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MANAGEMENT RECEIVABLES AND PAYABLES OF THE ORGANIZATION: THE MATHEMATICAL ASPECT

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Abstract

The article discusses the essence and content of the methodology for managing receivables and payables of an enterprise. The head of the enterprise must organize the appropriate work of the services and appoint officials for the management of receivables and payables, identify their functionality and responsibilities. The main objectives of these services are: a rational analysis of receivables and payables; its planning and forecasting; careful control of the reliability of debtors and creditors; work on the study of contracts and the correct compilation of mandatory items regarding receivables and payables; determination of penalties for late payment; initiation of litigation if necessary. The article explores methods of managing receivables and payables, analyzes their level, proposes a mathematical model for calculating the optimal ratio of receivables and payables. The importance of using software products for the construction and implementation of mathematical models for the selection of methods for managing receivables and payables is noted. The recommended ratio of receivables and payables with the aim of improving the financial condition of the company. The proposed model allows for a qualitative analysis of receivables and payables of enterprises of various fields of activity, including mixed ones.

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1. Introduction

The most important element of the existence of any company is a financial, reliable condition. The aspect of debt and the identification of its components characterize a stable economy, and therefore the proposals of the methods with regard to accounts payable and receivable are key.

2. Problem Statement

Currently, the scientific works of many scientists, including Arbatskaya (2019), Yelokhova (2018), Ivashkevich (2003), Klimova (2011), Muravyeva and Kashirina (2017), Sheremet and Starovoitova (2020) and others, are devoted to the problems of improving the efficiency of management of accounts receivable and accounts payable, methods of its assessment and features of analyzing its state while the authors of this article consider the problem of their relationship.

3. Research Questions

Governance Indicators receivables and payables amount to the whole system. The enterprise should be developed documents contain provisions on accounts receivable and accounts payable and debt management regulations (Maksimova & Tikhonova, 2019, par. 6, p. 254). Providing accounting and analytical information is an important aspect in the organization of accounting, so Arbatskaya (2019) notes "the need to ensure the quality and reliability of accounting and analytical information about income and accounts receivable of organizations is not in doubt, since such information is actively used-from the forecasting stage to the control stage" (par. 4, p. 92).

4. Purpose of the Study

To ensure the quality of the analysis – it is necessary to analyze the source – reporting was prepared in accordance with reporting requirements. "Reporting is accurate and complete, if it is formed on the basis of rules established by the regulations on accounting" (Arbatskaya, 2015, par. 2, p. 34). The analysis is performed on the basis of the second section of the asset balance – receivables balance and fifth section – payables. Reporting the data must be accurate and statements must be prepared in accordance with modern requirements, it is spoken by many both domestic and foreign authors, among which are the Razvan Hoinaru, Theodor Dumitru Stolojan, Syed Kamall, Michael Theurer, Patrick De Cambourg and Olivier Boutellis-Taft (Hoinaru et al., 2017, par. 1, p. 28).

To ensure the quality of the analysis, the source of the analysis – the report-must be compiled in accordance with the reporting requirements. To ensure the reliability of accounting data and accounting (financial) statements, organizations are required to conduct an inventory of assets and liabilities, during which their availability, condition and assessment are checked and documented (Belokonenko & Bichashvili, 2019, par. 1, p. 56).

An important factor in the company's financial stability is the proper accounting of accounts receivable and accounts payable. Otherwise, the organization may give rise to additional risks, such as those

associated with non-precision assessment and violated its financial stability (Khitrova, 2012, par. 2, p. 78) therefore there is a "need for integrated information analysis system" (Khitrova, Khitrova, 2018, par. 1, p. 690).

To assess the financial stability of an enterprise, it is necessary to use analytical procedures (Klimova, 2011). The main condition for the normal functioning of the enterprise is the analysis of accounts receivable and accounts payable (Ivashkevich, 2003). The analysis is carried out by assessing the total amount of debt, changes in the dynamics, structure and factors of formation, the presence of current and overdue debt (Yelokhova, 2018).

Applying analysis, planning, mathematical modeling, etc. to indicators of accounts receivable and accounts payable, along with accounting, you can timely monitor the objectivity of the assessment of the company's solvency, the effectiveness of working with suppliers and buyers. As Maksimova and Alganaeva (2016) note, "today, accounting is often given control and analytical features. This is due to the quite natural integration of accounting, control and analysis in conditions of widespread use of computerization" (par. 6, p. 54). Ivanovskaya and Biktagirova (2019) recommends using methods such as controlling, monitoring, and responsibility allocation in the process of managing accounts receivable and accounts payable (par. 1, p. 67).

