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The Process of Fund-Saving In the Theory of Innovative Economy

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Abstract
The research paper proves that the essence of the effectiveness of the innovation economy is the capital-saving intensification of production. The paper fully describes the economic mechanism of capital and labor saving in the production and marketing of products and services. The primary motivation for innovative business is the growth of labor productivity in equal conditions that leads to a reduction in cost per unit of output, which certainly provides high additional revenue, covering initial expenses. This is the formula for the efficiency of industrial-innovative development of the economy. Depending on the level of innovation, profitability can be different.

Keywords: Effective innovative economy; Mechanism of efficiency; Capital-saving production; Capital-saving; Capital-neutral and capital-intensive intensification.

JEL classification: O16; O32; O47

1. Introduction
The work is based on the author's research on the problem of managing the efficiency of social production to ensure economic growth. Since many factors of production enter the process of transformation of the aggregate of resources, one should expect a different level of their "mastery", i.e. different levels of efficiency.

Efficiency, as a key category of economic growth, is deeply studied by Kazakhstan and foreign scientists. At the same time, the problem has been little studied from the position of system scientific management of the production process aimed at achieving the desired level of effectiveness.

The peculiarity of this study is connected with the fact that theoretical and methodological developments stand above the economy-planned or market-oriented ones, and are aimed at developing methodological approaches to assessment of the effectiveness of different types of production.

On this issue, the author has published a large number of scientific papers, including two monographs, three recommendations for production in the form of assessment methodologies and a report to the Government of Kazakhstan.

It should be explained that for many years this process has been called fund-saving. Nowadays, in the literature, fixed assets are called capital, which is even more precise.

As a result, a theory of capital-saving has been developed and tested in the practice of calculating indicators for performance management in the framework of capital-saving production.

In connection with the goal, the following tasks were formulated:
1. to reveal the process and the mechanism of the efficient capital-saving production (or saving of a production fund);
2. to develop indicators for the savings of a production fund;
3. to show the level of effectiveness of types of intensification;
4. to make forecasts for intensive economic growth.

In connection with the tasks assigned, the study was conducted based on the author's research data.

2. Literature Review
Many scientists are worried about the future of the world economy. In the research by Irmen (2017), it is noted that in the last 50 years, there has been a rapid global economic growth. The world economy has increased sixfold. After 2014 and further, a sharp drop in the economy has been projected. It is explained by the population growth and the increase in the retirement age.

In the author's opinion, labor productivity is still increasing due to the transition in the advanced countries to the innovative economy. In the research by Manyika et al. (2015) and Ross (2018), Olokundun et al. (2017), the effect of primary factors of production, such as land, labor, capital and entrepreneurship, was analyzed (Utterback and Abernathy, 1975).

However, a review of the Western scientific literature did not provide data for the study of capital-saving production. The data was found in Russian studies (Kubayev, 1987); (Kubayev, 1998); (Aleksandrov, 1982); (Rudnev, 1980). Thus, this process was studied more in the Eurasian territory and the data were taken from these states.

The author's analytical study has been directed on the search for indicators of the estimation of capital and labor saving in economic processes. In the work (Measuring Performance), it is shown how changes in the economic

indicators directly or indirectly affect macroeconomic variables, allowing economists to judge whether there are improvements or deterioration in productivity.

3. The Mechanism of Efficiency of the Capital-Saving

In the innovative economy, new technologies play a leading role in the development of society and wealth. They determine and contribute to the intensification of production and marketing of goods and services. The intensification of production is affected by the transformation of living labor to machine tools and robots, so-called past labor, which results in saving the costs of aggregate labor. The essence and foundation of the innovative economy is the saving of capital and labor. As a result, the capital-saving form of production is determined by the economy of labor and capital.

Consequently, saving is an economic process of simultaneous saving of living and past labor in social production. A common sign of all types of intensification of production is the growth of labor productivity.

