

**ECONOMICS OF SCIENCE: DETERMINING ITS OBJECT AND SUBJECT
(PRELIMINARY ANALYSIS)**

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Abstract

In the article, the author synthesizes issues relating to science, efficiency of research activities and production of scientific knowledge to a separate area of research – Economics of Science. It is presented as a field of study. Main differences and similarities Economics of Science in relation to other research areas, covering generation of knowledge and technology (Knowledge Economy, Education Economy), is described. There are formulations of Economics of Science conceptual apparatus, the object and the subject of Economics of Science studying.

Key words: *Economics of Science, Knowledge Economy, Education Economy*

INTRODUCTION

Gradual development of science as a field of human activity and the aggregate of accumulated scientific knowledge is a sign of the formation and evolution of post-industrial society, has the economy with such determinants as innovation, high-tech manufacturing, industry of science and technology.

The Russian Government is committed to such society development. Based on analysis of recent conclusions, decrees, orders, regulations and other directives of the country's leadership relating to science and technology policy, there is an understanding: structural changes both in the management and financing in the Russian science should be happening. The beginning of these changes has already been made: the Russian Science Foundation and the Federal Agency of scientific organizations were formed, the merger of RAS, RAMS and RAAS was produced. Institutional conversions is accompanied by goal-setting of improving of research activities performance outlined in state and federal programs.

Range of issues related to the development of science is expanding with appearing new tools and mechanisms for support of research activities. Task of researchers is a creative comprehension of ongoing and planned reforms in Russian science, search and justification of answers for their effective implementation. There is an idea that this work should be done in a separate area of study, but at first, it is necessary to give a name for it.

1. TOWARDS FORMULATING DEFINITION OF ECONOMICS OF SCIENCE AS A FIELD OF STUDY: ABOUT TRANSFORMATION OF THE SNIPPETS IN THE ELEMENTS

Every time when it comes to theories about the effectiveness, issues are being acquired an economic form, fall down, anyway, in the economic plane. Economy, according to the existing practice, in fact, is associated with “efficiency”, “illiberality”, “thriftiness”, “rationality”. By G.P. Zhuravleva, it is appeared in several values, forms: first, as a scientific discipline, aimed at the study of human activity, its laws and regularities, conditions and elements of production, individual industries and economic activities; secondly, as the national economy (economic system) as a whole; thirdly, as a historically constituted set of economic relations between people (Zhuravleva et al. 2003).

While working on this article, the greatest interest in the annex to the field of science was the first economy essence– economy as a scientific discipline.

Actually, understanding of that essence has led to idea of synthesize the various issues of production efficiency and economic rationality of science in a separate section, an area of research of economic theory.

Theoretical economics, is submitted monotonously by some authors, namely as a theory, aimed at exploring the foundations of economic life, the general principles of economics (Kuznecov 2010, Dushen'kina 2014). However, several researchers give definitions for this concept, deserved special attention.

Thus, in the collective work of VolSU scientists economic theory is interpreted as “the science of how people tend to use limited resources to produce goods and services *rationaly distributing* and exchanging it, trying to satisfy their *unlimited needs* in order to fully develop their capacities and capabilities” (Zagorul'ko et al. 1995). N.G. Mankiw gives similar, perhaps less widely, but at the same time, more inclusive definition of economics as a scientific discipline, and he represents it as “the study of how society manages its scarce resources” (Mankiw 2008). I.K. Stankovskaya and I.A. Strelec give another formulation, indicating that “one of the most important appointments of economic theory is to develop *optimization* models of behavior of economic agents” (Stankovskaya & Strelec 2011).

In identifying the essential characteristics of the Economics of Science (Esc) as a field of study, marking the individual elements of definitions of the economics given by different authors – limited resources, rationally distributing, limitless needs, optimization models - has important practical significance.

Following that analysis, a synthesis of excerpts taken from definition of economics (economic theory) allows us to formulate the definition of Esc most correctly. However, the use of each of them in the primary form, likely to be the simplification because of an original distinguishing features of science as a field of human activity. In particular, there is an assumption that the token “unlimited needs” will be not applicable because the task of science, in the broadest sense, is not to satisfy the needs of individuals, but is to seek opportunities to address the common challenges facing humanity.

