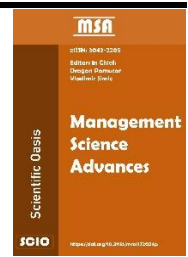




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## The Principle of Distributed Management in the Knowledge Economy

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### ABSTRACT

The subject of the research is the principle of "distributed management" and the possibility of its application in the "knowledge economy." The purpose of the study is to reveal the content of the "distributed management" principle, as well as to demonstrate its application in the field of knowledge economy management, when the power of a policy instrument and the cumulative effect of development policy are important. The methodological basis of the research is the theory of economic policy, ideas about the development of the "knowledge economy," a mathematical scheme for the implementation of the "distributed management" principle, the "income-risk" model, and the typification method. The overall result of the study is that we have obtained a picture of distributed management in the "knowledge economy" as a sector that includes the following types of activities: science, education, and high-tech sectors. The necessity of direct statistical accounting of the "knowledge economy" is substantiated in order to obtain an adequate assessment of the dissemination of knowledge and the application of development policy tools. The article identifies the pros and cons of measuring the "knowledge economy" by Eurostat and provides the author's proposals for direct measurement of this sector. In addition, a model of the development of the "knowledge economy" has been built in the "income-risk" coordinates. This model illustrates the application of various management methods based on the principle of "distributed management." The study defines knowledge management modes in the "income-risk" coordinates, which actualizes the formulation and solution of the "distributed management" problem, involving the consideration of changes in the impact and accumulation of implemented development policy measures. The perspective of the study is to measure the use of each of the possible tools to stimulate the development of the "knowledge economy" and to compare them across countries, in particular the European Union and other regions of the global economy.

### 1. Introduction

Knowledge management is usually considered at the microeconomic level, firm, corporation using information and communication technologies and learning effects, without taking into account the principle of 'distributed management' [1], and the leading role in the generation and

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dissemination of knowledge is assigned to universities [2]. Their role is leading in the creation of technologies and the acquisition of patents. However, there are studies paying attention to the connection of various macroparameters characterizing the knowledge economy as a macroeconomic sector [3]. At the same time, they investigate correlations or their absence, but the 'knowledge economy' is not identified, since indicators of costs for internal research and development, GDP per capita, GDP growth rate, the number of researchers and the human development index, which characterize the economy in general, are introduced. The vast majority of knowledge management research concerns the microeconomic, industry level. Moreover, it is precisely such studies [4] that have expanded, shifting the emphasis from management as such to the application of knowledge and obtaining additional competitive advantages through knowledge. Conceptual approaches in the field of knowledge management are also developing [5], shifting the emphasis from knowledge-intensive industries to knowledge-based service activities. Assessing income from the application and generation of new knowledge, as well as risk, is a very difficult problem, unlike other benefits created. With regard to the macroeconomic level, it can be assumed that the overall result of the analysis will be determined by how the sector of the "knowledge economy" is identified and measured. Depending on this, one or another mode of management and its development will be implemented. However, the strength of the applied management tools may be different for different types of knowledge and for elements of the 'knowledge economy'. This predetermined the purpose of the study – to consider the doctrine of distributed management in relation to the management of the "knowledge economy" as a sector of the modern economy, taking into account the changing functioning of this sector in the 'income – risk' coordinates. The methodology consists of the theory of economic development and the "knowledge economy", the principle of "distributed management", applicable at the level of macroeconomic analysis, as well as to solving management problems at the level of a firm and corporation. To achieve this goal, it is consistently necessary, firstly, to consider what distributed management is, and secondly, to identify models for the development of the 'knowledge economy' in income-risk coordinates, with a general focus on risk reduction.

## **2. Distributed Management of the Knowledge Economy: Research Methodology**

Management consists in the forceful action of the subject on the object in order to change the state of the object or ensure its movement in the required direction [6]. In control theory a function is usually used that describes the state of an object and its change, as well as a control function that provides a change in the state of the object. However, the object moves from one state to another not only under the influence of control actions but also the presence of other objects that also affect the control object in question. These two types of influence are very difficult to separate, which creates great difficulties in interpreting management and selecting management tools – economic policy measures. The rate of change in the state of the object is an important characteristic of management.

