

# Scientific Herald of Uzhhorod University

Series "Physics"

Journal homepage: <https://physics.uz.ua/en>

Issue 56, 2299–2309

Received: 28.02.2024. Revised: 18.05.2024. Accepted: 29.06.2024



DOI: 10.54919/physics/56.2024.229or9

## Plagiarism in the scientific environment: Assessing economic losses, current problems and solutions in countering research falsification

**Nelli Akylbekova**

Kyrgyz National University named after Jusup Balasagyn  
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic

**Gulmira Nurlikhina**

Almaty Humanitarian-Economic University  
050031, 36 Momyshuly Str., Almaty, Republic of Kazakhstan

**Azyk Orozonova\***

Kyrgyz National University named after Jusup Balasagyn  
720033, 547 Frunze Str., Bishkek, Kyrgyz Republic

**Gulnar Dzholdasbayeva**

Almaty Technological University  
050012, 100 Tole bi Str., Almaty, Republic of Kazakhstan

**Gulzana Nazarkulova**

Diplomatic Academy of the Ministry of Foreign Affairs of the Kyrgyz Republic named after K. Dikambaev  
720040, 36 Erkindik Ave., Bishkek, Kyrgyz Republic

### Abstract

**Relevance.** The relevance of the study is determined by the importance of developing approaches to assessing the damage caused to the scientific community and society as a whole by manifestations of deviant behaviour at all stages of the scientific process. The problem of science development from the point of view of ambivalence of scientific principles and behaviour of individual representatives of the scientific community is considered.

**Purpose.** The main objective of the study is to develop a conceptual approach that allows for the assessment of economic losses caused by deviations from constructive behaviour in the process of scientific activity.

**Methodology.** The set of methods used in the research process is represented by the methods of deduction and induction, analysis, and synthesis, comparative and system analysis, elements of economic and mathematical modelling.

**Results.** The cases of unfairness in conducting research and their impact on reducing the level of trust in science have been studied. The formation of a conceptual approach to the assessment of economic losses as an important scientific task, the implementation of which is carried out using an economic-mathematical model, is substantiated. The proposed solution will make it possible to unify methodological approaches to the assessment of damage from the manifestation of deviations in science.

### Suggested Citation:

Akylbekova N, Nurlikhina G, Orozonova A, Dzholdasbayeva G, Nazarkulova G. Plagiarism in the scientific environment: Assessing economic losses, current problems and solutions in countering research falsification. *Sci Herald Uzhhorod Univ Ser Phys.* 2024;(56):2299-2309. DOI: 10.54919/physics/56.2024.229or9

\*Corresponding author



Copyright © The Author(s). This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (<https://creativecommons.org/licenses/by/4.0/>)

**Conclusions.** The problems are defined, the detection and identification of which is necessary for the development of recommendations aimed at counteracting the manifestation of deviations in science. The scaling of the proposed approach to the assessment of economic losses that are inflicted on society when the principles of intellectual honesty are violated in the process of conducting scientific research will ensure the strengthening of the positions of social, ethical and economic justice, will increase the level of trust in science.

**Keywords:** ethics; ambivalence; deviant behaviour; implicit zone; economic-mathematical model.

## Introduction

Science and innovation are the engines of the economy, so the debate about the quality of scientific research and academic work has not lost its relevance for several decades. All over the world, efforts are being made to improve the quality and credibility of scientific research results, adherence to the principles of scientific and information ethics at all stages of scientific activity. In the scientific community, the consequences of misconduct can be devastating, both for individuals and teams of researchers and for entire fields of research. In addition to the loss of time and reputational costs for individual scientists, evidence of intellectual dishonesty in science can attract the attention of the public through the media, with negative consequences both for particular aspects of society and for research areas or schools of science. These problems are due to the new formats of the relationship between science and society as a result of changing scientific, social, economic and political contexts. It is also necessary to take into account the plurality of authors involved in the evaluation of scientific discoveries and the formation of the scientific agenda. The process of generating new knowledge increasingly depends on the possibilities of commercialization of the scientific product, forecasts of its economic and social efficiency both locally and globally.

The interest of researchers in intellectual dishonesty and other manifestations of deviant behaviour in science, ambivalence of scientific ethos is not new; active discussions in this direction have been conducted since the last quarter of the 20th century. The earliest works devoted to the study of conditions that facilitate and accelerate or slow down the search for scientific knowledge are the works of R.K. Merton [1]. The study of R.K. Merton's research was several decades ahead of the outburst of scientific interest in fraud, plagiarism, and other forms of deviant behaviour in science. Written in the late 1930s and early 1940s, they remain relevant and influence all subsequent research in this area, which often extends and develops R.K. Merton's ideas or recognizes the significant influence of his work, such as S. Cotgrove and S. Box [2].

Much later, in 1965, R.K. Merton and N. Kaplan [3] published a paper devoted to the problems of ambivalence in science, which is still a relevant source of discourse in the 21st century. Various aspects of ambivalence are addressed in their publications by C. King [4], R. Marsh [5], G. Nicholas et al. [6], J. Bandola-Gill [7]. Keeping the focus on ethical ambivalence emphasizes its insurmountability at the current stage of development of the scientific community and society at large. Exaggerated expectations of scientific performance set the stage for ambivalence, and the pursuit of funding, rankings, and status in the scientific community only exacerbates the problem. The diversity of methods, tools, and practices at the disposal of scientists also creates conditions for them

to violate the principle of epistemic equality, ethical norms and obligations, and the terms of the social contract. Future scientists face similar problems, e.g., I. Tindall et al. [8] investigated the relationship between students' negative emotionality and their involvement in plagiarism. The influence of cultural traditions on the predisposition to display deviant behaviour in the process of scientific research is reflected in the works of K. Dierickx et al. [9], C. Grondin et al. [10], D. Li and G. Cornelis [11].