An important indicator of the quality of accounts receivable management is its ratio to accounts payable (Khvorostyany, 2018). At the same time, there is currently no scientifically sound solution to the issue of the size of the ratio of receivables and payables. The existing opinions of analysts, scientists, and economists now differ significantly. For example, Yelokhova (2018) concludes that "the normative value of the ratio of accounts receivable and accounts payable is 09-1, 0" (par. 4, p. 88). Muravyeva and Kashirina (2017) on the contrary, say that "accounts payable should be approximately equal to accounts receivable, or exceed it by no more than 10 %" (par. 1, p. 97).

5. Research Methods

In our opinion, for more precise management of obligations it is better to use mathematical models (Ovanesyan, 2015; Ovanesyan, 2016), this will have more practical value than just theoretical recommendations and assumptions.

To build a mathematical model, we introduce the following notation:

DZ - receivables; KZ - accounts payable; Q - the amount of production; Q_d - the number of products for receivables; GP - calculated total profit; GP_d - estimated profit on receivables;

P – unit price; TR_n – net production; TR_b – gross output, i.e. VAT included;

TC – production costs; TC_d – costs of production of receivables;

VAT – the amount of value added tax on all products; VAT_d – the amount of value added tax on products on receivables; K_e – cost-effectiveness ratio.

The initial equality according to the main idea is as follows:

$$DZ_b = TC_d + GP_d + VAT_d, (1)$$

where DZ_b – gross receivables, i.e. with value added tax.

According to the main idea that accounts payable are needed to finance production activities due to lost income generated due to accounts receivable, we express the figures for accounts receivable through similar general indicators. To this end, we first calculate the cost-effectiveness ratio for all manufactured products:

$$K_e = (TR_b - VAT)/TC. (2)$$

We calculate a similar coefficient for accounts receivable, assuming that its value does not depend on the quantity of output:

$$K_e = (DZ_b - VAT_d) / TC_d. (3)$$

We equate the right-hand sides in equations (2) and (3) and solve the resulting equation with respect to TC/TC_d :

$$\begin{split} &(TR_b-VAT)/TC=(DZ_b-VAT_d)/\ TC_d \ .\\ &(TR_b-VAT)/\left(DZ_b-VAT_d\right)=TC/TC_d \\ &=TC/TC_d = TR_n\ /\ DZ_n. \\ &\text{Or}\ TR_n\ /\ TC=DZ_n\ /\ TC_d . \\ &TR_n\ /\ TC-1=r, \end{split}$$

where r is the profitability of production and therefore

$$\frac{DZ_n}{TC_d} = 1 + r. \tag{4}$$

And, since according to the formulated concept, accounts payable should cover the lost income to finance production in the amount of receivables, then formula (4) can be rewritten as

$$\frac{DZ_n}{\kappa \tau} = 1 + r. \tag{5}$$

Thus, according to formula (5), one can find the ratio of net receivables to payables. But receivables are included with VAT. Therefore, we transform the formula (5) accordingly, expressing this debt taking into account the value added tax:

$$DZ_b = (1+\alpha) DZ_n, \tag{6}$$

where α is the value added tax rate.

From formula (6) we obtain

$$DZ_n = DZ_b/(1+\alpha). \tag{7}$$

We substitute the expression from formula (7) into formula (4) and, after simple transformations, we obtain

$$KZ/DZ_b=1/(1+r)(1+\alpha).$$
 (8)

From formula (8) it follows that if the receivable is equal to DZ_b , then the accounts payable should be no less than

$$KZ = DZ_h/(1+r)(1+\alpha).$$
 (9)

If we proceed from accounts payable, then with its known value, the value of the corresponding receivables can be found by the following formula

$$DZ_b = KZ (1+r)(1+\alpha).$$
 (10)

Formula (10) can be commented as follows. If the customer is ready to credit his order for the amount of KZ, then the manufacturer can, without prejudice to himself, send products to the customer without prepayment for the amount calculated according to formula (10).