That conclusion is supported by the study result of the contents of several science's definitions made by other researchers. According to them, science is presented as “a system of knowledge generated and developed as a result of special social activities” <...> thus its development is determined by the *needs of society*” (Alekseev et al. 2012); as “a system of concepts of the phenomena and laws of the external world or spiritual people activity, making a possible to anticipate and to transform reality in the *public interest*, historically evolved form of human activity, “spiritual production” (Aref'eva 2010).

One scientific work (Kochergin, Semenov & Semenova 1981) is separately devoted study of the science phenomenon as a form of spiritual production. There the authors, focusing on the philosophical and sociological aspects of science (according to them science is presented as a kind of human activities associated with obtaining scientific knowledge), write about the social essence of science follows: “It is essential to understanding of scientific labor as a *general public one*, as awareness of the social essence of cognitive activity <...> social nature of scientific knowledge is following: it is a *product of social labor*, and therefore it is the public domain and it has no value”. And although the question of value of scientific knowledge requires a new rethinking in today's market (it should be borne in mind the work of “Science as a form of spiritual production” was written by the authors at the time when there was no market economy in Russia, and there is a planning one (1981)), the conclusion of the researchers on the social nature of science is reasonable.

Given the positions of different authors, the conceptual element associated with the term “society” (“public”) is suggested as a part of a definition of ESc. Therefore, the passage “limitless needs” of the definitions of economics is proposed to replace to “social needs” or “needs of society”.

The above conclusion about the superiority of *the universally useful function* of science (science for society) over *the individual consumer one* (science for human) is not extremely. It may be objected by researchers of economic disciplines, especially who believe that human is driven by only his personal

needs and interests in any activity, and this question can be put to further discussion, but in the logic of this article, it is not resolved.

In view of the foregoing, it is proposed to define ESc as follows.

Economics of Science (ESc) *is a section, “branch”, a separate research area of economics (economic theory), aimed at study of rational use of science limited resources and efficient production of scientific knowledge for social (socio-economic) problems solving.*

That arises the concept, including the features of two spheres of human activity – economy and science, representing a single area of research aimed at studying of economic foundations of scientific activity.

2. OBJECT AND SUBJECT OF ESC AS A FIELD OF STUDY: HOMO ECONOMICUS IN SCIENCE AND ECONOMIC RELATIONS ARISING IN THE COURSE OF ITS ACTIVITIES

In order to define the essential characteristics of ESc as a field of study it's necessary submit its object and its subject.

The object (in relation to the process of knowledge in humanitarian and social sciences – *my note*) should be understood as “fragment of reality, objective or mental, aimed at the study of scientific cognition”, but the subject of a study could be “only a very limited object in its range” (Tyapin 2014).

While agreeing with that approach, let us initially define the object of economics (economic theory).

It is presented that is the person in the economy, homo economicus, economic agent, actor concerned with the production, distribution, exchange and consumption of the product in different industries and scopes of human activities.

Consequently, consideration of ESc as separate branch of economics, presumes that the **object of its study** should be identified *as human economicus in the science – scientist acting in the sphere of science and technology as a specific sector of economy, including the scientific and technological complex.*

The **subject of ESc** will be *the economic relations arising in the course of scientist (scientists)’s economic activity, aimed at the production of scientific knowledge and technologies.*

Subject’s detailing of ESc, allocation of its subject subsections is based on the following assumptions.

Working on this article I was studying paper and books of researchers, including the term “economics of science”, in particular, in the name of publications. It was assumed that scientists have made significant achievements in the field of knowledge, referred to us as “Economics of Science.” However, there are practically not scientific papers titled “Economics of Science”. For example, in the book “Economics of Science in Russia” it definitely mean “the knowledge economy”, and it “is characterized primarily by a constant increase in the share of R&D expenditure of the government and private firms spending” (Musatov 2014), but a concept’s definition of “Economics of Science” was not disclosed there. Probably the researcher equates the notion of “economics of science” and the notion of “economy of knowledge”, however, this approach appears to be incorrect because of some arguments, presented in the next part of this article.

