Dynamic simulation of calculating the purchase of equipment on credit

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Abstract. The dynamic simulation of calculation of the purchase of the equipment on credit is presented in this article. The model is developed on the basis of systems dynamics method with the help of Powersim Studio. Calculations were carried out for two ways of paying off the credit debt: annuity and differentiated. The model was used as the tool for researching the variants of payment and deciding which one is more beneficial. As a result, the different sums of credit payments were received (assignments of percent, payments on a principal debt, the total amount of credit payments, etc.). The conducted research allows drawing a conclusion that the developed dynamic simulation is rather universal and it is possible to conduct the various research concerning the different sides of purchasing the equipment on credit on its basis.

1. Introduction

The production of machines and the equipment is the leading sector of the world industry which status defines the economic development of the country. Nowadays the production of machines and the equipment in Russia faced a number of problems [1, 2]. The main problems are: unsatisfactory status of fixed assets, increase in cost of products, decrease in its quality and profitability. All the listed problems lead to the general and financial deterioration of the enterprises [3].

The main problem of non-competitiveness of machines and equipment production in Russia are outdated fixed assets that have high level of physical deterioration and especially obsolescence. Such situation doesn't allow to master the knowledge-intensive and hi-tech products, doesn't allow to increase its quality.

According to the most experts one of the main reasons of this problem is the lack of investment resources both of the industry in general, and in the production of machines and the equipment [4, 5]. Solving this problem is possible using different forms of long-term crediting for purchasing the equipment by the enterprises [6].

The credit is the loan allowed by the creditor to the borrower under certain percent for use of money. The credit role is really important for reproduction of fixed assets. By taking a credit the enterprise can improve technological level of production, increase production much quicker, than at its absence [7].

Nowadays before the decision of the acceptability of one of the credit types or their combination is made the investment managers of the industrial enterprises face the need to define the form of the credit, the type of credit payments, the diagram and a method of percent charge on the credit and the risks of crediting.

The complexity of these factors predetermines the need of use of the management instrumental methods, such as economic mathematical modeling (EMM) that provides the efficiency increase of the made decisions by calculation the equipment purchasing on credit. Today one of such modern and widely used approaches is dynamic simulation [8].

2. Description of existing metrics
The models of calculation the annuity and differentiated credit payments are presented in fig. 1 and 2.
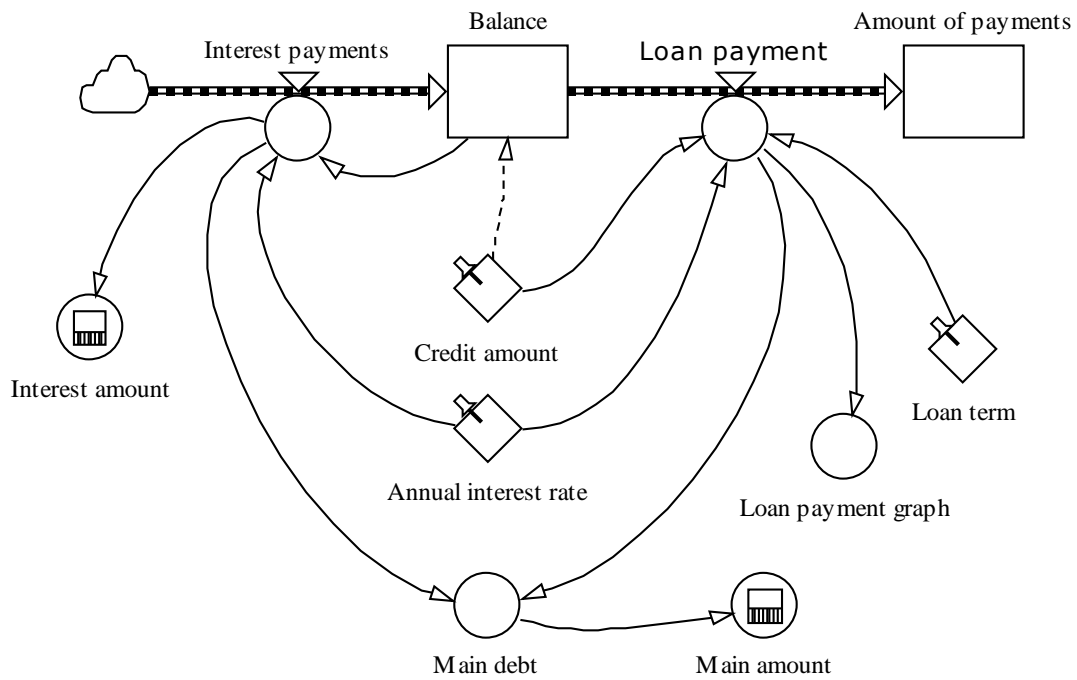