The discussion around the assessment of damage caused as a result of intellectual dishonesty or other manifestation of deviant behaviour in science focuses more on the problems of identifying and preventing violations of ethical norms, describing the qualitative parameters of the harm caused, and developing recommendations for levelling negative consequences. B. Halak and M. El-Hajjar [12] devoted a study to the development and evaluation of methods to prevent and detect plagiarism in education. However, the practical application of the mentioned methods is limited to the academic environment and has no prospects for adaptation in academic research. K. Tiidenberg [13] raises the problem of the difficulty of creating universal, out-of-context ethical norms that will ensure ethical behaviour of researchers. The author notes that in practice, many guidelines turn out to be "ill-equipped to deal with the complex ethical dilemmas faced by qualitative and internet researchers". Obviously, the focus of attention is on the problems of attitudes towards plagiarism and other forms of deviant behaviour in science; on issues of their detection and prevention. Less studied are the problems of assessing and redressing deviant behaviour in science.

Given the damage to society caused by the violation of intellectual honesty in the process of conducting scientific research, the formation of an approach to the assessment of economic losses is an important scientific task. In this regard, the aim of the study is to formulate a universal approach to the assessment of economic losses due to various manifestations of deviant behaviour in science, the adaptation of which will allow obtaining comparable data on the amount of damage caused. The main tasks solved in the course of the study include:

- clarification of definitions, reflecting the diversity of deviant behaviour in scientific activity and the variability of violations as a result of manifested bad faith and intellectual dishonesty in science;
- expanding the classification of plagiarism as a phenomenon violating scientific ethics by species;
- formation of a conceptual approach to the assessment of economic losses as a result of deviations in science;
- development of recommendations aimed at counteracting falsification, forgery, and plagiarism in the process of preparation and conduct of scientific research, design, and publication of its results.

## **Materials and Methods**

In the process of the study, a set of methods was applied, the use of which allowed achieving the goal in the most rational way. Deductive and inductive methods were applied in generalizing the results of the study of the level of trust in science and in forming hypotheses about the interdependence of the level of trust in science and the level of socio-economic development of the country. These methods were also used in clarifying and expanding the grounds for classifying plagiarism, in creating a scheme reflecting the multiplicity of results of deviant behaviour in science.

The methods of comparative and system analysis were applied in substantiating the feasibility of using the definition “deviant behaviour in science” and comparing its content with those presented in other scientific studies. These methods were also used to expand the classification of plagiarism by new types of attributes, and helped in forming the conditions necessary and sufficient for the creation of a conceptual model of damage assessment from deviant behaviour in science. These methods were applied in developing recommendations aimed at counteracting falsification, forgery, and plagiarism in the process of preparation and conduct of scientific research. Lastly, these methods were used in developing a conceptual approach to assessing economic losses due to various manifestations of deviant behaviour in science. Elements of economic and mathematical modelling were applied to create a conceptual approach to assessing economic losses due to various manifestations of deviant behaviour in science by solving the problem of building an economic and mathematical model.

The study was conducted in several phases. At the first stage, a categorical and conceptual framework was outlined, reflecting the content of the categories and definitions used in the study. Data on confirmed cases of research ethics violations are provided based on open-source information published by the United States Office of Research Integrity (ORI) [14–16]. The results of the Wellcome Trust (2018 and 2020): Wellcome Global Monitor 2018 [17], Wellcome Global Monitor 2020: Mental health [18] surveys are presented. The system reflecting the multiplicity of the results of deviant behaviour in science is formed, with the allocation of the implicit zone, the presence of which is a key element of the system and emphasizes the need for targeted efforts to identify the results of deviant behaviour at all stages of scientific activity. V.I. Levin’s [19] classification of plagiarism is supplemented with three new species features.

At the second stage, the analysis of studies that present methods for assessing damages resulting from unethical behaviour of representatives of the scientific community was carried out. To assess economic losses due to deviant behaviour in the process of scientific activity, the use of economic and mathematical modelling method is proposed. The sequence of development of the economic-mathematical model includes:

- defining a list of deviations (e.g., plagiarism, falsification, fabrication);
- determining the level of seriousness of the identified misconduct in terms of the harm caused (e.g.,

self-plagiarism or compilation of previously published scholarly work);

- determination of the average annual pre-tax income of a person found to have deviant behaviour (it is suggested to calculate the indicator for the last 3 or 5 years);
- formation and registration in the form of a sign economic-mathematical model of dependence reflecting the amount of economic losses subject to compensation due to deviant behaviour in science;
- formation and execution of dependencies for each type of deviations that affect the amount of economic damage;
- determination of the calculation methodology and the range of values of the indicator reflecting the seriousness of the detected violation (deviation) in terms of the damage caused. The proposed methods for solving this problem include the use of weighting coefficients according to the scale established for certain types of violations (deviations), or construction of optimization models reflecting the level of responsibility for each type of violation.

At the final stage, on the basis of the results obtained earlier, conclusions were formulated, allowing the use of the proposed conceptual approach to the assessment of economic losses due to deviant behaviour in the process of scientific activity by solving the economic-mathematical model. The expediency of continuing research in this direction is substantiated, it is determined that the amount of compensation calculated with the help of the proposed model will make it possible to move away from the formal approach to the issue of damage compensation.

## **Results**

In the process of science development, not only the scientific picture of the world changed, but also the style of scientific thinking. By the mid-20th century, the essentialist approach based on positivism was replaced by the existentialist approach of postpositivism, which investigates scientific knowledge in dynamics and reveals the forms of knowledge development. The scientific environment, creating prerequisites for the emergence of a scientific product, should provide institutional conditions for the full realization of scientific potential. However, information about research that violates the principles of information ethics and has signs of bad faith in the process of conducting the research itself and publishing its results, indicates the presence of serious institutional dysfunctions.

The low level of public trust in science is the result of, among other things, confirmed cases of scientific ethics violations. The potential danger to society from the use of scientific results obtained through elements of data manipulation, falsification, or forgery is very high. The United States Office of Research Integrity (ORI), whose mandate includes the development of procedures related to the analysis and prevention of research misconduct, makes information about identified misconduct publicly available on an ongoing basis. For example, in August 2022, the ORI website published data on three cases of misconduct by scientists whose research was funded by various government and donor programmes [14–16]. These are summarized in Table 1 for reference and to form an opinion on the possible extent of the damage caused by the

failure to identify the misconduct of the academics mentioned above.

