Methodological foundations of managing innovation-effective development of industrial production of the Arctic

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Abstract. This paper considers two types of leverage – operational and financial – used in the theory and practice of corporate financial management. It is shown that objectively there must exist another kind of leverage – investment and innovation - as the share of value added in sales value to material intensity of product. It allows you to determine the necessity and possibility of using innovation and investments of intensive type as well as to determine the amount of such investments to achieve the specified material intensity reduction level. The analysis results of industrial production trends in Russia’s regions in certain types of industrial activities (on the example of the Far North and Arctic regions-subjects of the Russian Federation) between 2005 and 2015 have shown that production, depending on the direction of changes in values of material intensity and capital productivity indicators, can technologically develop in four main areas, namely innovative/efficient, innovative/non-efficient, non-innovative/efficient and non-innovative/non-efficient. It shows that in most regions of the Far North and the Arctic industry development is not consistent with the best innovative / efficient direction but, in general, the situation here is more favorable than in country’s industry. The analytical relationship between material intensity, capital productivity and labor productivity, enabling the management of innovative / efficient development of industrial enterprises, industries and the corresponding growth of labor productivity, gross regional product and gross domestic product due to technological intensification of production, has been determined.

1. Introduction
In the theory and practice of corporate financial management two types of leverage - operational and financial – are considered [1-2]. The operational leverage is determined by the ratio of programmed costs of the enterprise to variable costs and shows the percentage change in pretax profit when sales revenue changes by one percent, so, it has a direct impact on the amount of the risk of pretax profit loss. The financial leverage is the ratio of the amount of loan capital to the amount of enterprise’s capital. Its value determines the percentage change in the net profit of the enterprise with a one-percent change in pretax profit. In the practice of financial management, it is believed that the value of the financial leverage ratio at a financially stable enterprise should not exceed one, since otherwise the financial risk of non-payment of loan interests by the enterprise and non-repayment of loans themselves begins to significantly increase. In a market economy, any enterprise can carry out three types of activities – usual (production of goods and services), financial and investment. The company
performs financial activities to attract necessary additional financial resources and, with investment activities, to invest free financial resources for the long-term use in various investment projects.

Thus, in the theory and practice of financial management three types of activity are considered, but used are only two types of leverage. Theoretically, it is reasonable to assume that there should be the third type of leverage – investment, but for many decades of foreign enterprises’ activities in a market economy, it did not appear. The question is why? The answer may be as follows.

The fact is that both types of leverage use in practice the profit category as the basis of any commercial activity of the enterprise. At the same time, the investment of financial resources in the investment activity of the enterprise should also ultimately ensure that it will receive future profits. To do this, there are various methods for assessing the economic efficiency of investments in Russia [3-4] and abroad [5,6]. However, from the point of view of state’s interests, any enterprise in its activities should not only pay taxes to the budgets of the relevant levels of the country’s budget structure, but also increase its value added (VA), that is, its contribution to the gross regional product (GRP) of the regions-subjects of the Federation and the gross domestic product of the state (GDP). VA can be increased in an extensive and intensive way, that is, either on account of additional amounts of material and labor resources and investment in fixed assets or due to more intensive use of these resources. The second way is more preferable, since it increases the economic efficiency in using of resources, namely, material productivity (i.e., reduced material intensity of product (MI) and increased share of value added in the structure of the sales value), capital productivity (CP) and labor productivity (LP) increase, which allows product costs and product sales to be reduced and profitability of production to be increased. Of course, with the intensification of production, it is theoretically desirable to increase the economic efficiency due to use of all three types of resources simultaneously but in practice, this is not typical of most enterprises. In order to understand the causes of the situation and to determine the direction of further actions of enterprises, regions and the state in intensification of the use of economic resources, we propose to consider the essence of the third type of leverage – investment-and-innovation (IIL).