4. Methods and Models of Effective Investment

In the author's previous studies (Kubayev, 1987), it was demonstrated that the basis for increasing labor productivity is scientific and technological progress (Ayesha); (West, 2011); (Bond, 2011); (Link, 2018). The use of technical means is the process of saving aggregate labor (ΔL), the value of which is determined by the ratio of living labor changes (ΔL_l) and past labor capital (ΔL_p).

Mathematically, it can be represented as follows:

$$\Delta L_i = L - \frac{\Delta L_{li}}{\Delta L_{pi}} \qquad (1)$$

where:

ΔL_i – savings of total costs from the introduction of technical means for the i-th period;

L – public in the main capital labor expended on a unit of production before the introduction of technical means or its improvement;

ΔL_{li} – the amount of change (decrease) in labor costs for the production of a unit of output for the i-th period (used as the difference in labor costs before and after the introduction or modernization of a technical facility);

ΔL_{pi}– the magnitude of the change (growth) in the costs of fixed capital (past labor) per unit of output per the i-th period (the calculation is similar to ΔL_i);

The increase in labor productivity is the most important factor of intensive economic growth. As noted, its growth is associated with scientific and technological progress. This condition of intensification of production can be mathematically presented as follows:

$$\Delta P > 0 \qquad (2)$$

where:

ΔP – change in labor production.

When studying the dynamics of scientific and technological progress, it can be seen that the values of ΔT and ΔK in the evolutionary and revolutionary phases of the development of the productive forces differ sharply.

At the same time, one should mention the optimal ratio of labor and capital, which ensures the highest growth rate of productivity of aggregate labor. On the path of social production, the development of productive forces and production relations, this ratio has been constantly changing. In general, there has been an increase in the share of fixed capital in a unit of product. In the period of the scientific and technological revolution, the share of fixed capital in a unit of product grows much faster under the influence of the scientific and technological progress. When the conditions for their effective application are ensured, the share of labor decreases with even greater speed.

A feature of high technology production consists in the fact that it involves labor cost at the much more expensive rate than the newly created one. The author's research shows that in the grain production, the share of capital reaches the cost rate of 76% and labor rate of over 60% (Table 1).

Table-1. The structure of labor (T) and capital (C) for the production of 1 centner of grain (excluding corn and rice) in the farms of Kazakhstan for 1971-1987

Expenses	Average annual expenses															
	1971-1975 crop 8.4 centner/hectare				1976-1980 crop 9.53 centner/hectare				1981-1985 crop 7.91 centner/hectare				1987 crop 10.83 centner/hectare			
			%				%				%				%	
	RUR	manhour	unit cost	labor unit cost	RUR	man hour	unit cost	labor unit cost	RUR	man hour	unit cost	labor unit cost	RUR	man hour	unit cost	labor unit cost
Labor	2.69	1.54	28.68	37.2	2.16	1.61	27.52	41.7	2.81	23.38	23.8	22.7	2.58	1.63	24.42	43.1
Including management and organization expenses	0.87	0.5	12.19	12.1	0.95	0.71	12.11	18.4	1.39	11.18	11.77	22.3	1.21	0.76	1.39	20.1
General capital	0.29	2.6	71.32	62.8	5.69	2.25	72.52	58.3	8.93	2.9	76.2	55.0	7.97	2.15	75.56	56.9
Total	7.84	4.14	100	100	7.87	3.86	100	100	11.8	5.28	100	100	10.55	3.78	100	10

These figures allow observing a certain tendency of growth, as well as to notice a significant share of the costs of the organization of production.

Therefore, under conditions of increased technical equipment of labor to ensure a saving-saving form of reproduction of the means of production, the value of capital-saving sharply increases: its insignificant saving is real for a considerable increase in labor productivity. So, if the cost of fixed assets is 2.5 times higher than the national income, then an increase in the total return on assets by 1% is equivalent to an increase in labor productivity by 2.5% (Khromov, 1982). The economy of the labor embodied in the machines of the past is, in fact, the economy spent on the production of means of production, living labor.