**Table 1.** Data on incidents of scientist misconduct published by ORI in August 2022

Surname, first name, patronymic, position, place of work	Sources of funding	Data on misconduct
Stuart G. Jarrett PhD, University of Kentucky, former Assistant Professor, Department of Toxicology and Cancer Biology and Cancer Center, University of Kentucky College of Medicine.	U.S. Public Health Service (PHS), specifically the National Cancer Institute (NCI), National Institutes of Health (NIH). National Centre for Advancing Translational Sciences (NCATS), National Institute of Environmental Health Sciences (NIEHS).	Deliberately, knowingly or recklessly falsified and/or fabricated Western blotting and histological image data relating to mechanisms of protection against melanoma by reusing, relabelling and manipulating images or using blank panels to falsely report data in twenty-eight (28) figures included in four (4) published PHS-supported papers, one (1) funded PHS grant application and two (2) unfunded PHS grant applications.
Deepak Kaushal PhD, Professor and Director, Southwest National Primate Research Center, Texas Biomedical Research Institute (TBRI).	U.S. Public Health Service (PHS), specifically the National Institute of Allergy and Infectious Diseases (NIAID), National Institutes of Health (NIH).	Deliberately, knowingly and/or recklessly falsified and fabricated experimental methodology to demonstrate results obtained under various experimental conditions that were included in the following one (1) published article and two (2) grant applications.
Janina Jiang MD, PhD, former Research Assistant, Department of Pathology and Laboratory Medicine, David Geffen School of Medicine, University of California (UCLA), Los Angeles.	U.S. Public Health Service (PHS), National Cancer Institute (NCI), National Institutes of Health (NIH), National Centre for Advancing Translational Sciences (NCATS).	Knowingly and recklessly falsified and/or fabricated flow cytometry data that was included in eleven (11) grant applications submitted for PHS funding.

**Source:** compiled by the author based on ORI data [14–16].

With the considerable body of evidence on ethical misconduct, antisocial behaviour, and intellectual dishonesty in the conduct of research and in the publication of its results, it is reasonable to believe that “anyone who behaves in this way puts their research career at risk and threatens the overall reputation of science and the health and well-being of the intended beneficiaries of the research” [20]. This is not so much about the resources devoted to research as it is about the potential dangers of continuing work, *in vitro* and *in vivo* experiments. Cases of misconduct and bad faith are not isolated. O.P. Sharma [21] published a study summarizing several cases of scientific ethics violations identified in 2002-2014. The most extensive studies examining, among other things, the level of public trust in science were conducted by the Wellcome Trust in 2018 and 2020: the Wellcome Global Monitor 2018 [17], Wellcome Global Monitor 2020: Mental health [18]. The study surveyed 140,000 people in 140 countries around the world, and as a result only 18% reported a “high” level of trust in science, with 54% having a “medium” and 14% a “low” level of trust in science; 13% did not answer the question. The published data confirmed that levels of trust in science are higher in developed countries.

The data presented show that the scientific community is under great pressure. Scientific development is cumulative and self-correcting. Every newly discovered truth is a step higher on the ladder of scientific development. Science should be original and innovative, but even talented scientists are hampered by high standards

of scientific ethics. The magnitude of the problem can be seen in information about the recall of four articles from the Proceedings of the National Academy of Sciences (PNAS) by G. Semenov, a Johns Hopkins University researcher who won the 2019 Nobel Prize in Medicine and Physiology [22]. As part of the objectives of this study, let us specify definitions that reflect the range of misconduct that is detectable and identifiable as the result of bad faith, intellectual dishonesty, and violations of scientific and information ethics.

In the scientific and academic environment, assessing the behaviour of a researcher at all stages of scientific activity as a set of actions, it is necessary to clearly define what is the norm and what is deviation, i.e., deviation from the norm. The problem of deviant behaviour in science has been raised in scientific circles since the mid-20th century [23; 24] and has not lost its relevance in the 21st century [25]. However, in the last two decades, deviations from the norm in the conduct of scientific research are less often defined as deviant behaviour, more often using the terms: antisocial behaviour [26], violation of scientific ethics [27], intellectual dishonesty [28], scientific dishonesty [29]. However, it is the definition of “deviant behaviour in science”, on the one hand, includes all possible types of violations from the point of view of ethics, morality, traditions, historical context, on the other hand, clearly limits such behaviour to acts related exclusively to the stages of scientific activity. The closest interpretation of deviant behaviour in science is presented in the work, where deviant behaviour in scientific activity is proposed

to be considered as all acts that are the opposite of constructive behaviour, consisting in compliance with ethical norms, norms of scientific and information ethics, including manifestations of bad faith and intellectual dishonesty in science [25].

Deviant behaviour in science will reflect the value system in a particular scientific community and may not be completely identical to the value system accepted and shared by members of other scientific and academic communities. In the scientific space there is a gradual unification of standards, ethical norms and rules, the violation of which is condemned and treated as a deviation from the norm. But the issues of defining and regulating ethical norms in science are still debatable, and the establishment of a system of moral norms and principles in some scientific and academic communities faces opposition, is ahead of time or lags behind.

An example of such a situation is an experiment conducted in China [30; 31] that resulted in the punishment of scientist Jiankui He's. The ensuing coverage of the unethicity of the research conducted generated debate

and led to the withdrawal of research by Chinese transplant scientists [32–35]. The importance of recall of published research findings has been justified in W. Bülow [36] and A. Caplan [37]. A comparison of attitudes towards plagiarism by biomedical researchers is presented in K. Dierickx et al. [9]. Issues of differences in perceptions of research misconduct based on cultural context are presented in C. Grondin et al. [10], D. Li and G. Cornelis [11]. In this way, robust debate has provided a cleansing opportunity where unanimous condemnation of ethical misconduct by the scientific community, open discussion leaves no room for ignoring such issues.