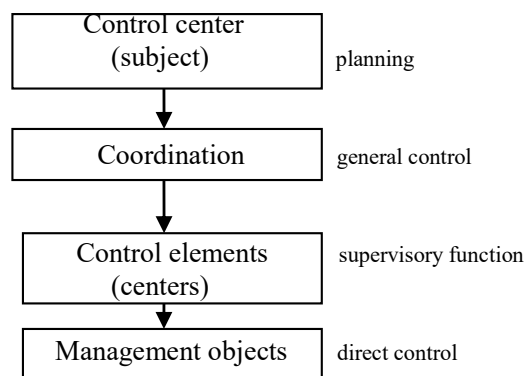
In technical sciences and practice, the term 'distributed control system' is used, which refers to a system for managing a technical (technological) process using decentralized data processing and computing. These control systems usually connect the interface of technical and computer subsystems connected in a single control loop for a particular technical object.

It is used in connection with the fact that it gives the technical system greater reliability of functioning, solving the tasks and performing the appropriate (assigned to the system) functions. This is reflected in a decrease in the number and depth of emerging dysfunctions and failures. In relation to information and computer systems, namely in them this distributed control scheme is

most commonly used, this type of control makes it possible to easily expand the system, convenient monitoring and debugging, fewer wired connections, etc. Distributed control for computer technology is a distributed database, as well as a set of computing programs, each of which executes its own computational algorithm, but all of them are subordinated to achieve the set goal. Thus, their actions are distributed among the areas of responsibility, working towards a common goal. The functioning of distributed elements in a technical system depends on their location.

Note that the term is quite well-known in technology, but it has a clear connotation there. At the same time, in management, apparently borrowing an approach from the management of technical systems, the term 'distributed management' was used in the sense of using heterogeneous systems used to describe the evolution of management structures from less complex (hierarchical) to more complex (matrix, network). Distributed management in management presupposes the emergence of additional decision-making (management) centers, similar to the technical system, with the allocation of the main center. The general scheme is shown in Figure 1. The control center assumes several coordination options and the presence of control centers (elements) that affect the control objects.

If we transfer this general scheme to the economy, then the center carries out planning (strategic), then it coordinates with other centers and development plans, including the implementation of the supervisory function at the level of management centers and forms of direct management at the management facility, which has its own operational and tactical plans (these elements are shown on the side in Figure 1 – on the right).

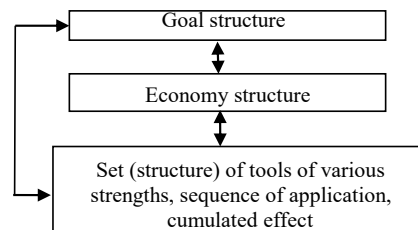


**Fig. 1.** Distributed control system (in engineering)

The meaning of distributed management in management is additional decision-making centers, which are somehow connected to the main center (either hierarchically, or matrix, network-centric, and so on.)

These approaches are well known in management theory, and many works have been devoted to them, including those by Russian authors, which are not considered here due to a different plot of this study. It boils down to the fact that the theory of economic policy essentially does not use the principle of distributed management and does not formulate it as a principle of formation and construction of macroeconomic policy. It is worth emphasizing that distributed management for the theory of economic policy is a completely different principle in terms of content than distributed management in engineering or management. Although the general meaning coincides and boils down to the fact that there is a structure of tools that distributes the distribution of applied measures in influencing various objects that are also linked into the structure. In other words, distributed management here is not the dispersion of decision-making centers – the structure of decision-

making or the organization of the management system itself or the technical system according to parameters and information networks and connections, but the structure of the impact measures themselves. Economic policy is based on the classical principle of 'goals – tools', which does not allow us to see the different strength and effectiveness of the use of tools, their distributed influence on economic objects, structure, development factors and goals.



**Fig. 2.** Distributed management of the economic system

Distributed management in economic policy reflects Figure 2, where the structure of goals in general does not coincide with the structure of the economic system and the set of tools used, which vary in number and influence over time. They show different effectiveness of their application and the 'cumulative effect' of their impact, when some tools lose their impact on the target or structural elements, while others gain. This dynamic process requires additional and extensive research.