In connection with this, the author proposes a principle of quantitative estimation of the level of fund-saving of intensive reproduction, based on a system of indicators characterizing the degree of saving of labor and capital. The following indicators are taken into an account in this system.

5. Indicators of the State of Funds

The capital-saving index (F_s) represents the ratio of the growth of labor productivity (ΔP) to the rate of growth in the fundraising ratio (ΔF) in per cent in a given time interval:

$$F_s = \frac{\Delta L}{\Delta F} \tag{3}$$

The analysis of the ratio $\frac{\Delta L}{\Delta C}$ of the rates of changes in labor and capital in a unit of production shows that the ratio of the growth rates of labor productivity and the growth of the labor-yield ratio can serve as the basic and objective criterion for estimating the level of intensification of production.

Known indicators and methods of assessment do not allow assessing the nature of intensive production. Such important indicators as the indicator of the efficiency of social production, the return on assets, the utilization rate of fixed assets and others, give only an indirect reflection of the ratio of the rates of change in technical equipment and labor productivity.

By the same principles, an estimation of savings can be carried out on the active part of fixed capital – technical means. Then the index of capital-savings on the active part of capital (F_{sa}) is the ratio of the rate of growth of labor productivity to the rate of growth of its machine-building (ΔM) in the percentage of the specified time interval:

$$F_{s\propto} = \frac{\Delta P}{\Delta E} \tag{4}$$

The inverse value of the capital-savings – saving indicator is the indicator of the costs of a production fund (F_c). This is the ratio of the growth rate of capital investment to the growth rate of labor productivity in per cent in a given time interval:

$$F_c = \frac{\Delta E}{\Delta P} \tag{5}$$

Similarly, the indicator of capital expenditure on the active part of capital (F_{ca}) – the ratio of the rate of growth of the equipment to the growth rate of labor productivity in a given time interval:

$$F_{ca} = \frac{\Delta E_a}{\Delta P_a} \qquad\qquad (6)$$

The main characteristic feature of the fund-saving intensive production consists in the fact that the growth of labor productivity outpaces the growth of its fundraising ratio. Now, with a value of F_α less than 1, and F_{ca} greater than 1, it deals with a capital-intensive one and, conversely, in the case when F_α is larger, F_{ca} is less than unity, with a savings-saving one and if these quantities are equal to unity with the fund neutral form of production.

These indicators of savings, their regulatory values become one of the tools of managing the level of intensification, and, consequently, the level of economic growth.

6. The Effectiveness Level of Intensification Types

In the economic literature, from the point of view of the change in the total costs per unit of land area and the unit of output, several levels of technical equipment of production are singled out in historical development.

Proceeding from this, the results of calculations for revealing the type of intensification in three stages are given in Tables 2-4:

a) low;

b) average;

c) high levels of technical equipment production.

Table-2. Identification of the type of intensification of reproduction at the low level of technical equipment of production (units cost) (calculated by the author)

Expenses and results	Cost and savings structure								
	At the starting point	At the time of assessment	Saving (+) Expense (-)	At the starting point	At the time of assessment	Saving (+) Expense (-)	At the starting point	At the time of assessment	Saving (+) Expense (-)
Labor	60	40	+20	60	40	+20	60	40	+20
Working capital	20	20	0	20	20	0	20	20	0
General capital	20	39	-19	20	26.8	-6.8	20	25	-5
Cumulative expenses	100	99	+1	100	86.8	+13.2	100	85	+15
Labor productivity (%)	100	134	+34	100	134	+34	100	134	+34
Capital-labor ratio	100	195	+95	100	150	+50	100	125	+25
Savings index		0.68			0.89			1.07	
Expenses index		1.45			1.12			0.93	
Type of intensification		Capital-intensive			Capital-intensive			Capital intensive	

Table-3. Identification of the type of intensification of reproduction at the average level of technical equipment of production (units cost) (calculated by the author)