The obtained formulas (9) and (10) allow us to calculate the ratio of one debt to another. So the ratio of receivables to payables, as follows from formula (10), should be equal to –

$$DZ_h/KZ = (1+r)(1+\alpha),$$
 (11)

and from formula (9) the opposite is

$$KZ/DZ_b = 1/(1+r)(1+\alpha).$$
 (12)

As follows from the above formulas, receivables should always be greater than accounts payable.

All of the above applies to the research debts in total. But in practice, interest may also arise in their ratios for each specific type of manufactured product. In this case, in the above formulas (11) and (12), it is necessary, in the corresponding notation, to indicate the product index, i.e.

$$KZ_{i}/DZ_{bi} = 1/(1+r_{i})(1+\alpha), i \in DZ$$
 (13)

$$DZ_{hi}/KZ_{i} = (1+r_{i})(1+\alpha), \quad i \in DZ$$
(14)

where DZ – many types of products for receivables.

We continue to work with formula (14). We rewrite it slightly modifying

$$DZ_{bi} = KZ_{i}(1+r_{i})(1+\alpha), i=1,2,...,n,$$

and sum the left and right sides of this formula by index i for receivables

$$\sum_{i \in DZ} DZ_{bi} = (1 + \alpha) \sum_{i \in DZ} KZ_i (1 + r_i). \tag{15}$$

Formula (15), in comparison with formula (14), makes it possible to draw a very important conclusion, namely that the ratio of receivables to payables for specific types of products and for their general values are different and, therefore, a simple summation of these relations taken for each type of product to obtain their total value is not permissible. Therefore, we continue the construction of a mathematical model.

It is known that the profitability of production of all products is calculated as follows:

$$r = \frac{GP}{TC} = \frac{TR - TC}{TC}. (16)$$

We rewrite formula (16) for those types of products that are included in receivables

$$r_d = \frac{TR_d}{TC_d} - 1,$$

or

$$\frac{TR_d}{TC_d} = I + r_d. \tag{17}$$

$$TR_d = (1+r_d) TC_d. (18)$$

Or unfolded

$$\sum_{i \in DZ} TR_i = (1 + r_d) \sum_{i \in DZ} TC_i \tag{19}$$

And since, according to the concept adopted, payables should cover precipitated related revenue receivable required to finance the costs in the formula (18) TC_d costs, should be replaced by KZ_d

$$TR_d = (1+r_d) KZ_d \tag{20}$$

Or unfolded

$$\sum_{i \in DZ} TR_i = (1 + r_d) \sum_{i \in DZ} KZ_i$$
 (21)

Repeat the derivation of the formula for each product included in receivables

$$r_i = \frac{TR_i}{TC_i} - 1,$$

$$TR_i = (l+r_i) KZ_i$$
 (22)

Sum the left and right parts of the formula (20) by the index i

$$\sum_{i \in DZ} TR_i = \sum_{i \in DZ} (1 + r_i) KZ_i$$
 (23)

Since in formulas (21) and (23) the left parts are equal, then we equate their right parts

$$(1+r_d)\sum_{i\in DZ} KZ_i = \sum_{i\in DZ} (1+r_i) KZ_i.$$
(24)

Now in formula (15), replace the sum in the right part with the left part from formula (24)

$$\sum_{i \in DZ} DZ_{bi} = (1 + \alpha)(1 + r_d) \sum_{i \in DZ} KZ_{i}. \tag{25}$$

Thus, the ratio of accounts receivable to accounts payable calculated using these values for specific types of products will be as follows

$$\sum_{i \in DZ} DZ_{bi} / \sum_{i \in DZ} KZ_i = (1 + \alpha)(1 + r_d). \tag{26}$$

The reverse relation –

$$\sum_{i \in DZ} KZ_i / \sum_{i \in DZ} DZ_{bi} = 1/(1 + \alpha)(1 + r_d).$$
 (27)

Comparing formulas (11) and (12) with formulas (24) and (25), we notice their similarity, but with one difference – in the second formulas, the value of the profitability of production is used only for those types of products that are included in the accounts receivable (r_d). Thus, in practice, only formulas (26) and (27) should be used, since calculations using formulas (11) and (12) can give an error.

The obtained ratios (26) and (27) allow us to draw a number of important conclusions. You can use them to determine the minimum value of these relations.