By modifying the economic structure and influencing factors, while simultaneously moving the system towards its goal (positive effect), in the next or distant interval, precisely due to some influence on factors or the economic structure, progress towards the goal will slow down or stop (negative cumulative effect). It is precisely such outcomes that economic and managerial science is currently unable to determine. It is very difficult for her to even assess the effectiveness of a particular policy instrument, since they are used simultaneously and it is sometimes not easy to identify individual influences, both because of the coherence of the instruments and the development goals, as well as the factors and conditions present, which also show their levels of connection and influence.

The principle of 'effective market classification', which binds each goal to its own tool and set of tools, does not work in practice, only preserving the principle of 'goals – tools', and not developing it. How can budget expenditures be considered to have no effect on monetization if, by borrowing, the state enters the open market and through it influences the amount of money supply? Institutional corrections are even more interconnected and unpredictably affect the functioning of specific economic entities, deforming the structure. For example, the 'Taxi Law' in Russia in 2023-2024. This led to a sharp increase in transportation prices – the profitability of one transportation over the same distance increased 2-3 times in some cases and in Russian cities. The number of drivers has decreased, and the accessibility of this transport for the population has also decreased with the resulting social restrictions. In full accordance with the 'cobra effect', which often manifests itself in the field of macroeconomic policy, few people expected such a result from streamlining accounting in the passenger transportation business. But it is precisely this outcome, which leads, at least in the medium term, to a negative transformation of the industry, pushing it into the field of degradation, that became apparent, and in a matter of months, with the generation of the 'elitisation effect' of taxi transportation.

However, this has not yet led to the abolition of the introduced standards, just as the protests of many experts on pension and social legislation did not lead to the abolition of pension reform, which

increased the retirement period and cut off millions of strata of the Russian population from social benefits.

In our opinion, these examples are a clear demonstration of the lack of a distributed management doctrine in the field of government decision-making and economic policy. They reflect a linear logic that obeys to a greater extent the principle of 'goals – tools', which is not rejected by the author as a kind of basic postulate, but should have been modified long ago, given the complexity of connections and solutions in the modern economy to change the practice of projected and implemented economic policy. Complex development tasks, such as a proactive strategy, can be implemented only by focusing on this management principle – 'distributed management', taking into account the cumulative effect of each instrument acting on the goals and elements of the structure of the economy. Otherwise, the effects on the economy, goals, and structure are built in an unpredictable way, outside the action plan, with unclear prospects for changing the set of tools and the content of the policy. At best, the effects on some obvious target, such as inflation, are justified. But the inadequate use of instruments, in particular, the interest rate, shows the opposite effect, instead of a significant decrease in the average period, there is a downward trend in prices. In the long term, inflation is decreasing, but economic growth is also slowing down.

Thus, the managed system is defined by the state of the control object and the control function, which reflects the state of the control subject. But in a mathematical sense, in particular, in the functional of Pontryagin [7] introduced the control function is not changeable, but in practice it is permanently changing, since the goals of development, the state of the objects of management and the power of the instruments of influence are subject to change.

Of particular note is the possible connection of two functions – the state of the object and management, which depend on time and on the tools used and initial conditions.

Here, direct and feedback links between the subject and the object of management become important. Management as an impact can no longer be considered as an exogenous factor. This is of great importance in knowledge management, which is very heterogeneous and requires the selection of specific incentive tools, since a common set of measures can have a very different impact on each type of knowledge. The goals of influencing knowledge can be to increase their volume, improve their quality, and expand the coverage of this knowledge. But they can be influenced by various tools. If we apply a well-known set, then its impact on the goals of knowledge development will be distributed differently to the specified goals in the field of 'knowledge economics'. This is what constitutes the so-called 'distributed management'. The idea of this doctrine, in contrast to Tinbergen's principle of 'goals-tools' [8], is that over time the power of influence of each tool affecting the control object changes, and the sensitivity of the goal and object to each tool changes, which forms a cumulative effect for each tool [9]. This approach significantly modernizes economic policy, taking it out of the classical approach, which considers management tools exogenously to the economic system [10].