Expenses and results	Cost and savings structure								
	At the starting point	At the time of assessment	Saving (+) Expense (-)	At the starting point	At the time of assessment	Saving (+) Expense (-)	At the starting point	At the time of assessment	Saving (+) Expense (-)
	1st stage of intensification			2nd stage of intensification			3rd stage of intensification		
Labor	40	31	+9	40	30,7	+9.3	40	30	+10
Working capital	30	31	0	30	30	0	30	30	0
General capital	30	38	-8	30	37	-7	30	32	-2
Cumulative expenses	100	99	+1	100	97.7	+2.3	100	92	+8
Labor productivity (%)	100	122.5	+22.5	100	123.3	+23.3	100	125	+25
Capital-labor ratio	100	126.7	+26.7	100	123.3	+23.3	100	106.7	+6.7
Savings index		0.97			1.0			1.17	
Expenses index		1.03			1.0			0.83	
Type of intensification		Capital-intensive			Capital-intensive			Capital-intensive	

Table-4. Identification of the type of intensification of reproduction at the high level of technical equipment of production (units cost) (calculated by the author)

Expenses and results	Cost and savings structure								
	At the starting point	At the time of assessment	Saving (+) Expense (-)	At the starting point	At the time of assessment	Saving (+) Expense (-)	At the starting point	At the time of assessment	Saving (+) Expense (-)
	1st stage of intensification			2nd stage of intensification			3rd stage of intensification		
Labor	20	18	+2	20	10	+10	20	10	+10
Working capital	40	40	0	40	40	0	40	40	0
General capital	40	41	-1	40	49	-9	40	41	-1
Cumulative expenses	100	99	+1	100	99	+1	100	91	+9
Labor productivity (%)	100	110	+10	100	150	+50	100	150	+50
Capital-labor ratio	100	102	+2	100	122.5	+22.5	100	102.5	+2.5
Savings index		1.08			1.22			1.45	
Expenses index		0.93			0.82			0.68	
Type of intensification		Capital-saving			Capital-saving			Capital-saving	

Specifically, in the methodological plan, this is accomplished by evaluating the efficiency indicators of savings under the different structure of labor and capital expenditure in total costs. At the same time, the ratio of the shares of labor, fixed capital and working capital in conventional units is taken as the initial structure:

a) 60 x 20 x 20 = 100;
b) 40 x 30 x 30 = 100;
c) 20 x 40 x 40 = 100.

Taking into account the fact that the main capital is the object of research, the working capital costs in the calculations are conditionally taken unchanged.

It is known that the intensification of production is carried out at the expense of all its factors: mechanization, melioration and chemicalization. Taking into account the object of the study, the author is more concerned with the issues of technical equipment, in no way diminishing the achievements of biology, agronomy and other natural sciences in improving the efficiency of agriculture.

At the first stage, the intensification of production occurs under the conditions of applying a large amount of manual labor per unit area, and, consequently, the significant labor input per unit of output (Table 2).

Intensification is observed due to the gradual replacement of manual labor by machine and the growth of social labor productivity. Significant costs for the creation and use of technology are justified by savings and growth in labor productivity.

The next stage of intensification is determined by technological progress, the economic essence of which is the reduction of labor costs for the production of agricultural products (Table 3). The share of fixed capital increases in the structure of costs of aggregate labor.

The third stage in the intensification of production is characterized by the effect of scientific and technological progress on the production and use of means of production for agriculture. In the structure of aggregate costs, this manifests as a sharp increase in the share of fixed capital (Table 4).

In addition, as follows from Tables 2-4, within each type, the intensification of production can be different: capital-intensive, capital-neutral and capital-saving. The capital-intensive type of intensification at all stages shows a low production efficiency. The insignificant overlap of labor savings over the increase in the cost of fixed capital is typical. A quantitative assessment for determining the type of intensification is provided by the indicators of savings and fund spending.