Considering deviant behaviour in science as an act or omission that leads to false or distorted scientific results, violates basic research standards and core social values, or provides misleading information about an individual's contribution to research, a schematic representation of the variety of outcomes of such behaviour is provided. A framework reflecting the diversity of outcomes of deviant behaviour in science is presented in Figure 1.

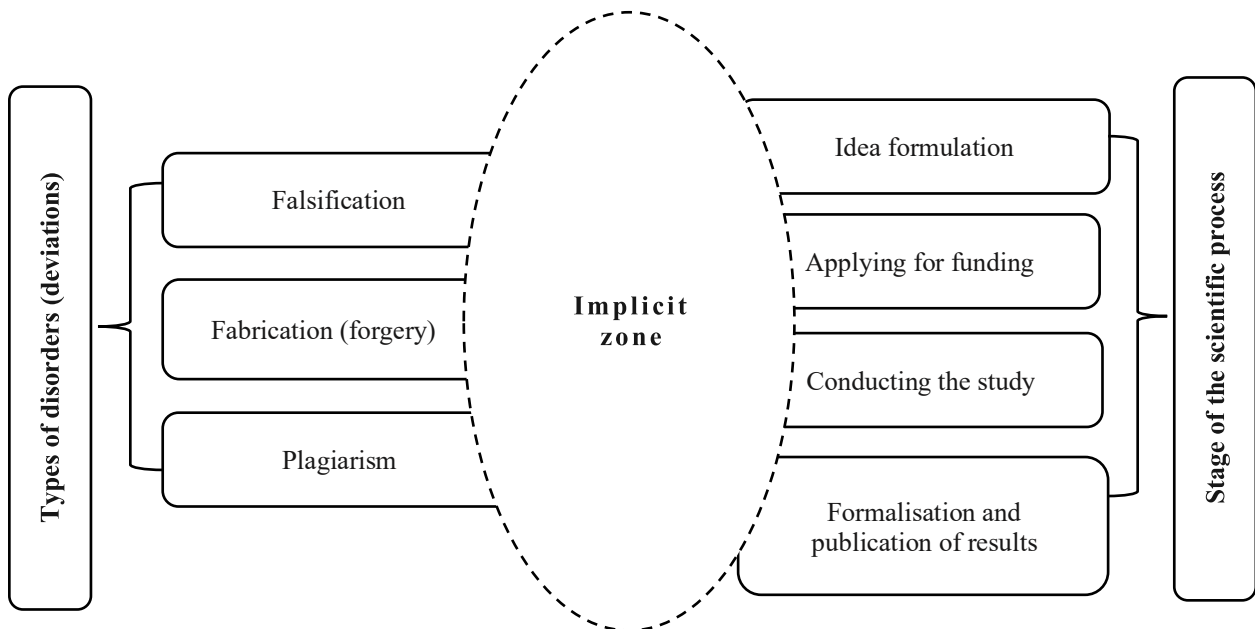


Figure 1. A framework reflecting the multiplicity of outcomes of deviant behaviour in science

The implicit zone emphasizes the need for targeted efforts to identify the results of deviant behaviour at all stages of research activity, and also reflects the multiplicity of possible options. The schematic representation of the system provides for the possibility of its detailing to the required level of accuracy. In addition to the results reflected in the scheme, deviant behaviour in science can manifest itself in coercion to co-authorship and unauthorized access to unpublished scientific papers by third parties. In a study by O.P. Sharma [21], Machiavellianism and self-promotion at the expense of team members are also named in an extension of the list of already mentioned deviant behaviours in science. The problem of ghostwriting [28] is difficult in terms of gathering evidence and assessing the damage caused, the issues of authorship and publication, which form only a part of it, are covered in the study of E. Kharasch et al. [38].

It is beyond the scope of this study to clarify and expand the range of violations that represent the result of deviant

behaviour in science; we note only that there are many variants of such manifestation. For example, fabrication may consist in “fudging” experimental data, referring to experiments that have never been conducted; falsification of data may consist in deliberately altering research results, methods, or procedures to achieve desired results. A special case of falsification is simulation, which results in “scientific knowledge” as a consequence of an imaginary experiment. The approach according to which unintentional or accidental errors and proven facts of deviant behaviour in the process of scientific activity are distinguished in science is generally accepted, but there are studies that also distinguish a “grey zone” [25]. According to the authors, the “grey zone”, or the area between common errors and apparent intellectual dishonesty, contains phenomena that are not clearly defined and evaluated.

Acknowledging that the allocation of three groups of errors due to the presence or absence of intent may be

justified by the research objectives, in this paper we will consider the results of deviant behaviour as consequences of acts committed consciously and purposefully at any of the stages of the academic process. Thus, violation of academic rules and norms of scientific ethics is firstly a crime.

The consistent solution of the research tasks provides for the expansion of the classification of plagiarism as a phenomenon violating scientific ethics by species. One of the most comprehensive classifications of plagiarism is presented in the work of V. Levin [19]. Classification features highlighted by the author:

- the nature of copyright infringements;
- volume of borrowings;
- execution technology.

It is proposed to supplement the classification presented by V. Levin [19] with a feature reflecting the intention, with the allocation of separate types associated with negligence or real intention to mislead, deceive the scientific community and the public. Through the prism of intent, the problem of plagiarism is investigated, but it seems appropriate to unify approaches to the classification of this phenomenon.

The next classification attribute is the stage of the scientific process. According to this feature, it is proposed to distinguish such types as: plagiarism of ideas and/or concepts; plagiarism accompanying an experiment; plagiarism of publications; plagiarism of a scientific product or knowledge. According to the degree of novelty of scientific knowledge and the sphere of dissemination, we propose to distinguish qualification works performed in the process of education; plagiarism of scientific works confirming qualification; plagiarism of scientific works claiming scientific discovery. The expediency of expanding the classification and specification of types of plagiarism in the paper is due to the possibility of their further use to demonstrate the universality of the proposed approach to the assessment of economic losses as a consequence of certain types of deviant behaviour.