The principle of 'goals-tools' of management can be mathematically represented as follows: let the number of goals be  $T_k$ , where  $k = 1 \dots N$ , the number of tools  $I_j$ , where  $j = 1 \dots M$ ,  $M \geq N$ , then the equations connecting goals and tools can be written according to (1).

$$T_k = \sum_{k=1}^N \sum_{j=1}^M a_{kj} I_j \quad (1)$$

Having set goals (by setting them), you can create a system of equations, the solution of which will give you the tools that will allow to achieve the set goals [8]. This approach is static, does not take into account either the diversity of goals and their coherence (the structure of goals), or the diversity of policy measures (management) and the structure of tools, which changes based on political preferences. If knowledge-related attitudes are chosen as goals, then it is not possible to see how the same tool affects different types of knowledge and how they, in turn, are related to each

other. This creates an inherent difficulty in forming a policy for the development of the 'knowledge economy', not to mention influencing the risks of obtaining new knowledge, which can be quite high, as well as the risks of applying already created (open) knowledge.

The development of the principle of 'goals-tools' in the form of linking tools to each goal also does not work in the field of 'knowledge economics', because it is impossible to see such a link in advance. Unfortunately, this interpretation of the Tinbergen principle does not work in the field of macro management either.

It is necessary to take into account the institutional changes [11], implementation of projects [12], investments [13], reliability of the functioning of management facilities [14], state of information systems [15] and human capital [16], etc., affecting macroparameters, the level of accumulated knowledge and their dissemination. There are so many of these conditions that a distributed management solution is a condition for the formation of a new system of equations linking changing goals, instruments of influence, development factors and changing conditions that determine both conditions, factors, and policy measures and development goals.

Let's show one of the options for 'distributed' management. Under it a set of impacts on the management object is considered, taking into account the strength of the influence of tools on the goals and factors of the development of the object. In this case the principle of 'goals-tools' is modified and expanded. Distributed management links a change in purpose with a change in tools and factors. If the number of tools (M) and factors (L) do not match, then the system of equations can be written as follows [8]:

$$\frac{dT_k}{dt} = \sum_{k=1}^N \left\{ \sum_{i=1}^L b_{ki} \frac{dF_i}{dt} + \sum_{j=1}^M a_{kj} \frac{dI_j}{dt} \right\} \quad (2)$$

It is fair to note that the presented system of equations (2) with respect to  $a_{kj}$ ,  $b_{ki}$  has the same disadvantage as the system of equations (1). These coefficients determine the strength of the influence of changing tools and factors on the goals. In Lucas's theory of expectations, the same disadvantage arises when evaluating expectations [10]. When complex goals are considered, for example, building knowledge and its quality, then we have the right to raise the problem of fundamental limitations regarding the assessment of past managerial influences relevant in the current regime and determining the future state of the management object. This basic condition is the basis for the uncertainty of creating – discovering new knowledge, spreading and ensuring high-quality assimilation and replication of knowledge, which is the risk of knowledge activity at various facilities – firms, corporations, regions, and nationwide. However, it is still appropriate to note that the principle of 'goals-tools', arising from the mathematical logic of equations (1), which postulates the superiority of the number of tools to the number of goals, is transformed. It turns out a fundamental reservation, reduced to the fact that, according to expression (2), the number of goals should not exceed the sum of the number of tools and active factors. Otherwise, system (2) will not have a solution. Thus, the number of tools may be less than the number of goals. These are the outcomes we have in the practice of macroeconomic management and knowledge management.

The equation coefficient (2) will symbolize the strength of the influence of a factor or a specific tool, the effectiveness of which is determined by the movement towards the goal, the speed of this movement and the achievement of the goal, taking into account the cumulative effect of the tool.

Having presented the 'knowledge economy' in the form of a sector consisting of science, education and high-tech sectors of activity, we will show the principle of 'distributed management' within the framework of a theoretical scheme. It is reflected in Table 1.