Coming back to the question of analysis of works titled “Economics of Science”, it can be concluded that American authors have attained more significant results in formulation and report of this field of study.

In 2002 “Kluwer Academic Publishers” got out the book of American economists titled “The Economics of Science and Technology: an Overview of initiatives to Foster innovation, Entrepreneurship, and Economic growth” (Feldman, Link & Siegel 2002), including the next special paragraphs:

- Dimensions of R&D with paragraphs «Sources of Funding of R&D», «R&D Activity in Large and Small Firms», «R&D Activity by Geographic Location»;
- «The Patent System»;
- «Tax Incentives»;
- «Research collaborations»;
- «Infrastructure Technology»;
- «Labor Market for R&D Scientists and Engineers»;
- «Public Accountability».

In addition, the separate paragraphs of the paper are dedicated on such topics as entrepreneurship (The Entrepreneurial Process; An Integrated Entrepreneurial Process, Public/Private Partnership).

According to this list, we can conclude that the paper of the authors is structured on a wide range of economic issues: finance, taxes, patent law, which, at the same time are specified on the R&D sector. And the development of R&D researchers have linked with business opportunities, public-private partnerships.

The paper “The Economics of Science and Technology: an Overview of initiatives to Foster innovation, Entrepreneurship, and Economic growth” is useful primarily in terms of defining the content of ESc as a research area. And subsequent study of conceptual and methodological approaches, using in the book by the authors (I would just like to summon other researchers for that) can help to expand the possible field of study of ESc.

With reference to the foregoing, I think that the subsections of ESc should be focused on specific sections of economics (economic theory). At the same time, we must also take into account the existing progress in the disclosure of ESc issues (from American authors – The Economics of Science and Technology) produced by other researchers (Fig. 1).