The task of forming a conceptual approach to the assessment of economic losses due to deviant behaviour in the process of scientific activity can be solved using an economic-mathematical model that takes into account the types of deviations (e.g., plagiarism, falsification, fabrication), the severity of the identified violations (e.g., self-plagiarism or compilation of previously published scientific work), the average annual level of pre-tax income of a person found in deviant behaviour for the last 3-5 years. Then the economic-mathematical model will have the form (1-4):

$$T = F(C_{\text{plagiarism}}; C_{\text{falsification}}; C_{\text{fabrication}}), \quad (1)$$

$$C_{\text{plagiarism}} = F(p_i; x_i; Y), \quad (2)$$

$$C_{\text{falsification}} = F(\text{fals}_i; x_i; Y), \quad (3)$$

$$C_{\text{fabrication}} = F(\text{fabric}_i; x_i; Y), \quad (4)$$

where: T – total compensation for damage – amount of economic losses to be compensated due to deviant behaviour in science; Y – average annual level of pre-tax income of the person found in deviant behaviour (for the

last 3 or 5 years); i – serial number of the detected violation (deviation) taken into account in the model building;  $x_i$  – indicator reflecting the severity of the detected violation (deviation);  $C_{\text{plagiarism}}$  – plagiarism compensation – amount of compensation for plagiarism;  $p_i$  – amount of compensation for i-th case of plagiarism;  $C_{\text{falsification}}$  – falsification compensation – amount of compensation for falsification;  $\text{fals}_i$  – amount of compensation for i-th case of falsification;  $C_{\text{fabrication}}$  – fabrication compensation – amount of compensation for fabrication;  $\text{fabric}_i$  – amount of compensation for i-th case of fabrication.

The indicator reflecting the seriousness of the detected violation (deviation) can be calculated using weighting coefficients according to the scale established for certain types of violations (deviations), or on the basis of building optimization models reflecting the level of responsibility for each type of violation. In the process of solving the model, formula (1) can take the following form (5):

$$T = C_{\text{plagiarism}} + C_{\text{falsification}} + C_{\text{fabrication}}. \quad (5)$$

The proposed conceptual approach to the assessment of economic losses due to deviant behaviour in the process of scientific activity can be optimized by identifying a smaller range of violations (deviations) than represented in the model. The solution of the economic-mathematical model will make it possible to obtain comparable data to continue research in this direction. The amount of compensation calculated with its help will make it possible to move away from a formal approach to the issue of compensation for damages to representatives of the scientific community whose rights have been violated.

Consideration of issues related to the assessment of economic damage caused to the scientific community by its individual representatives would be incomplete without examining the current problems and options for countering deviant behaviour in science. As a rule, there are several aspects reflecting the current state of the plagiarism problem: technological, socio-cultural, personal, and psychological. The legal aspect of the consequences of deviant behaviour in science is usually considered separately, in isolation from the general context, relying on the legal framework and case law of a particular state. The influence of economic and political aspects on the state of the problem is less often raised in scientific works.

Assessing the current state of problems associated with deviant behaviour in science, we consider it appropriate to group the main reasons provoking undesirable consequences for the scientific community as follows: ethical, socio-cultural, technical, and technological, economic, legal, institutional, political. It is worth stating that solving the problems of plagiarism, falsification, and other manifestations of deviant behaviour in science requires the development of solutions that can slow down their spread in the academic and scientific environment. An important step on the way to prevent deviant behaviour in science can be:

- increasing the level of intellectual and social capital, both at the level of the individual organization and at the level of the academic and scientific community;
- creating the necessary and sufficient institutional conditions to prevent deviant behaviour in science;

- strengthening legal and economic accountability for proven cases of deviant behaviour in scientific research;
- fostering a culture of academic honesty and integrity in the academic and scientific community, and raising standards of teaching quality;
- cultivating values of negative attitudes towards plagiarism, falsification and other types of dishonest behaviour in science.

## **Discussion**

In the process of development of science, the style of scientific thinking changed and trust in the results of scientific labour was formed. However, the problems of ethics and antisocial behaviour, typical for any society, were also manifested in the scientific environment. Norm and deviant behaviour in science were actively studied in the late twentieth century [23; 24]. The development of research in this direction revealed a contrast between societies with strong norms and low tolerance for deviant behaviour and societies with weak norms and high tolerance for deviant behaviour [39]. The chronology of research ethics as interpreted by D.B. Resnik [40] allowed seeing the signs and manifestations of ambivalence on the example of individual events in the history of science, covering the period from 1620 to 2020. Despite the fact that many studies have abandoned the interpretation of ethical violations in science as deviant behaviour, we believe it is reasonable to adhere to this definition as it more accurately reflects its essence.

The use of the definition “deviant behaviour in science” in the research process is substantially justified and allowed covering all possible types of violations in terms of ethics, morality, traditions, historical context, which are allowed at different stages of scientific activity. A close in content characteristic of deviant behaviour in science is given in the work of S. Nikolić et al. [25]. Thus, it was possible to reflect that the problems of ethics in science go far beyond individual cases of falsification, fabrication of data and plagiarism, and are relevant for all stages of scientific activity, and the causes of violations are often found in the previous events. An example is the relationship between academic honesty and ethical behaviour in future professional life. J.G. Guerrero-Dib et al. [41] present the results of a study reflecting the situation in Mexican universities. The authors note a rather low level of academic integrity in Mexico, justifying the importance of promoting academic integrity in universities for several purposes. Firstly, the need to obtain the knowledge and skills necessary for a particular profession. Secondly, the need to develop skills of ethical behaviour and awareness of the importance of ethical standards in the decision-making process.