**Table 1**

Distributed management at the macro level – knowledge economy

| Tools | Added value of the elements of the economy structure, which together give the sector of the 'knowledge economy' |           |             |
|-------|-----------------------------------------------------------------------------------------------------------------|-----------|-------------|
|       | Science                                                                                                         | Education | 'High tech' |
| 1     | +                                                                                                               | -         | n           |
| 2     | -                                                                                                               | -         | +           |
| ...   | -                                                                                                               | n         | -           |
| N     | +                                                                                                               | +         | n           |

In Table 1 '+' means (positive sensitivity of the element to the tool) such an application of the tool that leads to an increase in the added value of the element of the 'knowledge economy', '-' (negative sensitivity to the tool) means a distance from the goal, that is, a decrease in added value or the absence of its increase, 'n' is element of 'knowledge economy' does not respond to the tool. Macroeconomic policy measures (money supply, interest rate, budget expenditures, exchange rate, etc.), as well as measures to influence elements of the 'knowledge economy', in particular, stimulating the number of researchers, patents, the number of teachers, teachers, students at universities and schools, industry incentives for the introduction of high technologies, for example, digitalization and much more. All this can increase the knowledge economy, or not affect it, it all depends on the scale and effectiveness of measures in their combined application.

Table 1 reflects the current situation, which may change if a new, previously unused policy tool is introduced. Then it, like the system of equations, must be rebuilt taking into account such an introduction. This is especially true for the subsequent action of tools that dynamically change their strength. It also matters how this new tool will influence the government's measures already in place – to weaken or strengthen their effect.

The size of the 'knowledge economy' as a sector can be estimated by the amount of value added created  $Y$ , which consists of similar values for science, education and high-tech sectors. However, it is possible to assess the development of this sector from the perspective of other goals – income, risk, the number of researchers and graduates, the created scientific contribution, patents, etc. Thus, goals can be set that also depend on a certain set of applied and introduced management tools.

Thus, we can write the following:  $Y = \sum Y_i$  (from one to three according to Table 1); then  $Y_i = a_{0i} + a_{1i}I_1 + a_{2i}I_2 + \dots + a_{Ni}I_N$  ( $N$  is number of tools).

With regard to the goals, the number of which is  $K$ , for the  $j$ th option, we can write the following:  $K_j = b_{0j} + b_{1j}I_1 + b_{2j}I_2 + \dots + b_{Nj}I_N$ .

In practice, it may turn out that the goals are related, that is,  $Y = f(K)$ , where  $K$ , for example, is an increase in the number of researchers, which is relevant, in particular, for modern Russia. In other words, there is a task of increasing – expanding the knowledge economy, at the expense of science and technology, which is problematic to solve without increasing the number of researchers, which has been declining for many years. Having set goals, including structural elements (build-up, gross value added), it is possible to obtain a system of equations from which unknown values of instruments can be distinguished. Mathematically, the number of equations should be equal to the number of unknown tools, then the solution is not difficult. With the nonlinear nature of the equations, the solution can be obtained by numerical methods. With this formulation, optimization tasks are also possible, in particular, conditional optimization, which impose a framework for achieving some kind of optimum. This approach can be included as a block in the input-output method, overcoming its obvious (one of many) drawback when the calculation is based on direct costs – an assessment of their structure and relationship to the output structure. At the same time, it suggests the need to use and take into account policy tools, taking into account the 'cumulative effect' of policy and 'distributed management'. In addition, the elements of the knowledge economy

can show a certain coherence, which can be designated as.  $K_j = h(K_{j-1})$ , for  $j > 1$ . The cumulative effect can be estimated as follows:  $a_N > 0$  is positive cumulative effect,  $a_N < 0$  is negative cumulative effect,  $a_N = 0$  is neutrality.

Next, we will consider the main models of knowledge management, taking into account the possibility of reducing uncertainty – the risk of reproduction and dissemination, the use of existing knowledge at any management facility and for any scale.