Figure 1. Chart of flows and calculation levels of annuity credit payments.
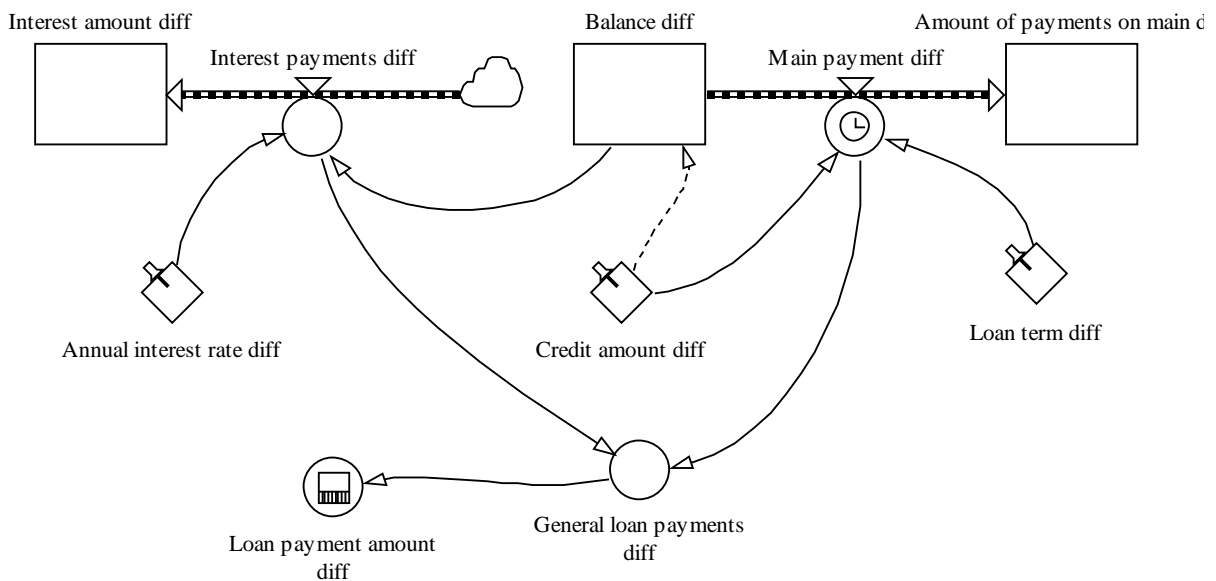

Figure 2. Chart of flows and calculation levels of differentiated credit payments.

The model of annuity payments consists of two levels:

- Balance.
- Amount of payments.

Also, two flows are presented on the chart:

- Interest payments.
- Amount of payments.

The differentiated payment model includes three levels:

- Balance diff;
- Interest amount diff.
- Amount of payments on main diff.

Also, there are two flows on the chart:

- Main payment diff.
- Interest payments diff.

In addition to the listed flows and levels there are auxiliary variables at the scheme.

Let's take a look at the algorithm of credit payments calculation

Annuity payment – monthly credit payments the amount of which does not change before the credit term termination. But with the annuity scheme, the payments at first mainly go towards repayment of credit interest, and to a lesser share on the principal; this proportion tends to change towards the end of the credit agreement.

Annuity payment consists of two parts: the principal of loan and interest accrued on the remaining principal amount.

In a course of time, the amount of the principal decreases, and the amount of interest on the credit accrued on this amount also decreases. The calculation of interest occurs by multiplying the balance of the principal at the time of calculation by the annual interest rate. The calculation of the principal amount is determined by deducting the amount of the total interest payment.

Differential payment is monthly credit payments, the amount of which decreases by the end date of the loan agreement. The monthly differentiated payment includes the amount of credit repayment of the loan body (principal) and the credit interest accrued on the remaining amount.