Attitudes towards different forms of scientific dishonesty among postgraduate students at major medical faculties in Sweden and Norway are presented in the work by B. Hofmann et al. [29]. The studies found a high level of willingness to report misconduct, but little awareness of relevant policies on scientific behaviour. Some forms of scientific misconduct were considered acceptable by a significant minority, which distinguishes the data from Sweden and Norway from those from Mexico and other less developed countries. Issues of research malpractice in India are presented in the work by I. Palla and M. Singson

[42]. They note the increase in identified cases of deviant behaviour in scientific research, the large amount of evidence of misconduct confirmed by qualitative and quantitative methods, the need to develop a strategy aimed at identifying deviations in science and the development of preventive measures to combat them.

In support of the previously discussed hypothesis about the relationship between weak public support for ethical norms and high tolerance of deviant behaviour, the results of the study by A. Albayatey [43] are relevant. In this research the problems of quality of scientific research in colleges of the University of Baghdad and methods of combating manifestations of antisocial behaviour in the process of research are studied, including the proposed wider use of software to detect violations. The author presents the results of the impact of plagiarism on the quality of scientific research at the University of Baghdad, formulating conclusions about the lack of interest in the use of methods to detect scientific plagiarism in research, the presence of problems with morality and scientific integrity. In contrast to the previously reviewed works, this study focused on the problems of scientific ethics observance by teachers and scientists, thus confirming the hypothesis of higher incidence of dishonesty in countries and regions with a lower level of socio-economic development.

W. Stommel and L. Rijk [44] contributed to the discussion of ethical behaviour in online data research, which is important for understanding contemporary communication and social life. The authors conclude that there is a mismatch between research ethics in “theory” and “practice”. Arguments in favour of research ethics when the Internet is the subject of research or only a tool are presented in the paper [45]. However, advances in science and technology only intensify the struggle for resources and competition in the scientific environment. It should be noted that there are cases when manifestations of intellectual dishonesty are timely detected, but even in such situations it is not always possible to stop the publication of materials that violate copyright and rules of scientific ethics. Z. Shahreki and E. Rakhshani [46] published articles with signs of falsification and plagiarism. Timely appeal to the editorial office of the journal did not stop the publication of materials, did not provide verification of the facts presented and review of the works [47; 48].

Reputable journals usually use special software packages to detect plagiarism and adhere to high standards when publishing manuscripts. Maintaining the reputation of a scientist depends not only on the observance of ethical standards, but also on the careful choice of venues where the results of research are planned to be published. An encouraging result is the experience summarized in the work by S. Shimray [49], who analysed 157 scientific articles on COVID-19 that were withdrawn for various reasons. In addition to considering the full range of disorders resulting from deviant behaviour in science, it is important to assess the possible origins of the current state of the problem. The scheme proposed in this paper, reflecting the diversity of results of deviant behaviour in science, the allocation of implicit zone in it and the possibility of its further detailing depending on the objectives of the study, allow us to use it as an auxiliary

tool in the process of solving the problems of damage assessment. The same purposes are served by expanding the classification of plagiarism as a phenomenon that violates scientific ethics by additional species characteristics.

There is a paucity of research on a comprehensive assessment of the damage caused by deviant behaviour in science. In reviewing the impact of one of the most notorious “misguided” research programmes on its participants, A.M. Diamond [50] concludes that scientists experienced significant lost financial losses, which he estimates at between \$13.000 and \$19.000. However, the damage to society caused by ethical breaches by scientists is not only measured in terms of the loss of time and reputation of individual members of the scientific community, but is also accompanied by a decline in the credibility of science. In this regard, it is important to develop approaches to assessing the damage caused by deviant behaviour and to find ways to recover such damage.

The conceptual approach proposed in this paper expands the possibilities of researching this problem and provides tools for its gradual solution. The use of economic and mathematical modelling allows, on the one hand, to unify the process, on the other hand, provides a wide range of opportunities for solving the set tasks in different ways. Assessing the current state of the problem of deviant behaviour in science, the main reasons producing undesirable consequences for the scientific community were formulated, and the choice of areas of improvement that can provide a real counteraction to the spread of antisocial behaviour in the academic and scientific environment was substantiated.

## Conclusions

The results of the study allowed us to conclude that researchers are interested in the problem of science development, an important component of which is the counteraction to deviant behaviour at all stages of the scientific process. The analysis of situations describing cases of misconduct and bad faith in the scientific environment, their relationship with the decline in the level of trust in science, is presented. Reducing the correlation between the level of trust in science and the level of socio-economic development of the country, which is confirmed by the results of surveys conducted in 140 countries, remains an urgent task.

The use of the category of “deviant behaviour in science” in scientific circulation has been substantiated, the content of the concept has been clarified, which covers all possible types of violations of ethics, morals, traditions, while limiting such behaviour to acts related exclusively to

the stages of scientific activity. Investigating the manifestations of intellectual dishonesty, a scheme reflecting the multiplicity of results of deviant behaviour in science is presented, in which an implicit zone is highlighted, which is a problem field and focuses on identifying the results of deviant behaviour at all stages of scientific activity. The schematic representation helps to ensure the necessary level of detail of deviant behaviour outcomes depending on the research objectives. In the process of solving the research problems, V.I. Levin’s classification of plagiarism was expanded according to several types of attributes, which provides a comprehensive approach to the consideration of the phenomenon of this phenomenon. The additional attributes were the attribute reflecting the intention, the attribute reflecting the stage of the scientific process, the attribute expressing the degree of novelty of scientific knowledge and the sphere of plagiarism distribution.

Considering that the damage that is inflicted on society when the principles of intellectual honesty are violated in the process of conducting scientific research affects the social, ethical, legal and economic context, the formation of a conceptual approach to the assessment of economic losses as an important scientific task is justified. The purpose of the study, which consists in the formation of a universal approach to the assessment of economic losses due to various manifestations of deviant behaviour in science, is achieved through the development of an economic and mathematical model. The adaptation of this model to the conditions of the experiment will unify methodological approaches to determining the amount of damage to be compensated; in the process of accumulating empirical data will ensure the comparability of the results obtained.