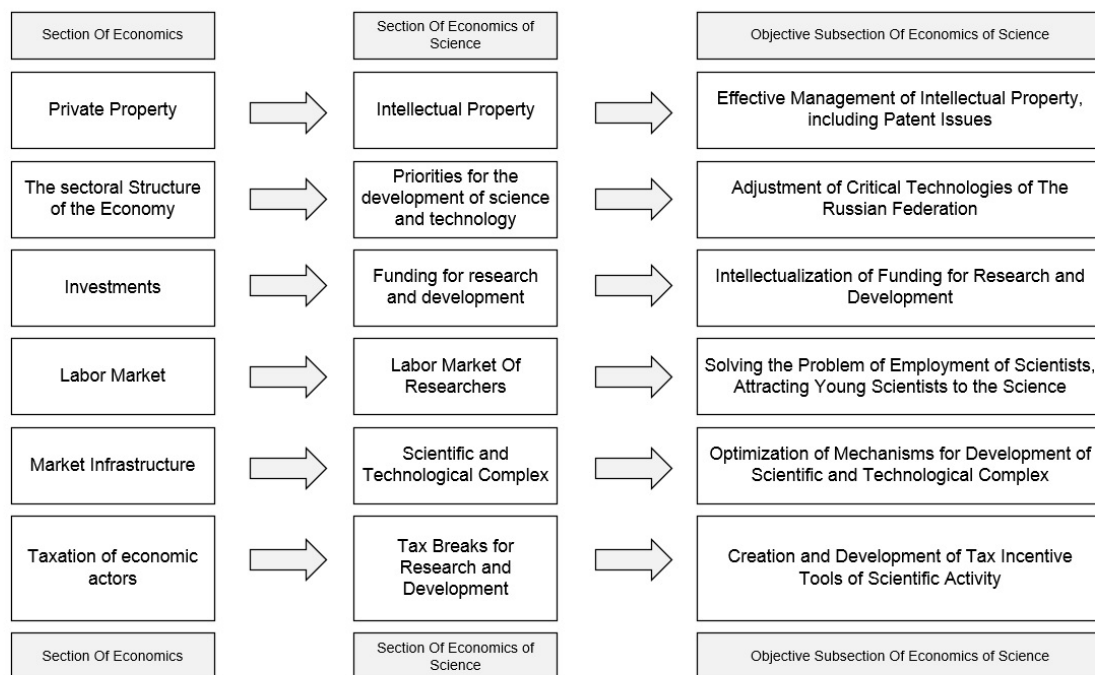


Figure 1. Transposition Economics (Economic Theory) sections in the ESc

3. ESC IN THE SYSTEM OF DISCIPLINES, AIMED AT THE STUDY OF KNOWLEDGE AND TECHNOLOGY GENERATION

Earlier, researchers were conducting the work on merging of economy and other research areas connected with processes of knowledge and technologies generation (reproduction). For example, it is known the works on such subjects as knowledge economy (Stepanova 2004, Zhurahovskij 2013, Shmulev et al. 2009, Maksakovskij 2012), education economy (Basovskij & Panin 2014, Anisovcev 2012, Alalykin 2012). Works of Kolesov's, Makarov's, Kleiner's are had wide popularity and practical application in Russia. In addition, there is an offer to studying economy of innovation as a separate discipline (in relation to the transport industry) (Podsorin 2012). In that regards, the question arises, what is the difference between ESc as a field of study and others areas of research proposed by other authors?

To understand that, it's necessary to address to the definitions contents of "science", "education", "knowledge", "innovations" and to its derivatives in relation to economy sphere: "economics of science", "knowledge economy", etc.

First of all, we will originally compare the contents of concepts definitions "science" and "education". In addition to above analysis of definitions of concept of science, the following should be noted.

In many sources definition of science is explained as the activity aimed at finding out a special type of knowledge. In particular, this concept is defined as "the special type of the cognitive activity aimed at development of objective, systemically organized and reasonable knowledge of the world" (Stepin 2000-2001); "sphere of human activity directed on new knowledge receiving" (Aref'eva 2010).; "field of the professional human activity with such main objective as gain new scientific knowledge" (A. Novikov & D. Novikov 2013).

As for definition of concept "education" it is presented as "familiarizing of the person to cultural values of science, art, morality, law. <...>; process and result of development of the systematized knowledge, allowing to occupy a certain niche in cumulative activity of society" (Aref'eva 2010); "process and result of assimilation of the general and specialized social experience by the person, systematized knowledge, abilities, and also public norms and values" (Belyakova & Matvejcheva 2009).

Therefore, science and education are represented as the fields of human activity connected with process of knowledge acquisition. Nevertheless, I think it is important to emphasize the next points about those two fields. The first one (science), is connected with critical analysis of various facts. It includes matters of disproving, verifying and supplementing of existing knowledge, formulating it in new forms, creating in fact a gain of total volume of knowledge in society (function –*general creating*). The second one (education) – is connected with transfer of existing knowledge from one subject of the public relations to another one. At that an ultimate aim of that transfer is always a person or a group of persons (function – *separately mediatorial*). As for issues of generation of technologies, the science is just engaged search of answers for understanding of objective reality, creation (justification) of technologies (theories, concepts, tools, mechanisms, samples, prototypes), promoting improvement of life for all society; the education resolves the issues of a person understanding of subjective reality, it develops outlook of the person, his competences. Nevertheless the process of the accomplishment of scientific and technological opening is carried out by the experts having the necessary qualification, skills. Education is actually solved the matters of acquisition for such skills by researchers.

Thus, science and education, as spheres of activity of society, generate knowledge, however, it is represented, that the science carries out this function *for all society*, and education – *for certain person*; generation of technologies both for all society and for certain person is based on scientific and educational activity.

Functional difference of science and education as the fields of human activity stipulates the distinction of studying objects and subject of ESc and Education Economy (EE).

The **object of ESc** is the scientist acting in the sphere of science and technology, including the scientific and technological complex (departments of postgraduate and doctoral studies of higher schools, research institutes, state scientific centers, science and technology parks, clusters, special economic technology and innovation zones, etc.).

The **object of EE** is manifested as a learner of the educational sector including the educational complex (comprehensive and specialized schools, departments of higher schools, centers of competences and development, etc.)

As for difference between **ESc and EE subjects of study**, in the first case it is the economic relations arising between the scientist and other subjects of economic activity during the production of the scientific knowledge expressed in results of scientific researches and R&D (scientific publications, patents); in the second case it is the economic relations in the course of production education products, namely – competences, skills required for the certain person for his vital activity, self-realization, and for performance of labor function in economy.