Differential payment consists of two parts: the principal of loan and interest accrued on the remaining principle amount.

In a course of time, the amount of the principal debt decreases, and the amount of interest on the credit accrued on this amount also decreases. The calculation of the debt amount is carried out by dividing the original credit amount for the period determined for the return of the credit. The calculation of interest occurs by multiplying the balance of the principal debt at the time of calculation by the annual interest rate and all this is divided by a time of one year period (12 months or 365 days).

3. The interface of models' management of annuity and differentiated calculation of credit payments

The interface of models' management of annuity and differentiated calculation of credit payments is presented in Figures 3 and 4.

The interface structure consists of two parts: input of initial data and monitoring of calculation results. Before starting the calculation, the following data is entered: credit amount; annual interest rate on the credit and the term of the credit. On the second part of the interface, the calculation results are displayed in graphical form: total credit payments, payment on the principal debt, interest payments and the balance of the principal debt.
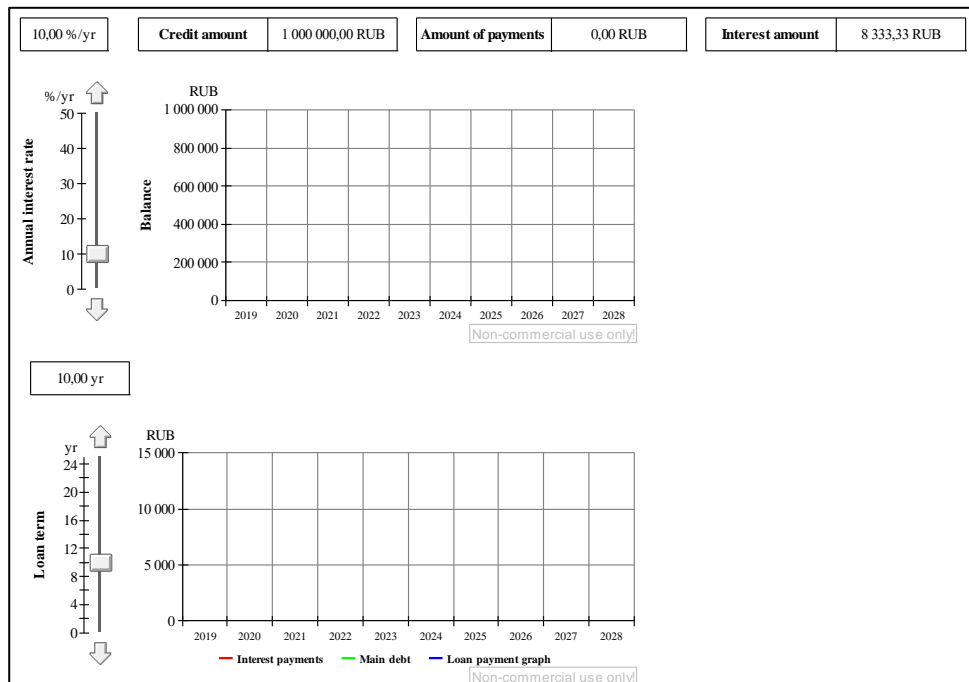
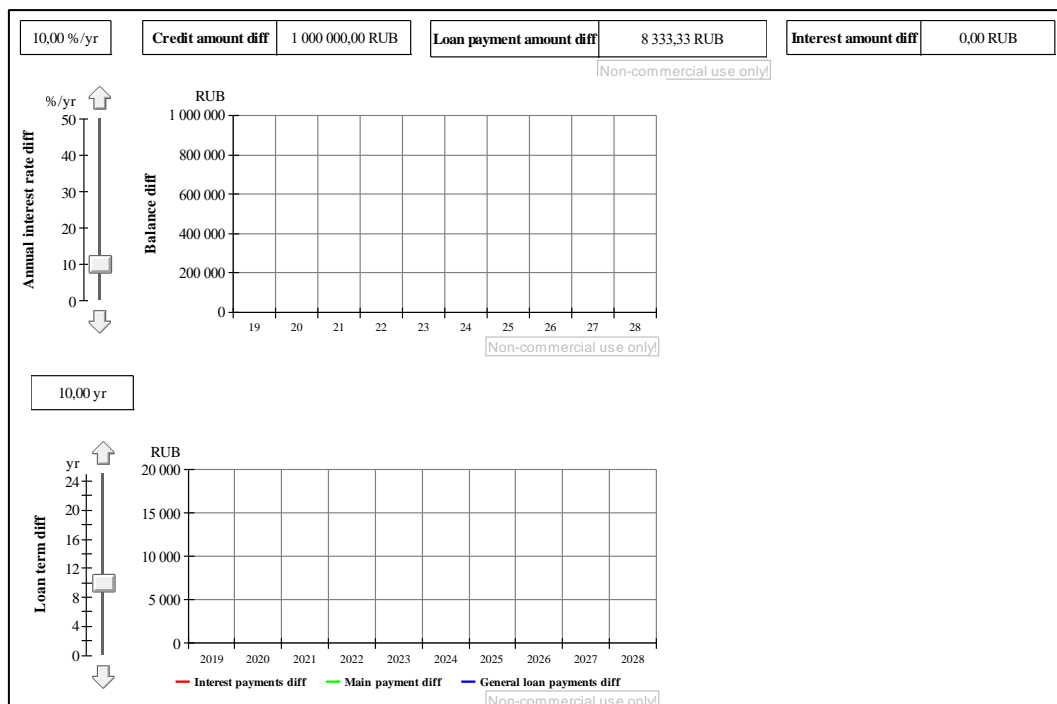**Figure 3.** The control panel for calculating annuity credit payments.

