender's cost of capital ($WACC$) and the missed payment's numerical order (T').

In the case under consideration (missed instalment at the period $T' = 5$) the number of additional payment periods (prolongation) (N) is 1.38.

Thus, the lender must prolong the effective period of the loan agreement up to 9.38 years to compensate the loan's loss of NPV caused by the missed interest payment at the 5th period on the assumption that interest rate on this loan stays fixed.

2.7 Increasing of interest rate

It is to be noted that we have the missed payment at the period T' that is composed of the fixed part of the principal amount $\frac{P}{T}$ and accrued interest.

Hence, this sum of the missed payment at the period T' can be treated as a cash outflow $CF_{T'}$:

$$CF_{T'} = \frac{P}{T} + r \times \left(P - (T' - 1) \times \frac{P}{T} \right) \quad (22)$$

or

$$CF_{T'} = P \times \left(\frac{1}{T} + r \times \left(1 - \frac{T' - 1}{T} \right) \right) \quad (23)$$

Compensation for these losses, considering the time value of money, is to be made by increasing the loan's interest rate accruing on the rest of the main debts' payments over a period $[T'; T]$ (figure 11).

This statement can be written as:

$$PV'_{[T';T]} - PV''_{[T';T]} = CF_{T'} \quad (24)$$

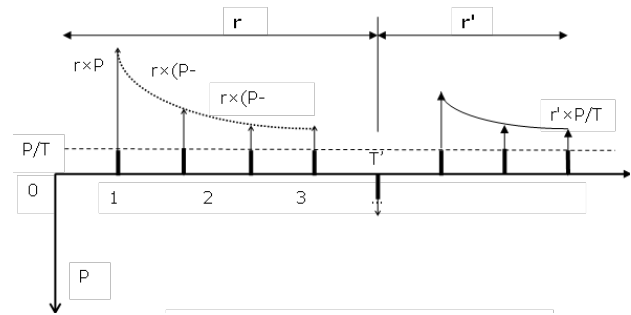


Figure 11. Cash flow chart

In equation (24) $PV'_{[T';T]}$ is the present value of the loans' cash flows that will be generated using modified interest rate r' for payment periods that are followed by the missed payment ($[T'; T]$):

$$PV'_{[T';T]} = \sum_{t=1}^{T-T'} \left[\frac{\frac{K}{T} + K \times r' \times \left(1 - \frac{T'-1+t}{T} \right)}{(1+WACC)^t} \right] \quad (25)$$

$PV''_{[T';T]}$ is the present value of the loans' cash flows that could be generated using the original interest rate r for payment periods that are followed by the missed payment ($[T'; T]$):

$$PV''_{[T';T]} = \sum_{t=1}^{T-T'} \left[\frac{\frac{K}{T} + K \times r \times \left(1 - \frac{T'-1+t}{T} \right)}{(1+WACC)^t} \right] \quad (26)$$

Consequently, the left side of an equation (25) is

$$PV'_{[T';T]} - PV''_{[T';T]} = P \times (r' - r) \times \sum_{t=1}^{T-T'} \frac{1 - \frac{T'-1+t}{T}}{(1+WACC)^t} \quad (27)$$

Substitution of (26) and (22) for (25) yields equation (27) containing the only one unknown variable – the modified interest rate r' for payment periods that are followed by the missed payment ($[T'; T]$):

$$r' = \frac{\frac{1}{T} + r \times \left(1 - \frac{T'-1}{T} \right)}{\sum_{t=1}^{T-T'} \frac{1 - \frac{T'-1+t}{T}}{(1+WACC)^t}} + r \quad (28)$$

where T is the loan's term, r is the original interest rate, $WACC$ is the bank's cost of capital, and T' is the payment period's consecutive number with the missed payment.

In the case under consideration, the modified interest rate (r') for the rest of periods ($[5'; 8]$) followed by the missed payment at the period 5 is 41,75% and checking calculation is represented in table 8.

3 Discussion

In this study the combination of econometric and value-based approaches was used to develop the cash-flow based econometric models for the main types of bank loans. The proposed models are based on the assumption that any loan can be presented as the bank's investment project with

Table 8. Numerical illustration: cash flows and NPV calculation for the serial loan with the missed payment and modified interest rate, thousands UAH

Period (<i>t</i>)	Repayment $\left[\frac{P}{T}\right]$	Remaining principal of the loan	Interest rate, %	Interest pay- ment	Cash flow (CF_t)	Present value factor $\left[\frac{1}{(1+WACC)^t}\right]$	The present value of cash flow $\left[\frac{CF_t}{(1+WACC)^t}\right]$	Cumulated NPV
0	-	10	13	-	-10	1	-10	-10
1	1,25	10	13	1,3	2,5	0.92	2,36	-7,63
2	1,25	8,7	13	1,13	2,3	0.85	2,04	-5,59
3	1,25	7,5	13	0,97	2,2	0.79	1,76	-3,82
4	1,25	6,25	13	0,81	2,06	0.73	1,51	-2,3
5	-	6,25	13	-	0.00	0.68	0,00	-2,3
6	1,25	3,75	41,75	1,56	2,81	0.63	1,77	-0,5
7	1,25	2,5	41,75	1,04	2,29	0.58	1,33	0,8
8	1,25	1,25	41,75	0,52	1,77	0.54	0,95	1,76
NPV = 1,760,44								

such attributes as initial outflow (principal), following inflows in the form of loan payments and bank’s cost of capital. We deduced the formulas for calculating the expected net present value for classic (1), annuity (12), and serial (19) loans that can be used as a targeted measure of the loan’s economic effect for a bank at the moment of loan issue. For the cases of problem loans where borrower breaks the loan’s payment schedule and it leads to the reduction of the loan’s expected NPV we developed calculating formulas for the loan terms’ rescheduling:

- recalculation of the interest rate (5) and prolongation of the effective period of the loan agreement for a classic loan (11);
- recalculation of the instalment (14) and prolongation of the effective period of the loan agreement for annuity loan (21);
- recalculation of the interest rate for a serial loan (27).