In these calculations, with the low level of technical equipment, $F_s = 0.68$, $F_c = 1.45$ (Table 2), which indicates a low efficiency. At the average level of equipment production under the capital-intensive intensification, greater efficiency can be achieved: $F_s = 0.97$, $F_c = 1.03$ (Table 3). Industrial and economic conditions with a decrease in the cost-saving indicators (F_s, F_{sa}) of less than one lead to an increase in the capital intensity of production, a decrease in the return on assets. That is, the costs of increasing the technical equipment of labor do not pay off and additional investments in production are required. The effect, obtained from the growth of labor productivity, is reduced by losses from increasing the capital intensity of production.

As follows from the tables, the most effective at all levels of equipment production is the capital-saving intensification: the index of savings in these calculations reaches $F_s = 1.46$ (Table 5). Increase in the indicators of savings over the limits of unity indicates a decrease in the capital intensity of production and the growth of the return on assets. The effect of saving social labor is complemented by savings in means of production accumulation. The economic process of saving funds is observed.

Table-5. The intensification status and forecast on the example of grain production in Kazakhstan (costs per man-hours) (calculated by the author)

Expenses and results	Cost structure per 1 centner of grain with savings or expenses						
	Actual state			Transitional state	Forecast level, 2020		
	1971-1975	1981-1985	Saving (+) Expense (-)		Progressiveness, Technology and Production	Saving (+), Expense (-) in comparison	
						1971-1975	1981-1985
Labor	1.54	2.4	-0.86	…	0.23	+1.31	+2.17
Working capital	2.6	2.9	-0.3	…	0.8	+1.8	+2.1
General capital	1.4	1.43	-0.03	…	0.73	+0.67	+0.73
Cumulative expenses	4.14	5.28	-1.14		1.76	2.38	+3.52
Labor productivity (%)	100	55.8	-44.2		100	669	1000
Capital-labor ratio	100	102	+2		100	52	51
Savings index		0.55	-		-	12.8	19.6
Expenses index		1.53	-		-	0.078	0.051
Type of intensification		No intensive growth		Capital-intensive, Capital-neutral			Capital-saving

The level of savings is influenced by numerous factors, which can have a positive or negative influence on it. In specific production and economic conditions, one or another may prevail. Therefore, in the economy, saving is important primarily as a process. In different periods of the development of the national economy, various factors of social production predominated, and consequently, different trends. For example, according to Rudnev (1980), in the eighth five-year plan in the USSR, the capital-saving form of intensification prevailed, and in the ninth and early tenth – capital-intensive.

To correct social production, the whole complex of social and economic reforms in the country can contribute to the trend of saving funds. However, as the decisive factor here, the creation of a market mechanism for accelerating scientific and technological progress should be considered, which could solve the problem of substantial cost savings of advances per unit of output and turn new technologies into a means of making it cheaper.

As follows from the tables analyzed, the calculations confirm the above feature of the process of saving. With the increase in the level of technical equipment, the price of capital-saving sharply increases. Table 4 shows that insignificant costs (growth) of capital can provide significant savings in labor costs. A characteristic feature of highly-equipped production is the fact that with an insignificant level of intensification, the process of saving funds is already observed.

At the same time, the inverse feature of large, technically equipped production is the rapid loss of intensive economic growth in general, with some inconsistency in the level of technology and organization of developing conditions and production requirements.

7. The Forecast of Intensive Economic Growth

The right-hand side of Table 5 of the appendix shows the predicted structure and the value of total costs by the Timiryazev Agricultural Academy (TAA) technique (Gataulin, 1983) for the production of one centner of grain in the conditions of zone 172. The calculations are based on the standard technology (Mikaya, 1984). The data of the table indicate the forthcoming huge work required to achieve the projected level of economic growth.

It follows from the analyzed tables that during the transitional stage, the third type of intensification is not excluded: the fund neutral type, when the rates of technical equipment and growth in labor productivity are equalized, and the savings and fund spending indicators are equal to one.

Studies show that the general feature of all analyzed types of intensive economic growth is the increase in labor productivity, in all cases, intensive growth is organically linked to increased labor productivity.