Above-mentioned difference of ESc and EE objects and subjects it should be noted their interrelation, interconditionality proved by many factors. For example, one of the principles of scientific and technological policy pursued in Russia is integration of science and education. Financial security of scientific activity are included the tasks connected with development both of science and education. It is difficult to imagine how can the budgeting of university postgraduate departments be carried out of the general estimates of universities expenses. Besides, there is the initiative about creation of small innovative firms focused on research development, on the basis of higher educational institutions, in Russia. These circumstances lead to idea about crossing of the fields of study in ESc and EE (Fig. 2).

Further let's provide some words on comparison of ESc and Knowledge Economy (KnE). According to other researchers "In spite of a plenty books and papers about a problem of knowledge usage in economy, now there is no unambiguous, exact and standard definition of the concept "knowledge" (Makarov & Kleiner 2007). "Formulation of comprehensive definition of this concept represents as a serious scientific problem", – the researchers write.

The definitions of concepts "science" and "education" outlined earlier in the article contain equally the term "knowledge" as fundament and base. Knowledge is result of science and education as separate fields of human activity. From here it would be possible to draw a conclusion that knowledge in a broad sense is a product of science and education, result of scientific and educational activity.

KnE is a difficult and ambiguous concept. Researchers of this question writes about KnE as the phenomenon, connected with feature of conducting economic activity in new conditions: "It displaces industrial and post-industrial economy based only on use of natural resources <...>. All that allows to consider the economy based on knowledge as special type of economy with sectors of a technological materialization of knowledge playing a crucial role, and with production of knowledge as a source of economic growth" (Kolesov 2008). Thus, according to approach of the researchers the KnE is represented as a new type of economic activity.

Coming back to the description of meaning of economy according to G.P. Zhuravleva, given at section 1 of the article, above definition of scientists corresponds to such substance of economy as the general system of managing. Whether it is possible to consider KnE as separate area of researches and if so, how is this field of study correspond to ESc?

It is possible to assume that the answer to the first part of the question – positive, and complexity, multidimensionality of KnE causes need of allocation it in separate scientific discipline which could become a new image of the economic theory.

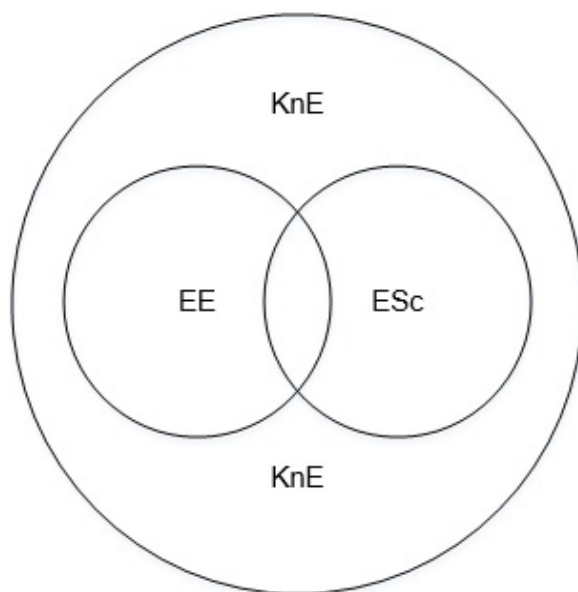


Figure 2. Structural and abstract large-scale ratio of separate fields of study connected with science and education; KnE – Knowledge Economy, EE – Education Economy, ESc – Economics of Science.

Comparing the ESc to such field of study as KnE it is necessary to allocate more narrower specialization of the first one, its specification on studying of development of scientific researches and increase of their economic efficiency.

As for **KnE**, it covers not only questions of science and its economic efficiency, but also questions of education and training, processes of receiving specialized knowledge, abilities, competences for society as a whole and for the certain person in particular. Thus, the KnE absorbs in itself both ESc and the EE (Fig. 2).

To define such field of study as economy of innovations, we will present definition of concept “innovations”.