Figure 4. The control panel for calculating differentiated credit payments.

4. Results

During the experiment, the calculations for annuity and differential payments (Figures 5 and 6) on the following baseline data were made:

- Equipment price - 1 million rubles.

- The contract is executed for 10 years.
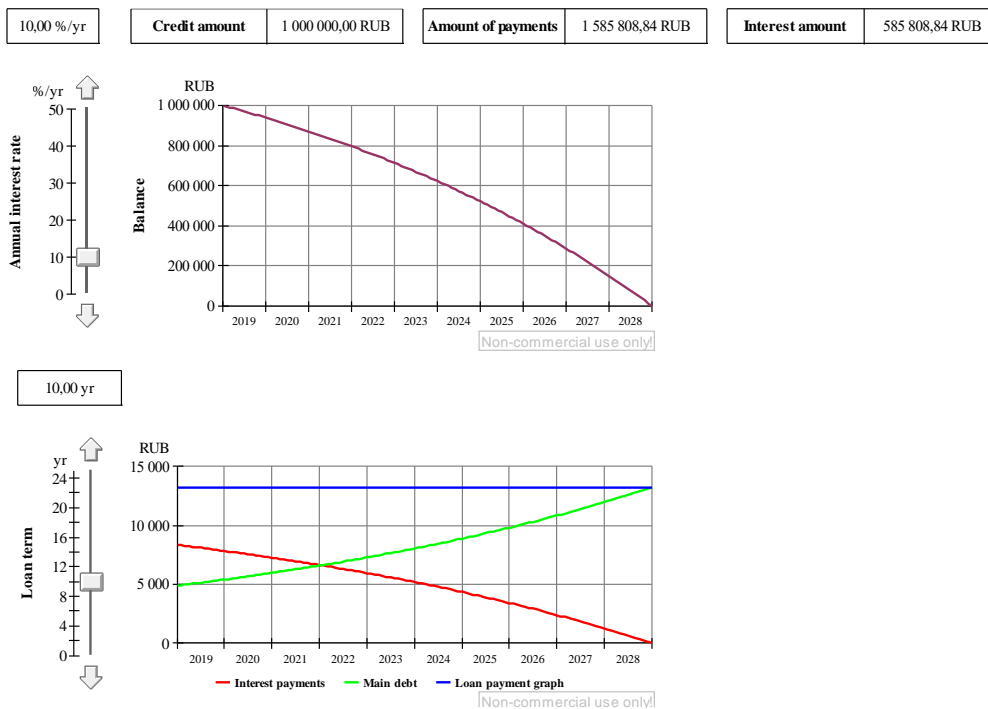- Loan rate - 10% per year.