As follows from the formula (26) at zero profitability of production, meaning the break-even point, the ratio of accounts receivable to accounts payable will be equal to 1.2, since the value added tax rate today is 20 %. If this ratio is calculated for products that are not subject to value added tax, then its value will still be greater than one due to the value of the profitability of production. The value equal to one will only be in the case when both the profitability of production and the value added tax rate will be zero, which is extremely unlikely in practice. And another important conclusion is that the more profitable the production of products sold without prepayment, the smaller the potential accounts payable may be.

Thus, it can be argued that the well-known statements that the ratio of the studied debts should lie in the range from 0.9 to 1 do not have a scientific basis.

It is of interest to analyze the relationship of debts to each other, with different combinations of values included in them, including negative profitability of production. For this purpose, let's go back to formulas (26), (27) and estimate the limit values of these relations.

Table 01 shows the results of the analysis.

Table 01. The debt to each other, at different combinations of their constituent values

VAT rate, α	Profitability, r_d	Ratio <i>DZ / KZ</i>	Ratio KZ/DZ
1	2	3	4
0	0	1	1
A	0	1+ α	$1/(1+\alpha)$
A	0,5	1,5(1+α)	$1/1,5(1+\alpha)$
A	1	2(1+ α)	$1/2(1+\alpha)$
α	- 0,5	$0,5(1+\alpha)$	$1/0,5(1+\alpha)$
α	-1	0	8

As can be seen from table 1, the ratio of accounts receivable to accounts payable and back is equal to one only in one extremely unlikely case, when both the profitability of production and the value added tax rate are equal to zero. In all other cases, the values of these relations differ greatly from one. For example, if the profitability value is zero and the VAT rate is arbitrary, the limit value of the ratio of accounts receivable to accounts payable is always greater than one, and the higher the rate, the greater the value of this ratio. Further, with an increase in the profitability of production, with a constant VAT rate, this ratio increases, and with a hundred percent profitability, it becomes more than two, and the more the higher the VAT rate. An interesting conclusion for the case when the profitability of production is negative-the accounts receivable must be less than the payables and the less the negative profitability is lower and the limit $(r_d = -1)$ is zero.

6. Findings

We will make calculations based on the model presented above using the example of several applications:

1. Consider the activities of JSC "Silicate plant". The company, in addition to its main activity-the production of silicate bricks, is a resource – supplying organization for residents and organizations of the village of Antipikha, with a population of about 2,500 people. The company supplies cold (potable) water, hot water, heating and water disposal in the village.

And if the profitability of the production of silicate bricks of GSK is positive and equal to 0.18, then resource supply (except for cold water supply) is a loss-making type of activity, due to the fact that the provision of municipal resources is a regulated type of activity. Tariffs for this type of activity are set by the PCT authorities for a period of no more than 1 year and it is very difficult to economically justify all the costs and expenses incurred by the enterprise for resource supply, in addition, during the year, prices for fuel, cargo transportation, etc. usually become higher.

As a result of the above, the profitability of providing services:

- heat supply is: -0.14;
- hot water supply is: -0.22;
- water disposal is: -0.12;
- cold water supply is: 0.12.

It is also necessary to note the very weak payment discipline of the population, because only 62 % of the population pays for their own utilities. Accordingly, consumer debt for such activities as the provision of public services is constantly growing, unless additional measures are taken to enforce it. Accordingly, additional measures lead to additional costs, often not covered by the collection of penalties from debtors.

It is known that the company's accounts payable is a source of financing of production activities due to the loss of income generated due to debtors ' debts.

Let's determine how much the ratio of the company's accounts receivable to accounts payable deviates from the optimal values.

The obtained ratios (26) and (27) allow us to draw the following conclusions.

As follows from the formula (26) for the specified values of profitability of production of each type of product, the optimal ratios of accounts receivable to accounts payable are presented in table 02:

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Table 02. Ratios of accounts receivable and accounts payable by types of activity of JSC " Silicate plant»

Type of production (services)	VAT rate, α	Profitability, r_d	Optimum ratio <i>DZ / KZ</i>	Real <i>DZ / KZ</i> ratio
1	2	3	4	5
Silicate brick	0,2	0,18	1,416	1,09
Heat supply	0,2	- 0,14	1,032.	1,35
Hot water supply	0,2	- 0,22	0,936	1,36
Cold water supply	0,2	0,12	1,344	1,29
Water disposal	0,2	- 0,12	1,056	1,21

As can be seen from table 2, the actual ratio of accounts receivable to accounts payable at the enterprise for the above types of production (activity) is far from optimal and is:

- for the production of silicate bricks: 1.09, which is significantly lower than the optimal value;
- for providing heat supply services: 1.35, which is much higher than the optimal value;
- for providing hot water services: 1.36, which is much higher than the optimal value;
- for cold water services: 1.29, which is very close to the optimal value;
- for providing water disposal services: 1.21, which is significantly higher than the optimal value.

