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Olena Zhytkevych

DEVELOPMENT OF PRINCIPLES FOR CONSTRUCTION OF A RATIONAL METHOD FOR FORMALIZATION THE ASSESSMENT PROCESS OF THE NEGATIVE IMPACT OF THE ENVIRONMENTAL PROBLEM ON THE COMPETITIVE MARKET

The object of research is environmental issue, caused by global warming which has negative impact on market. Since, any negative impact is associated with externalities, a market cannot be considered as an efficient market. According to the literature research, market with externalities cannot recover by itself.

Thus, one of the most problematic places is the proper identification of the problem related to environmental factors. The identified problem and its impact on a market should be modeled to determine possible negative effects on market participants. Based on the study's results it is possible to approach the development of alternative solutions to the problem in order to increase economic efficiency. Because environmental factors are dynamic and have significant impact on a market, it is not possible to ignore such a relationship, which can lead to a source of a wide range of dangers.

The problem can be attributed to the not studied enough, which, in turn, provides a large field of activity for its further study.

One of the productive ways to solve this problem is to perform an economic analysis of the environmental problem as an external problem and develop principles for building a rational method of formalizing the assessing process for the negative impact of environmental problems on the competitive market. This will make it possible to automate the process, which will serve as a basic aspect of developing a plan of further actions.

To achieve this aim, the author analyzed the environmental factors caused by climate change and have an impact on the ecosystem and markets. The foundations and needs for a climate policy were also analyzed. The climate policy is designed to improve the situation. The basic principles of constructing a rational method of formalizing the process of assessing the negative impact of environmental problems on the competitive market have been proposed by the author.

Keywords: *economic analysis of environmental issue, modeling of environmental issue, competitive market model.*

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1. Introduction

According to The United Nation announcement: «2021 is the beginning of the Decade on Ecosystem Restoration, a rallying call for the protection & revival of ecosystems around the world. The next 10 years will be critical for addressing the climate crisis. There has never been a more urgent need to restore damaged ecosystems than now. The healthier our ecosystems are, the healthier the planet – and its people» [1, 2].

This statement requires lots of organization work from policymakers, other authorities and everyone towards the right solution of the problem mentioned above. Therefore, it is possible to begin with defining the problem then creating the plan of actions towards eliminating or diminishing the negative impact of externalities on ecosystems.

Defining the environmental problem is very critical, since the result of policy depends on it.

Climate change refers to a major change in a climate measure such as temperature, wind or precipitation that is prolonged, so lasting decades or longer. This type of response may be associated with a natural phenomenon such as variations in solar intensity or changes in ocean circulation,

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it may also be related to human activities such as deforestation or the burning of fossil fuels [3–5].

One source of controversy is the predicted climate response to increasing production of so-called greenhouse gases (GHGs). The scientific community is not in complete agreement on climate change and its impacts. In any case, national and international policy responses to the issues of climate change are somewhat tentative due to the complexity and uncertainty involved.

The concept of «Climate change» is closely related to the problem of global warming. Understanding the potential problem of global warming requires us to define the phenomenon of global warming. The phenomenon is based on the following: sunlight that penetrates the atmosphere hits the earth's surface and reflected back where it is absorbed by naturally occurring gases such as carbon dioxide (CO_2). This absorption process heats the atmosphere and warms the earth's surface.

This natural phenomenon is responsible for the existence of life on earth as we know it. Without the so-called greenhouse gases, the temperature on Earth would be about 30 to 40 degrees Celsius cooler. Global warming falls under the broader term climate change, although the two terms are often used interchangeably [3–5].

While this warming is a natural process, the problem is that greenhouse gas emissions have increased significantly over time, particularly CO_2 emissions. This trend is believed to be mainly related to increasing human activities, such as the burning of fossil fuels (i. e. oil, coal and natural gas) and deforestation. Since greenhouse gases affect the temperature of the earth, a significant disturbance of their natural levels would lead to climatic changes.

Although a number of greenhouse gases are responsible for this warming phenomenon, the most important are carbon dioxide, methane and nitrous oxide. The ability of a greenhouse gas to trap heat in the atmosphere is measured relative to carbon dioxide by its global warming potential.

Despite the growing consensus that increasing amounts of CO_2 will change the Earth's climate, no one knows with certainty the timing or magnitude of the outcome, in part because there are many factors to consider. Not least the influence of feedback effects that can either weaken or amplify the warming phenomenon [5–7].