2. Materials and methods

With the intensification of production and the transition of the country’s economy to an intensive path of economic growth, the material intensity of enterprises’ products should be reduced. The IIL is calculated as the ratio of the share of VA in the structure of sales value of product to material intensity of product. Its value shows the percentage change in the level of MI with a one-percent change in the share of VA. In theory, it can vary from zero to infinity, and in practice it is within the range of 0.1 to 10 at Russian enterprises. To reduce material intensity of product, technological innovation of intensive type is needed [7,8], that is, improvement of existing or introduction of new technologies into production. But what should be their volume?

When analyzing the activities of several leading Russian industrial enterprises for the 2010-2015 period, we determined that there is a proportional relationship between the values of capital intensity (CI) and material intensity (MI), which is reflected by the coefficient k [9]. Then, the same dependence was identified for twelve regions of the North (2005-2015) for each of the three types of industrial activity [10]. As a result, it was shown that:

\[ IIL = k*CP - 1, \]  \hspace{1cm} (1)

where IIL is an investment and innovative leverage;

\( k \) is the proportionality coefficient between the values of capital intensity and material intensity;

\( CP \) is capital productivity of fixed assets.

Thus, in order to achieve the desired value of IIL, the enterprise should increase the value of capital productivity to the level of:
\[ CP = \frac{(IIL + 1)}{k} \]  

However, it should be borne in mind that the value of the coefficient of proportionality \( k \) when changing the IIL values may also vary in different directions. As a result, it turns out that increasing the level of capital productivity always reduces the level of material intensity and, conversely, a decrease in capital productivity does not always lead to an increase in material intensity.

Analysis of the results of industrial production in the regions of the North by types of industrial activity for the period 2005-2015 showed that production can develop in four main directions, depending on the ratio of the values of \( CP \), \( MC \) and \( k \). They are: innovative / efficient, in which an increase in capital productivity leads to a decrease in material intensity; innovative / non-efficient, when the material intensity decreases with a decrease in capital productivity, non-innovative / efficient with increasing both capital productivity and material intensity and non-innovative / non-efficient while reducing capital productivity and increasing material intensity. Accordingly, the best development trend is the first direction, and the worst - the fourth one.

The results of calculations of the coefficient \( k \) for industrial production of the North regions [10] have confirmed the theoretical conclusion that the increase in its values is directly related to a significant renewal of fixed assets, which provides a reduction in material intensity of product, so it can be referred to as a coefficient of technological effectiveness level of production at which technological intensification of enterprises’ activities takes place [11]. However, the theoretical analysis also shows that the innovative / efficient direction of the development is possible in the case when the value of the coefficient \( k \) does not increase but decreases at a slower rate than the increase in capital productivity. Accordingly, the fourth (non-innovative / non-efficient) direction is possible when, on the contrary, the value of the coefficient \( k \) increases, but at a rate slower than the capital productivity decreases.

Thus, in order to ensure the innovative and effective development of any enterprise, it is necessary to significantly renew the active part of fixed assets and maintain this state until the rate of \( k \) value exceeds the rate of growth in capital productivity as a result of an increase in production volumes on the renewed technological basis. If the renewal of fixed assets concerns mainly the increase in their passive part, the material intensity reduces due to the growth of the coefficient \( k \), but with a decreasing level of capital productivity. As a result, the company’s development will be innovative but non-efficient.

If the company renews only the passive part of fixed assets or does not renew them at all, then it moves to the worst non-innovative / non-efficient direction of development. With long-term not renewing the active part of fixed assets and increasing the degree of their wear and tear, the material intensity begins to increase, although the capital productivity increases due to the growth of production volumes, which corresponds to the non-innovative / efficient direction of development.

3. Results
Table shows the real situation with the development of industrial production in Russia between 2005 and 2015 (by five years) on the example of certain types of industrial activity in the regions of the Far North and the Arctic.

Thus, it is obvious that, in general, the industrial development trends in the regions of the Far North and the Arctic do not fully correspond to innovative / efficient direction of economic growth. The most difficult situation was in mining industry, where three of the seven regions followed the most unfavorable non-innovative / non-efficient direction. Nevertheless, the industry of the Magadan region as a whole shows a stable trend to innovative / efficient development.