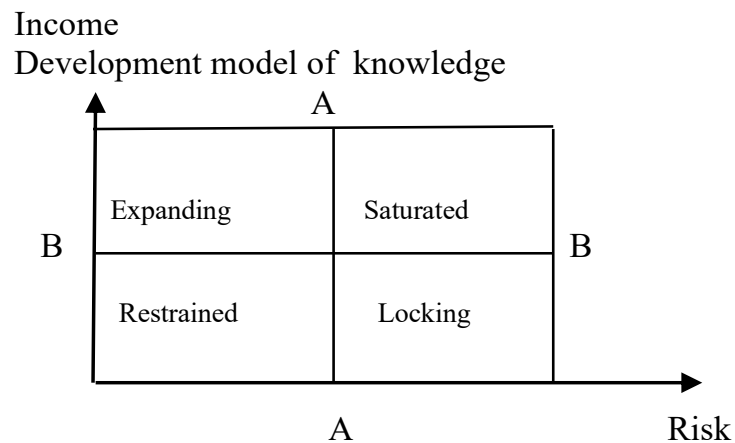
### 3. Discussion of the Results

Knowledge is even more heterogeneous than the objects of the economy, and they change faster and on a larger scale. In addition, the goal of developing specific knowledge may be vague, which increases the requirements for the selection of management tools. However, the known, acquired knowledge can be controlled in terms of expanding its application, increasing the coverage of this knowledge and practical implementation – embodiment in the form of a technology or product. The use of a particular tool that affects the introduction, dissemination of knowledge, or its transformation, unlike purely economic objects, is described with great difficulty by the amount of income and risk. The reason is that the profitability of a particular knowledge is not obvious and arises in the current mode of using this knowledge, and the risk arises from the influence of specific tools, but is different, which creates the problem of comparing the risk for the same or different types of knowledge. Even for standard economic objects, risk and income change along their trajectories, often unrelated. However, there may be situations that reveal a connection between the specified parameters.

It is generally believed that the growth of income is accompanied by an increase in the risk of receiving it. However, in relation to knowledge, creation or application, income may be absent in the primary time interval, and the risk may increase as well as decrease. Moreover, each result depends on many conditions and even the content of knowledge itself. If, in relation to standard economic objects, the goal may be to increase income with the least risk, maximize income and minimize risk, then with respect to knowledge, this statement does not work, since the goal is to obtain specific knowledge or apply the knowledge obtained, regardless of how income and risk will change. This is especially true in a situation where knowledge is highly relevant and without it is problematic to imagine the development of some kind of activity.

Figure 3 reflects general knowledge management models in situations where there is high or low income and risk. The models are separated by lines AA and BB respectively. The four basic situations of income and risk from knowledge management embody management regimes that are characterized by a set of tools designed to either stimulate income, reduce risk, or simultaneously affect both relevant parameters (income and risk).

With low income and the risk of applying knowledge, a model of restrained knowledge management is being formed. This forces the subject of management to look for opportunities to influence both income and risk, increasing the former, restraining the growth of the latter, assuming an established relationship between these parameters. With low risk and high income, there is a model of expanding with high income and risk of obtaining it, a rich knowledge management model is being formed. In this model, high income is reproduced in very risky conditions of applying knowledge, limiting the fact of using knowledge to further increase income. It is important to reduce the risk here. With low income and high risk, a model of locking development develops, since it is problematic to invest in knowledge that provides a high risk of application with a small income, and incentives for such activities are lost.



**Fig. 3.** Income-risk matrix knowledge management models

According to the models in Figure 3, the following are the best basic situations of income and risk changes in knowledge management:

- i. Growth of income and risk;
- ii. Income growth and risk reduction;
- iii. Reduced risk with the same income;

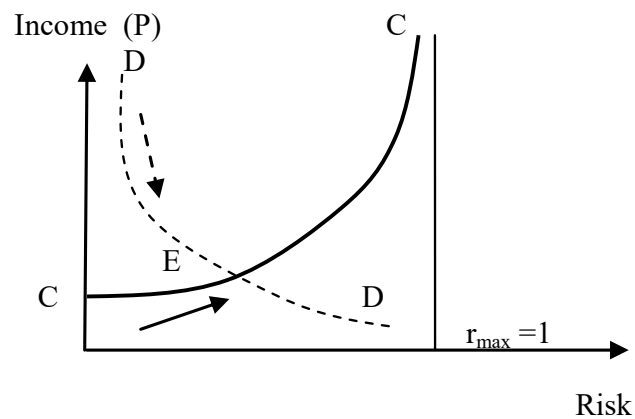
The second option is the most acceptable. However, in the reproduction of knowledge, as noted above, not only income is important, but also the content and purpose of the knowledge being created itself.