	Credit amount	1 000 000,00 RUB	Amount of payments	1 585 808,84 RUB	Interest amount	585 808,84 RUB
10,00 %/yr						

Figure 5. The results of the annuity credit payments calculation.

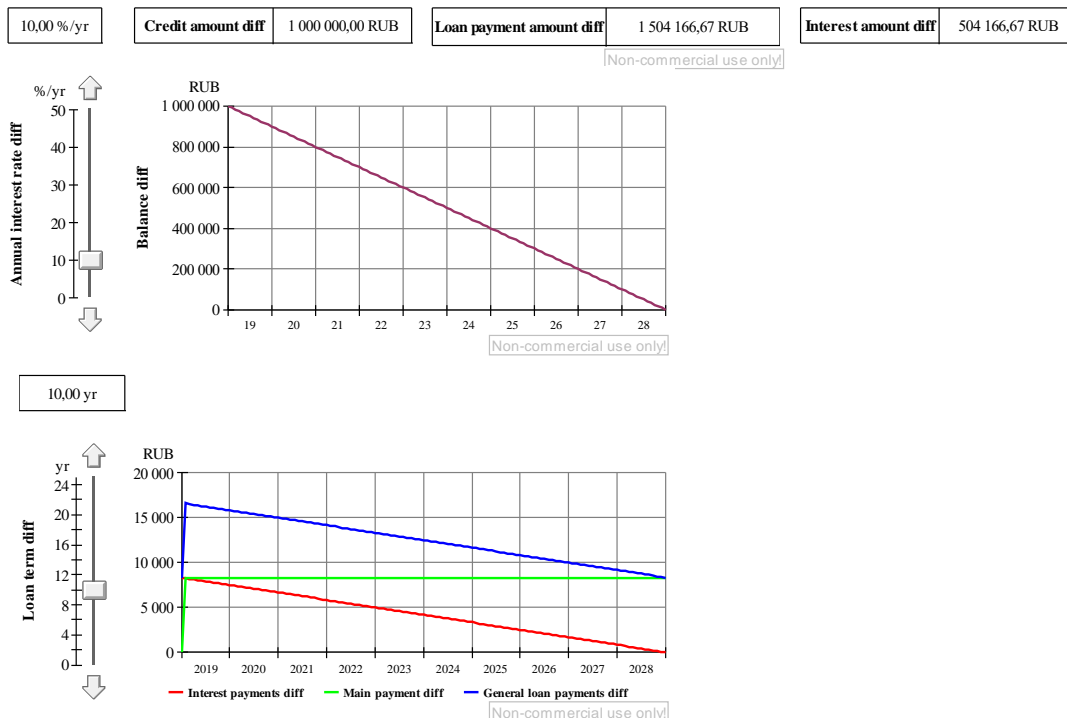|	Credit amount diff	1 000 000,00 RUB	Loan payment amount diff	1 504 166,67 RUB	Interest amount diff	504 166,67 RUB
10,00 %/yr						

Figure 6. The results of the differentiated credit payments calculation.

From figure 5 it can be seen that in case of annuity credit payments, the borrower returns the funds in equal parts, however, initially, a significant part of the money goes to repay the credit interest, and

not the principal. The calculation of credit annuity payments is made in such a way that the client immediately makes a payment to the account of paying interest, and only a certain part of the payment, which increases with time, is spent on repaying the credit itself,

As we can see from the Figure 6, the principal debt is reduced each month to the same share, and interest accruals are made to the remaining amount. As a result, the largest payments are made in the first months of the payment schedule, and the smallest - at the end of the credit period.

On one hand, the total credit overpayment with the annuity system of debt repayment is greater than with a differentiated scheme. The reason for this is the slower repayment of principal, from which interest is calculated. But, on the other hand, with a differentiated system, the primary credit load (about half of the credit period) is higher than with annuity.

5. Conclusion

As a result, based on the calculations made, the lender makes his choice in favor of annuity payments, as it guarantees him an overpayment. But for a borrower, differentiated payments are beneficial, as with differentiated payments the amount of payments is lower.

It should also be noted that the constructed simulation model of credit payments for the purchase of equipment can be used for real estate payments, road transport payments, etc. So, this model can be considered universal.

References

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