In conclusion, the consolidated groups of problems are defined, the detection and identification of which is necessary for the development of recommendations aimed at counteracting falsification, forgery, and plagiarism in the process of preparation and conduct of scientific research, design, and publication of its results. In the continuation of the study, the development and testing of the conceptual model of economic damage assessment, its optimization under the conditions of a specific experiment aimed at the analysis of losses caused by deviant behaviour of representatives of the scientific community is of scientific and practical interest.

## Acknowledgements

Not applicable.

## Conflict of Interest

Not applicable.

## References

- [1] Merton RK. The sociology of science (1942). Chicago: University of Chicago; 1973.
- [2] Cotgrove S, Box S. Science Industry and Society. London: Routledge; 2013.
- [3] Merton RK, Kaplan N. The Ambivalence of Scientists. Science and Society. Chicago: Rand McNally; 1965.
- [4] King C. Unsure theory: Ambivalence as methodology. *Arts*. 2022;11(4):78.
- [5] Marsh R. The ambivalent view of science. London: Routledge; 2021.
- [6] Nicholas G, Foote J, Kainz K, Midgley G, Prager K, Zurbriggen C. Towards a heart and soul for co-creative research practice: A systemic approach. *Evid Policy*. 2019;15(3):353-370.
- [7] Bandola-Gill J. Between relevance and excellence? Research impact agenda and the production of policy knowledge. *Sci Public Policy*. 2019;46(6):895-905.

- [8] Tindall I, Fu K, Tremayne K, Curtis G. Can negative emotions increase students' plagiarism and cheating? *Int J Edu Integr*. 2021;17:25.
- [9] Dierickx K, Nemery B, Yi N. Perceptions of plagiarism by biomedical researchers: An online survey in Europe and China. *BMC Med Ethics*. 2020;21(1):44.
- [10] Grondin C, Cong Y, Keshavarzi N, Geisser M, Kolars J, Hutchinson R. Ethical perspectives of Chinese and United States physicians within a research collaborative. *Account Res*. 2021;29(5):294-308.
- [11] Li D, Cornelis G. Differing perceptions concerning research misconduct between China and Flanders: A qualitative study. *Account Res*. 2020;28(2):63-94.
- [12] Halak B, El-Hajjar M. Design and evaluation of plagiarism prevention and detection techniques in engineering education. *High Edu Pedagog*. 2019;4(1):197-208.
- [13] Tiidenberg K. Research ethics, vulnerability, and trust on the internet. In: J. Hunsinger, M.M. Allen, L. Klastrup (Eds.), *Second International Handbook of Internet Research* (pp. 569-583). Dordrecht: Springer; 2020.
- [14] Case Summary: Jarrett, Stuart G; 2022. <https://ori.hhs.gov/content/case-summary-jarrett-stuart-g>
- [15] Case Summary: Kaushal, Deepak; 2022. <https://ori.hhs.gov/sites/default/files/2022-08/FRN%202022-16946%20Kaushal.pdf>
- [16] Case Summary: Jiang, Janina; 2022. <https://ori.hhs.gov/content/case-summary-jiang-janina>
- [17] Wellcome Global Monitor 2018; 2018. <https://wellcome.org/reports/wellcome-global-monitor/2018>
- [18] Wellcome Global Monitor 2020: Mental health; 2020. <https://wellcome.org/reports/wellcome-global-monitor-mental-health/2020/>
- [19] Levin V. Plagiarism, its essence and struggle against it. *High Edu Russ*. 2018;219(1):143-150.
- [20] National Academy of Sciences, National Academy of Engineering (US), Institute of Medicine (US) Committee on Science, Engineering, and Public Policy. On being a scientist: A guide to responsible conduct in research. Washington: National Academies Press; 2009.
- [21] Sharma OP. Ethics in science. *Indian J Microbiol*. 2015;55(3):341-344.
- [22] Nobel Prize winner Gregg Semenza retracts four papers; 2022. <https://retractionwatch.com/2022/09/03/nobel-prize-winner-gregg-semenza-retracts-four-papers/#more-125592>
- [23] Zuckerman H. Norms and deviant behaviour in science. *Sci Technol Hum Values*. 1984;9(1):7-13.
- [24] Nachman BY. Deviance in science: towards the criminology of science. *Br J Criminol*. 1986;1:1-27.
- [25] Nikolić S, Jajić S, Vila A, Ivanović S. Intellectual dishonesty in science. *Acta Med Medianae*. 2013;52(2):56-60.
- [26] Hashmani T, Jonason P. Antisocial behaviour. In: T. Shackelford, V. Weekes-Shackelford (Eds.), *Encyclopedia of Evolutionary Psychological Science* (pp. 1-6). Cham: Springer; 2017.
- [27] Ünal M, Toprak M, Başpınar V. Ethical violations and sanctions in scientific publications: A framework proposal for social sciences and humanities. *Amme Idar Derg*. 2012;45(3):1-31.
- [28] Svirina A, Anand A. Dubious or decisive? Digging deeper into the unchartered path of academic ghostwriting. *J Organ Change Manag*. 2021;35(1):38-58.
- [29] Hofmann B, Helgesson G, Juth N, Holm S. Scientific dishonesty: A survey of doctoral students at the major medical faculties in Sweden and Norway. *J Empir Res Hum Res Ethics*. 2015;10(4):380-388.
- [30] Niu Y, Shen B, Cui Y, Chen Y, Wang J, Wang L, Kang Y, Zhao X, Si W, Li W, Xiang A, Zhou J, Guo X, Bi Y, Si C, Hu B, Dong G, Wang H, Zhou Z, Li T, Tan T, Pu X, Wang F, Ji S, Zhou Q, Huang X, Ji W, Sha J. Generation of gene-modified cynomolgus monkey via Cas9/RNA-mediated gene targeting in one-cell embryos. *Cell*. 2014;156(4):836-843.
- [31] Raposo V. The first Chinese edited babies: A leap of faith in science. *JBRA Assist Reprod*. 2019;23(3):197-199.
- [32] Higgins W, Rogers W, Ballantyne A, Lipworth W. Against the use and publication of contemporary unethical research: The case of Chinese transplant research. *J Med Ethics*. 2020;46(10):678-684.
- [33] Goldstein C, Peterson A. Is it unethical to publish data from Chinese transplant research? *J Med Ethics*. 2020;46(10):689-690.
- [34] Sade R, Carpenter A, D'Amico T, Drake D, Entwistle J, Ray S. Reply: The boat, the sword, and the opacity of Chinese transplant data. *J Thorac Cardiovasc Surg*. 2022;164:127-129.
- [35] Holm A, Fedson S, Courtwright A, Olland A, Bryce K, Kanwar M, Sweet S, Egan T, Lavee J. International society for heart and lung transplantation statement on transplant ethics. *J Heart Lung Transplant*. 2022;41(10):1307-1308.
- [36] Bülow W, Godskesen T, Helgesson G, Eriksson S. Why unethical papers should be retracted. *J Med Ethics*. 2021;47(12):e32-e32.
- [37] Caplan A. The ethics of the unmentionable. *J Med Ethics*. 2020;46(10):687-688.
- [38] Kharasch E, Avram M, Bateman B, Clark J, Culley D, Davidson A, Houle T, Jiang Y, Levy J, London M, Sleigh J, Vutskits L. Authorship and publication matters: Credit and credibility. *Anesthesiology*. 2021;135(1):1-8.
- [39] Gelfand MJ. Culture's constraints: International differences in the strength of social norms. *Curr Dir Psychol Sci*. 2012;21(6):420-424.
- [40] Resnik DB. Research ethics timeline; 2022. <https://www.niehs.nih.gov/research/resources/bioethics/timeline>