In general, it is necessary to look for tools that affect risk in the direction of its reduction, and income in the direction of increase (from the applied knowledge). However, the content of knowledge may not allow to reduce risk and increase income. Thus, the composition of the object and its structure brings standard estimates on the income–risk scale to a completely different plane [9]. It is necessary to distribute the tools according to the impact on knowledge itself, and only then on the income and risk from its application.

The change in income and risk for the economy/facility occurs differentially. In any case, the presented models are described exactly like this.

Note that the knowledge management models presented in Figure 3 assume that the tools affect income and risk separately, not to mention different types of knowledge. However, for a particular knowledge, it may turn out that the risk and income of its application may be related. However, this implies a lack of connection between income and risk. This should be taken into account when making decisions.

Assuming that these parameters are related for the same knowledge, situations arise when achieving one parameter may worsen the second parameter [9]. Figure 2 reflects the CC line of income growth with increasing risk, and the DD line of income decrease with increasing risk.



**Fig. 4.** Income-risk dependence options in relation to knowledge management

Knowledge management should be aimed at changing the law of the relationship between income and risk, which follows from Figure 4. If an ordinary economic object were considered, this would be achievable (not in all the same cases), but when knowledge is considered, it becomes impossible to provide such an influence to change the law of the relationship of parameters. This is a characteristic property of knowledge, and for each type of knowledge it manifests itself in its own way. Influencing knowledge in order to increase income with increasing risk is a completely natural outcome. However, reducing the risk of applying knowledge, if it also causes a decrease in income, cannot suit the subject of management. If the risk increases and the income does not increase, then the process of building knowledge and its application may stop according to such an economic criterion. Thus, in the field of knowledge management, it is important to take into account the change in relevant parameters characterizing the economy of knowledge creation and implementation.

Point E in Figure 4 is of interest, where income and risk are the same, but are given by different types of knowledge and management models, since Figure 4 embodies all the models of Figure 3. The power of tools according to the doctrine of 'distributed management' is different, but their influence can lead the economy to point E. From this point, it is advantageous to move along the EU line to the left, since income almost does not decrease, and the risk decreases significantly. The option of an increase in income and risk or a decrease in income with an increase in risk are the worst in this case, given the current elasticity of the curves shown in Figure 4. If the curves under consideration reflected the composition and content of knowledge, then it would be possible to assess how the structure of knowledge gives one or another combination of income and risk. Such a task can be described as promising within the framework of distributed management.

This example reflects the importance of 'distributed' management in achieving goals and meeting accepted criteria. The analysis using Figure 4 proceeds from efficiency, estimated as follows, We introduce an indicator of the efficiency of reproduction and use of k-type knowledge:  $E_c = P_k (1 - r_k) / Z_k$ , where  $P_k$  is the income from the k-type of knowledge,  $Z_k$  is the cost,  $r_k$  is the risk of using this type of knowledge. To increase efficiency with income growth, it is necessary to exceed the growth rate of costs (investments) and the weighted growth rate of risk. The weighting coefficient, in this case, will be equal to  $r/(r - 1)$  [9]. The vast majority of knowledge management models assume significant limitations due to the fact that 'distributed management' is not taken into account. Only it allows to choose the tools to which the goals are sensitive, capable of influencing the relevant parameters of the general economic plan and characterizing the object of management, in this case, knowledge. Thus, distributed management allows to see special risks, their relationship with income, the structure of knowledge and choose tools that can positively affect the change of these

parameters in their relationship. Modern approaches in the field of management do not allow to achieve the same result.

Considering the macroeconomic level of knowledge management, although the above statement is valid for any level of management, nevertheless, in the author's opinion, it is necessary to identify the sector of the 'knowledge economy', the development of which involves a set of different tools due to its heterogeneity and the differing sensitivity of the elements of the knowledge sector to the tools themselves (distributed management) [17]. Table 2 gives an idea of the differences in the interpretation of the 'knowledge economy' at the level of measurement, which cannot but affect the formation of policies that stimulate this economic sector, which is the backbone for the modern development of society.