The most important indicator of production efficiency -its increase in value determines the level of personnel’s wages - labor productivity - can also be calculated using the IIL concept if you use the capital labor:
Table 1. Conformity of industrial activities of the Far North and Arctic regions to development trends

| Regions                      | Extraction of minerals | Manufacturing activity | Production and distribution of electricity, gas and water |
|------------------------------|------------------------|------------------------|----------------------------------------------------------|
| Nenets Autonomous District   | 4                      | 3                      | 4                                                        |
| Murmansk region              | 2                      | 3                      | 2                                                        |
| Yamalo-Nenets Autonomous district | 4                  | 3                      | 2                                                        |
| The Republic Of Sakha (Yakutia) | 2                   | 3                      | 2                                                        |
| Chukotka Autonomous District | 2                      | 2                      | 2                                                        |
| Kamchatka Krai               | 4                      | 3                      | 2                                                        |
| Magadan region               | 3                      | 1                      | 1                                                        |

\[
LP = FC*CP
\]  \hspace{1cm} (3)

\[
LP = FC (k *MI)
\]  \hspace{1cm} (4)

\[
LP = FC*(IIL + 1)/k
\]  \hspace{1cm} (5)

where \(FC\) is labor productivity;
\(FC\) is fixed capital (per worker);
\(CP\) is capital productivity;
\(MI\) is material intensity;
\(k\) is coefficient of technological effectiveness level;
\(IIL\) is investmen-innovation leverage.

The level of labor productivity in the Russian economy is several times lower than in the developed countries, and the material consumption of production is significantly higher [12,13], so the study of the possibilities of labor productivity growth is an extremely urgent task [14,15].

Unfortunately, the decline in the level of capital productivity in industry in the regions of the Far North and the Arctic leads to the fact that labor productivity in these regions is not increasing quickly enough. It is obvious that, on the one hand, the extensive growth of labor productivity in the industry of these regions is provided mainly by increasing the level of fixed capital per worker. On the other hand, it is clear that a significant increase in capital productivity and hence, labor productivity can be
achieved only by reducing material intensity of a product with technological innovation of an intensive type, that is, renewal of the active part of the fixed assets of industrial enterprises on a new technological basis. In [9], we show that the situation with the decline in capital productivity and material intensity in industry is typical not only of the Far North and the Arctic regions but also of industry of the Russian Federation as a whole.

Thus, the use of the concepts of investment and innovation leverage and the coefficient of technological effectiveness level of production allows an analytical interdependence between labor productivity, capital productivity and material intensity to be formulated.

Accordingly, there is an opportunity to manage the innovative and effective development of industrial enterprises, industrial production sectors, as well as the industry of the regions- subjects of the Federation and the country as a whole. As a result, due to the intensification of production, a significant increase in labor productivity, GRP of regions and GDP of the country can be provided.

4. Conclusions

1. It is shown that to manage the intensive development of industrial production, another type of leverage – investment and innovation- as the ratio of the share of value added in the structure of sales value to material intensity of production should be used. It is necessary, first of all, to determine the volume of investments of intensive type, which provide a required level of reduction in material intensity of product and a corresponding increase in the share of value added in the structure of sales value.

2. It is determined that to reduce the level of material intensity of product it is necessary that, firstly, capital productivity should increase and, secondly, the value of the coefficient of technological effectiveness level of production should not decrease at a rate higher than the rate of capital productivity growth.

3. It is noted that in most regions of the Far North and the Arctic, the development of industry does not correspond to the best innovative and efficient direction, but in general, the situation is more favorable than in the country's industry.

4. The analytical interdependence between material intensity, capital productivity and labor productivity, enabling management of innovative - efficient development of industrial enterprises, industries and the corresponding growth of labor productivity, GRP and GDP due to technological intensification of production has been determined.

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