This study has several strengths. First, the proposed value-based approach to the problem loans terms’ rescheduling by its nature is economically feasible and equitable upon both parties and excludes prejudiced attitude. Second, the developed calculating formulas are simple for use in practical work and can be easily automated and incorporated in the existing dashboard of credit monitoring. Third, there is no need for credit officer to prepare some special data for calculation – all necessary data are kept handy at all times.

The findings in this study are subject to several limitations. First, the assumption as to whether the cost of capital for the lender is non-fluctuating is quite disputable. Secondly, it is intentionally supposed that borrower is not able to meet the credit payment 1) in full, 2) only once, 3) at the definite period. For cases when default in payment happens more than once, the proposed in these study formulas can be used over and over again. Thirdly, we assumed that borrower would not be able to meet the credit payment only once and would be able to service a loan in the future. For confirming this favourable scenario bank needs to make a new long-time forecast of borrower’s creditworthiness and liquidity and check it regularly.

It has previously been found that much of the current literature focuses on one particularly important aspect of the cause of bank insolvency: the relationship between non-performing loans and bank failure (e.g. [10, 11]). Some authors have considered the macroeconomic effects of the problem and nonperforming loans on banking systems [12–14]. The study [15] presents some bed loans’ management methods that already exist in the literature and makes a clear distinction between the ex-post and ex-ante management of such loans. The different characteristics of informal restructurings and of enhanced and hybrid debt restructurings are covered by the study were represented in [16]. Kryklii et al. described the domain role of the bank’s problem loans management system in the strategy of the problem debts’ mitigation [17]. The restructuring techniques like debt-equity swap and write-offs to ease debtors’ debts and to help viable businesses to successfully survive recession have been analyzed by Dedu [18]. The duration models to analyze the factors affecting the duration of private debt restructuring for distressed firms were represented by Jiang-Chuan et al [19].

In this research, we intentionally did not analyze the regulatory approaches related to the banking system entirely and focused attention only on the ex-post problem loans’ management at the level of a given bank. Therefore, our study adds to the previous knowledge: banks can use the value-based econometric approaches in the process of problem loans’ terms rescheduling to prevent the reducing their value.

These findings are likely to have practical consequences. First, the developed formulas for calculation of loan’s NPV can help banks to assess the expected economic effect of the loan at the process of loan approval as well as to assess the value of credit portfolio for the analytical purposes. Second, the use of formulas related to the problem loan terms’ restructuring can not only simplify the procedure and provide the economically feasible equitable decisions but also help viable businesses to successfully survive the recession.

The proposed econometric approach is based on the single-variable econometric models. For the future, more research is required to develop a deeper understanding of

the relationships between two recommended approaches: increasing of interest rate and prolongation of the effective period of the loan agreement. These approaches are not mutually exclusive and can be combined. It allows setting basic parameters for the two-factor model where the fractional increase of one parameter leads to fractional reducing of another one. All one has to do is to solve the two-variable equation with a modified interest rate (r) and additional loan term (N):

$$E(NPV) = f(N, r'), \quad (29)$$

where $E(NPV)$ is the expected initial NPV of a loan for the lender.

The solution of this equation will be a feasible solution set where all optimal combination presented on the trending graph (figure 12).

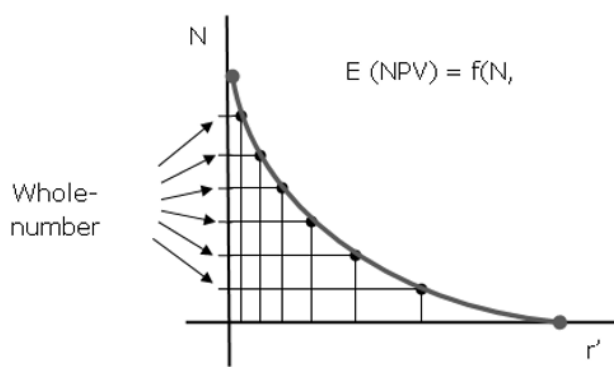


Figure 12. Two-factor model for loan terms' reformating

To the right of trending graph there is an area of sub-optimal solutions where loan's virtual NPV for lender out-numbers the expected initial $E(NPV)$ of a loan and to the left of trending graph vice versa. For practical application, the feasible solution set can be reduced through the use of whole-number values for additional payment periods (N) according to the repayment terms of a loan: month, quarter or year.

4 Conclusions

This study set out to develop the econometric models and applied approaches to an issue of the problem loan terms' rescheduling. This study has shown that that the NPV criteria can be used for credit's performance evaluation and provided a way not only calculate projected increment of credit's present value for the lender but recalculate loan terms if needed as well.

The key advantage of the suggested method of the loan's terms renegotiation consists in its focus on the use of the value-based approach in cases where loan terms can be reformatted with the use of either increasing of interest rate or prolongation of the effective period of the loan agreement. This is the first study that has provided a lender with formulas for the loan terms' rescheduling.

At practice, restructuring or rescheduling exercise may result in variation to the existing terms of the loan/financing facilities. In particular, there is a need for further research, considering econometric modelling of bank activities in the era of Covid-19 [20]. Additionally, there is a need to consider value-based approach to the problem loans terms' rescheduling due to the national economies peculiarities. More extensive study is required. Thereby, this is the subject for future researches.

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