- [41] Guerrero-Dib JG, Portales L, Heredia-Escorza Y. Impact of academic integrity on workplace ethical behaviour. *Int J Edu Integr*. 2020;16:2.
- [42] Palla I, Singson M. How do researchers perceive research misbehaviour? A case study of Indian researchers. *Account Res*. 2022;30(8):707-724.
- [43] Albayatey A. The impact of plagiarism on the quality of scientific researches “empirical study”. *J Econ Adm Sci*. 2020;26(118):32-57.
- [44] Stommel W, Rijk L. Ethical approval: None sought. How discourse analysts report ethical issues around publicly available online data. *Res Ethics*. 2021;17(3):275-297.
- [45] Salwén H. Research ethical norms, guidance and the internet. *Sci Eng Ethics*. 2021;27:67.
- [46] Shahreki Z, Rakhshani E. Checklist of agromyzid leafminers (Diptera: Agromyzidae) in Sistan region – Iran. *Int Arch Appl Sci Technol*. 2016;7(2):4-8.
- [47] Shahreki Z, Rakhshani E, Sasakawa M. A contribution to the agromyzid leaf miners (Diptera: Agromyzidae) of Iran. *Biol Nyssana*. 2012;3(1):31-36.
- [48] Shahreki Z, Rakhshani E, Gumovsky A. Identification parasitoids of leafminer flies in Sistan region – Iran. *Int Arch Appl Sci Technol*. 2016;7(2):9-13.
- [49] Shimray S. Research done wrong: A comprehensive investigation of retracted publications in COVID-19. *Account Res*. 2022;30(7):393-406.
- [50] Diamond AM. The career consequences of a mistaken research project: The case of polywater. *Am J Econ Sociol*. 2009;68(2):387-412.

## **Плагіат у науковому середовищі: Оцінка економічних втрат, актуальні проблеми та шляхи вирішення в протидії фальсифікації досліджень**

### **Неллі Акилбекова**

Киргизький національний університет імені Жусупа Баласагіна  
720033, вул. Фрунзе, 547, Бішкек, Киргизька Республіка

### **Гульміра Нурліхіна**

Алматинський гуманітарно-економічний університет  
050031, вул. Момишули, 36, Алмати, Республіка Казахстан

### **Азик Орозонова**

Киргизький національний університет імені Жусупа Баласагіна  
720033, вул. Фрунзе, 547, Бішкек, Киргизька Республіка

### **Гульнар Джолдасбаєва**

Алматинський технологічний університет  
050012, вул. Толе бі, 100, Алмати, Республіка Казахстан

### **Гульзана Назаркулова**

Дипломатична академія Міністерства закордонних справ Киргизької республіки імені К. Дикамбаєва  
720040, пр. Еркіндік, 36, Бішкек, Киргизька Республіка

### **Анотація**

**Актуальність.** Актуальність дослідження визначається важливістю розробки підходів до оцінки шкоди, яку завдають науковому співтовариству та суспільству в цілому прояви девіантної поведінки на всіх етапах наукового процесу. Розглядається проблема розвитку науки з точки зору амбівалентності наукових принципів і поведінки окремих представників наукової спільноти.

**Мета.** Основною метою дослідження є розробка концептуального підходу, що дозволяє оцінити економічні втрати, спричинені девіаціями від конструктивної поведінки в процесі наукової діяльності.

**Методологія.** Сукупність методів, що використовуються в процесі дослідження, представлена методами дедукції та індукції, аналізу та синтезу, порівняльним та системним аналізами, елементами економіко-математичного моделювання.

**Результати.** Досліджено випадки недобросовісності у проведенні досліджень та їх вплив на зниження рівня довіри до науки. Обґрунтовано формування концептуального підходу до оцінки економічних втрат як важливого наукового завдання, реалізація якого здійснюється за допомогою економіко-математичної моделі. Запропоновано рішення, яке дасть змогу уніфікувати методичні підходи до оцінки шкоди від прояву девіацій у науці.

**Висновки.** Визначено проблеми, виявлення та ідентифікація яких необхідна для розробки рекомендацій, спрямованих на протидію проявам девіацій у науці. Масштабування запропонованого підходу до оцінки економічних втрат, які завдаються суспільству при порушенні принципів інтелектуальної чесності в процесі проведення наукових досліджень, забезпечить посилення позицій соціальної, етичної та економічної справедливості, підвищить рівень довіри до науки.

**Ключові слова:** етика; амбівалентність; девіантна поведінка; неявна зона; економіко-математична модель.