Innovations are defined by the Russian federal law “About Science and the State Scientific and Technical Policy” as “a new or a considerably improved product (goods, service) or the process, a new method of sales or a new organizational method in business practice, of workplaces organization or of public relations”. In scientific literature the innovations be treated as “novation in a context of replacement for traditional forms of activity by new ones, organized by investment of capital in new development, realization of ideas and providing a know-how” (Aref’eva 2010).

Despite high popularity of the term “innovation” in scientific and business environments, in public authorities, unambiguous interpretation of it is still absent. Moreover, its usage in different contexts, in relation to different fields of human activity – industry, education, medicine, small business – leads us to idea of consideration for innovations as modern image of the economic development, one of its types. At the same time, the main essence of innovations as necessary, indispensable condition of economic development is lost.

I allow myself to assume, **innovations** is not a type of economic development (of nation, region, firm), but it is only and true driving force of that development allowing to be successful, advanced for it, solving problems of its competitiveness. Therefore, pertinently will be to give position of one Russian researcher who writes “innovations is a new way of the solution of a task (through overcoming,

achievement, a gain of...) (Vashchenko 2011). So economic development assumes existence of processes of overcoming, refraction, high-quality growth through innovations.

Whether it is correct to talk about economy of innovations as a type of economic activity and an area of scientific interests?

In a broad sense, innovations are an essence of economy, its contents. Nevertheless, considering economy of innovations in any values is unproductive and not constructive occupation. In this regard, inclusion that concept as a separate research area in system of the disciplines studying processes of knowledge and technologies generation is inexpedient.

INSTEAD OF CONCLUSIONS

For many questions in this article further efforts and study are needed both from scientists-theorists, and practitioners: the officials who are operating educational and scientific institutions, managers of state corporations, scientific and production associations and firms. In particular, it is necessary to separately study a question of formation for the categorical conceptual framework of ESc, and studies of justification about inclusion more important terms in it and of inapplicability others ones in it. Similarity of forms and contents, objects and methods of scientific pioneering on various subjects expands the field of study, however the amount of concepts used in researches are also being increased. Correctness of it is being deserved a close attention because it is reflected as the accuracy of scientific judgments, creation of hypotheses and its proofs. (Klypin 2010). For example, if such concepts as “scientific and technological complex”, “scientific and technological potential” reveal by researchers from the different points of view (Semenov 2013), and their definitions are represented quite reasonable, other important concepts which could be a part of economics of science, – scientific and technological capital, scientific and technological rent – are low-studied and unsolved.

REFERENCES

1. Federal Law of Russian Federation from 23th of August of 1996 № 127-FZ “*О науке и государственной научно-технической политике*” [About Science and the State Scientific and Technical Policy];
2. *Большая Российская энциклопедия* [Great Russian Encyclopedia]. Volume 22, 2013, Scientific Publishers «Great Russian Encyclopedia», Moscow;
3. Stepin, VS. 2000-2001, *Новая философская энциклопедия: в 4 т.* [New Encyclopedia of Philosophy: in 4 volumes], Internet version, Institute of Philosophy of the RAS, Nat. social.-scientific. Fund. Mysl, Moscow. Mode of access: <http://iph.ras.ru/elib/2011.html>;
4. Novikov, AM & Novikov, DA 2013, *Методология: Словарь системы основных понятий* [Methodology: The Dictionary of The Basic Concepts.], Book House “LIBROKOM”, Moscow;
5. Arefieva, GS 2010, *Философский словарь инженера* [Engineer’s Philosophic Dictionary], Publishing House MEI, Moscow;
6. Mankiw, NG 2008, *Ten principles of economics*. Mode of access: Google. Words of request: “mankiw principles of economics”;
7. Belyakova, A & Matvejcheva, O 2009, *Большая актуальная политическая энциклопедия* [Large current political encyclopedia], Moscow. Mode of access: <http://beliakov.net/polit/educ.html>;
8. Туарин, IN 2014, *Философские проблемы экономики: учебное пособие* [Philosophical problems of the economy: tutorial], VoSU, Vologda;
9. Vidyarin, VI, Dobrynin, AI, Zhuravleva, GP, Tarasevich, LS 2003, *Экономическая теория: Учебник* [Economic theory: Tutorial], Infra-M, 2003;