And, indeed, if the growth of productivity of labor $\Delta P = 0$, then the index of fund-saving F_s is also equal to zero:

$$F_s = \frac{\Delta P}{\Delta F} = \frac{0}{\Delta F} = 0 \tag{7}$$

In creating conditions for intensive economic growth at the stage of high technical equipment of production, among other factors, replacing inefficient technologies with cheaper and more efficient and cost-effective forms of organizing their use plays a leading role. Cost-effectiveness is provided by developing market relations.

8. Limitations

The above theoretical and methodological developments show that the production of fixed capital can be carried out under three conditional relations of labor productivity and its technical capacity. The first one is when the rate of growth of technical labor exceeds the growth of its productivity, the second – the growth rates of these indicators are equal, the third – the growth of labor productivity outpaces the growth of its technical equipment.

With the predominantly intensive type of economic growth, the latter passes through the first phase of unilateral intensification, characterized by the fact that the growth in labor productivity is accompanied by a decrease in the return on assets and is primarily associated with a capital-intensive form of renewal of fixed assets. A further increase in production efficiency is achieved by providing a fund-saving form of technology renewal. It allows the release of resources, the means of production, ensures the growth of real output with the same amount of capital investment.

From the point of view of saving the past labor and the ratio of the rates of price growth and the productivity of new and old technology, one can form three groups (Aleksandrov, 1982):

1) the growth of prices is less than the growth of productivity;
2) these indicators are equal;
3) the increase in prices outstrips the growth of productivity of machines.

These provisions are united by the fact that the dynamics of prices and productivity of machines are controlled by the same factors as the dynamics of the ratio of capital-labor ratio and labor productivity.

However, according to Konkin (1983), "the comparison of prices and productivity of machines without taking into account other economic and social factors is erroneous and methodical since it does not take into account the whole complex of economic effect components, does not fix the saving of manpower and socio-economic importance of improving working conditions in the workplace with the use of modern, more advanced technology".

The capital-saving type of technology renewal is determined by the intensification of all phases of its production. However, in economics, the problem of integrated management of these processes is poorly developed throughout the cycle of development, exchange and application of new technology.

The conditions for the conservation of the intensification of production can be summarized as follows:

1) saving labor (L) and capital (C);
2) more intensive labor saving in comparison with the growth of capital in a unit of production;
3) outstripping the rate of productivity in comparison with the rate of growth of the labor-endowment of labor ($F_s > 1$).

Now, having revealed the economic essence of the most effective production, fund-saving intensification, it is necessary to show the mechanism of its realization. The theory reveals the deep roots of providing effective production by ensuring the optimal combination and interaction of labor and capital. Further, it is necessary to bring

it to the stage of practical implementation in order to create socio-economic conditions for the process of saving funds.

In everyday economic activities, this process is not visible. Like any major category, it can be estimated only at a distance in time (a certain period of time) and methods of in-depth scientific analysis.

However, the economics is practiced the same way as physics, chemistry, medicine and other sciences in order to more accurately determine trends, parameters, diagnose economic processes and phenomena.

In the author's case, it is necessary to periodically (3-5 years or more) establish:

- − Is the process of labor- and capital-saving or not?
- − On what type of intensification of production does the economy work?
- − Capital-raising, capital-neutral or capital-saving?

And in this regard, what level of economic growth should be expected? The method of practical calculations of intensive economic growth is covered in other works of the author mentioned earlier.

9. Conclusions

The process of saving in the economy has been revealed and described. Capital-saving is aimed at increasing the efficiency of the economy. This process is more evident in the innovative economy. The primary motivation for innovative business consists in the fact that growth of labor productivity in equal conditions leads to a reduction in costs per unit of output, which certainly provides high additional revenue, covering initial expenses.

This is the formula for the efficiency of industrial-innovative development of the economy. Depending on the level of innovation, profitability can be different. The concepts of capital-saving, capital-neutral and capital-intensive intensification have been experimentally confirmed. Indicators of capital- and labor-saving intensification have been developed. Calculations showed that the capital-saving intensification of production is the most efficient.

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