**Table 2**

**Knowledge Economy - Differences in Measurement and Management Tools**

| Name of the measurement method   | Content of the measurement method                                                                                                                                                                                                                                                     | Disadvantages and advantages of identification are the dimensions of the 'knowledge economy'                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Management tools                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) According to Eurostat         | The 'knowledge economy' as an economic sector includes subjects and elements of the economy, where the number of employed persons with an established high educational level exceeds the established standard (33%), the type of activity entirely belongs to the 'knowledge economy' | A full measurement of the knowledge economy is carried out for employees with a certain level of education, but the disadvantage is that they do not represent the sector as such, since they are dispersed throughout the economy and many types of activities. The measurement is not accurate, because it is included in the knowledge economy, in particular, coke production, petrochemistry, etc., etc., since people with the specified educational level work in these types. Here there is a clearly overestimation of the 'knowledge economy'                                                    | They are aimed at increasing the proportion of educated people in each type of activity, with education above the established standard, constant retraining, transfer of experience, etc. This will increase the sector measured in the specified way                                                                                                                                                                                                                          |
| 2) Direct method (author's [16]) | The sector of the 'knowledge economy' is estimated by the value added created in three basic types of activities – science, education and high-tech sectors of the 'high tech' economy                                                                                                | The 'knowledge economy' is evaluated in its pure form by activities related to the generation – creation of knowledge (the field of science), replication and dissemination – education (here there is also a partial modification of knowledge) and the application of the most advanced knowledge in highly technological activities. The assessment is also not accurate, because knowledge is also used in other activities. Nevertheless, in its pure form, as a direct value-added method, it gives an idea of the scale of the relevant activities that make up the core of the knowledge economy.' | The instruments are aimed at the development of science, education and high-tech sectors, that is, they include scientific and technical, educational and sectoral policies. Within the framework of educational policy, it is appropriate to influence the expansion of the number of educated and competent workers, which increases the sector of the 'knowledge economy' according to the first measurement method and includes its tools within this management approach. |

As we can see from Table 2, management tools according to the second method of identifying the 'knowledge economy' are distributed systematically across sectors – science, education and high-tech activities, which implies distributed management for the development of science, education and knowledge-intensive types of work. There is only a problem of their coordinated application and determination of the cumulative effect of the goal on the tool, that is, the strength of the management tool acting on a specific goal or element of the economy has changed over time. When identifying the sector of the 'knowledge economy', according to the first Eurostat methodology, distributed management can be localized only for the purpose of building educated and competent personnel, which clearly gives a higher assessment when summing up such activities [17], moreover, the quality of training and education (knowledge) is not taken into account. According to the second author's assessment method (Table 2) of the 'knowledge economy', the size of the sector in terms of volume is usually less, making up some kind of pure (although not absolutely accurate) assessment of this type of activity. The 'goals-tools' approach in management in general and in knowledge management dominates both standard and classical, but the idea of distributed management, developed here and in other works of the author [17], has not a bad prospect, both at the level of knowledge macroeconomics and in organizations implementing knowledge management – at the microeconomic level. In addition to science and education, the innovation of the economy, the institutional regime, information and communication technologies, as well as the formed incentives for obtaining and introducing new knowledge are important for the knowledge economy development [18-20].

#### **4. Conclusions**

To summarize we formulate the most valuable conclusions.

Firstly, distributed management involves assessing the strength of the tools used, acting on specific goals and elements of the economy, in particular, 'knowledge economy' sector. In relation to specific knowledge, the use of this approach looks problematic, since it is not easy to identify those tools that will affect this type of knowledge.

Secondly, the macroeconomic analysis of the 'knowledge economy' allows to consider the situation in the 'income - risk' coordinates, despite the existing limitations of income and risk assessment. The overall management strategy should be aimed at increasing income, possibly with a time lag, and eliminating the risk of generating and implementing knowledge, taking into account the structure of specific knowledge and its content.

Thirdly, the identification of the 'knowledge economy' is important for the application of the doctrine of 'distributed management', since the option of representing this sector as a set of activities included in it allows for a more adequate application of the distribution of tools, weighing their impact on the structural elements of the 'knowledge economy'.

Thus, distributed management, unlike the classical 'goals-tools' method, is becoming a very promising form of change not only in macroeconomic management, but also in knowledge management, both at the macro and micro levels.

#### **Conflicts of Interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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