10. Zagorul'ko, MM 1995, *Основы экономической теории и практики: учебно-методическое пособие* [Fundamentals of economic theory and practice: a teaching aid], VolSU Publishing, Volgograd;
11. Stankovskaya, IK & Strelec, IA 2011, *Экономическая теория: Полный курс MBA* [Economic Theory: The Complete MBA course]
12. Alekseev, AP & Vasil'ev GG 2012 *Краткий философский словарь* [Short Philosophical Dictionary], RG-Press, Moscow;
13. Kuznecov, NT 2010, *Экономическая теория: Учебник* [Economic theory: Tutorial], Mart, Rostov-on-Don;
14. Dushen'kina, EA 2014, *Экономическая теория: конспект лекций* [Economic theory: lecture notes], Mode of access: Bookmate;
15. Makarov, VL & Kleiner, GB 2007, *Микроэкономика знаний* [Knowledge Microeconomics], E'konomika, Moscow;
16. Basovskij, LE, & Panin, VA 2014, *Экономика образования: Учеб. пособие* [Education Economy: tutorial], Infra-M, Moscow;
17. Anisovec, TA 2012 *Экономика образования и образовательного учреждения: учебно-методическое пособие (компендиум) [Текст]* [Economics of education and educational institutions: teaching manual (compendium) [Text]], Department of offset printing HSE, St. Petersburg;
18. Alalykin, AV 2012 *Экономика образования: учебное пособие* [Education Economy: tutorial], Tyumen State University Publishing, Tyumen;
19. Podsorin, VA 2012 *Экономика инноваций: учебное пособие для магистрантов по направлению "Экономика"* [Economy of Innovation: a textbook for candidates for a Master's degree in the direction of "Economy"], МИИТ, Moscow;
20. Kochergin, AN, Semenov, EV & Semenova, NN 1981 *Наука как вид духовного производства* [Science as a form of spiritual production], Novosibirsk;
21. *Цикл публичных дискуссий «Россия в глобальном контексте». Выпуск 15: Экономика знаний: контекст российский проблем* [A series of public discussions, "Russia in the global context" Issue 15: The knowledge economy: the context of Russia's problems];
22. Stepanova, TE 2004 *Экономика знаний: методологический аспект* [Knowledge Economy: methodological aspect], SSU Publishing, Saratov;
23. Zhurahovskij, SN 2013 *Экономика, основанная на знаниях, как объект экономического анализа* [Economy based on knowledge, as an object of economic analysis], Article in the collection of scientific papers "Knowledge Economy: Institutions and structures: Coll. scientific. P.", Institute of Scientific Information for Social Sciences of the Russian Academy of Sciences, Moscow;
24. Shmulev, GA, Steshina, ON, D'yachenko, ON, Kurakin, IV & Sedich', VV 2009 *Экономика знаний – новая парадигма экономической теории: монография* [Knowledge economy – a new paradigm of economic theory: monograph], BSTU, Bryansk;
25. Maksakovskij, VP 2012 *Экономика знаний* [Knowledge Economy], Smolensk: Universum;
26. Feldman, MP, Link, AN & Siegel, DS 2002 *The economics of science and technology: an overview of initiatives to foster innovation, entrepreneurship, and economic growth*, Kluwer Academic Publishers;
27. Musatov, A 2014 *Экономика науки России* [Economics of science in Russia.], Russian State Library;

28. Vashchenko, VP 2011 *“Еще раз о сути инноваций” [Once again about the essence of innovation], Almanac “Science. Innovation. Education”. 10th edition, Publishing house “Languages of the Slavic culture”, Moscow;*
29. Semenov, EV 2013 *Научно-технологическая сфера (сфера НИОКР): способы представления объекта [Sphere of science and technology (R&D sphere): some ways of presenting the object], Almanac “Science. Innovation. Education”. 14th edition, Publishing house “Languages of the Slavic culture”, Moscow;*
30. Klypin, AV 2010 *Соотношение категорий в теории взаимодействия экономики и природы [The ratio of categories in the theory of interaction between economy and nature], Herald of Volgograd State University. 9th Review, Research of Young Scientists, 8th edition, Part 2*