It is obvious that the company actually cross-subsidizes through the production of silicate bricks, the provision of heat supply, hot water and sanitation services, which is a very risky policy. In order to improve the ratio of accounts receivable to accounts payable, it is obviously necessary to strengthen the work of the legal Department of the enterprise to accelerate the recovery of lost revenues from the provision of unprofitable heat supply services, hot water and water disposal from the budget of the municipality.

2. Limited liability company "Granat" provides hotel services in Chita on the basis of a 3-storey building with a room Fund of 32 rooms.

Table 03. Ratios of accounts receivable and accounts payable by type activities of "Granat", LLC"

Type of production	VAT rate, α	Profitability	Optimum ratio	Real DZ/KZ
(services)	vAI rate, u	r_d	DZ/KZ	ratio
1	2	3	4	5
Accommodation in a single room (day)	0,2	0,10	1,32	1,1
Accommodation in a double room (day)	0,2	0,17	1,40	1,27
Accommodation in a triple room (day)	0,2	0,21	1,45	1,43
Accommodation in a single Suite (day)	0,2	0,22	1,46	0,93
Accommodation in a double Suite (day)	0,2	0,24	1,49	0,95

As can be seen from table 3, the actual ratio of accounts receivable to credit at the enterprise for the above activities is:

- for the "single room" service: 1.1 which is significantly lower than the optimal value;
- for the service "Accommodation in a double room": 1.27, which is close to the optimal value;
- for the service "Accommodation in a triple room": 1.43, which is very close to the optimal value;
- for the service "Accommodation in a single Suite": 0.93, which is much lower than the initial value;

- for the service "Accommodation in a double Suite": 0.95, which is much lower than the initial value;

The above picture characterizes the specifics of the organization's work. The company has several service agreements with large contractors for the reception of employees who come to study from other regions of the TRANS-Baikal territory, providing increased demand for triple rooms. The excess of accounts payable over accounts receivable for the service "accommodation in a Suite" is associated with a fairly typical situation of canceling an order for accommodation in a prepaid room.

3. LLC Beton in Chita, is engaged in production of reinforced concrete products and commodity concrete. The product range consists of more than 40 items. The most popular types of production are given as an example.

Table 04. Ratios of accounts receivable and accounts payable by type activities of Beton LLC"

Type of production	VAT rate, α	Profitability,	Optimum	Real
(services)	VAI Tate, a	r_d	ratio <i>DZ / KZ</i>	DZ/KZ ratio
1	2	3	4	5
Commodity concrete	0,2	0,12	1,34	1,26
Floor plates PC 72	0,2	0,17	1,40	1,08
FBS 24 blocks	0,2	0,14	1,37	1,32
Curbs 100-20	0,2	0,2	1,44	1,47
Staircase	0,2	0,15	1,38	0,91

As can be seen from table 4, the actual ratio of accounts receivable to credit at the enterprise for the above activities is:

- for the type of production "Commercial concrete": 1.26 which is close to the optimal value;
- for the type of production "PC 72 floor Slabs": 1.08, which is far from the optimal value;
- for the production type "FBS 24 Blocks": 1.32, which is very close to the optimal value;
- for the type of production "Borders 100-20": 1.47 which is very close to the optimal value
- for the type of production "Staircases": 0.91, which is much lower than the optimal value.

The above picture characterizes the specifics of the organization's work with suppliers of rolled metal, which currently work exclusively on prepayment. Accordingly, the production of the most metal-intensive nomenclature has very far values of the actual ratio of accounts receivable to accounts payable from the optimal ones.

7. Conclusion

The above calculations show full agreement with the above-mentioned theory that the lower the profitability, the less the optimal ratio of accounts receivable to accounts payable. Thus, the model presented above offers an excellent tool for analyzing accounts receivable and accounts payable of enterprises and organizations, which can be used in any field of activity, including mixed ones.

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