Environmental economists are interested in externalities that damage the atmosphere, water supply, natural resources, and overall quality of life. To model these environmental externalities, the relevant market must be defined as the good whose production or consumption generates environmental damage outside the market transaction [3, 4]. Therefore, research and modeling of the environmental issue and its impact on the economy as a system an urgent problem and needs further solution.

2. The object of research and its technological audit

The object of research is environmental issue, caused by global warming which has negative impact on market. Since, any negative impact is associated with externalities, a market cannot be considered as an efficient market. According to the literature research, market with externalities cannot recover by itself. Thus, one of the most problematic places is to appropriately identify the problem related to environmental issues and asses its impact on the market. Modeling this process is necessary in order to identify possible negative influence on market's participants. In order to solve the problem towards increasing economic efficiency, the development of alternative plans is followed. The development of alternative plans is based on received outcomes from modeling. The problem can be attributed to the not studied enough, which, in turn, provides a large field of activity for its further study.

3. The aim and objectives of research

The aim of research is to study the negative influence of an environmental problem on a competitive market and model this impact, thus determining the economic inefficiency of such a market.

To achieve the aim of the identified study let's proceed the following scientific objectives:

1. To analyze environmental factors on the ecosystem and the market, as well as foundations and needs for a climate policy in order to improve the situation.

2. To develop principles for building a rational method of formalizing the process of assessing the negative impact of the environmental problem on the competitive market. The formalized process is designed to determine the negative influence of environmental factors on a competitive market and modeling this impact for further proceeding with developing alternative plans to solve the problem.

4. Research of existing solutions to the problem

Many scientists work on theoretical and methodological aspects of determining the negative impact of environmental factors on the market, in particular its economic efficiency. The results of the work describe the environmental factors in details and their negative impact on the entire ecosystem [1], investigated approaches to climate policy design and its implementing [2].

The article proves that the modern market economy requires special methods for determining the economic consequences of environmental problems and managing them. The methods must be adapted to modern markets regardless of their sizes.

Author pays particular attention on the needs to develop and implement a plan to address the problem through policy development.

Many authors who consider the effectiveness of the market under such conditions, they identify a number of problems that complicate the functioning of environmental situations in their work [3–5].

Many works regarding the vulnerability of sectors and ecosystems address the implications of climate change across a broad range of economic sectors and natural ecosystems. But these works contain many critical uncertainties such as rapid or catastrophic changes in climate and impacts, the assumptions made about adaptation, which have not been taken into account [6–8].

Regardless of the nature of the sectors many authors admit that climate change will greatly alter the character of ecosystems and could have many adverse effects [9–11]. Although, the societal sectors such as agriculture, water resources and natural sectors such as terrestrial ecosystems and aquatic ecosystems are considered to be less vulnerable

to climate change than natural sectors because the societal sectors have much greater capacity for adaptation [11].

In general, most researchers agree, that natural ecosystems appear to be at much greater risk from climate change than societal systems such as agriculture and forestry. This is because ecosystems have much more limited adaptive capacity than societal systems, particularly societal systems in a developed country [11]. This points an opportunity to solve arisen environmental problems.

The identification of the environmental issue is very important and the inability of the competitive market solve it requires appropriate public policy. Now let's consider foundations and needs for a climate policy. From an economic perspective, climate has the characteristics of a common good. While it is not exclusive (no one can be prevented from enjoying it), it is also rival (some individuals can use it to the detriment of others). This is especially the case when individual producers emit greenhouse gases that disrupt the climate and cause global warming that affects all individuals, including those who have emitted fewer greenhouse gases. By contrast, a common good is a non-excludable but competing good, a good from whose consumption no one can be excluded, but whose use by one individual is costly or reduces the use of the good by other individuals. Furthermore, since climate disruption is the result of greenhouse gas emissions, these emissions can be analyzed as pollution, which corresponds to a negative externality in economic analysis. Pollution has social costs that are higher than private costs because the whole community suffers from the consequences of pollution, not just the individual who produces it. The action that causes the externality tends to be chosen excessively by the producers, and this is harmful to the common good. Thus, the nature of the common good and the presence of negative externalities constitute a market failure that requires public intervention.

The public sector has several means of intervention at its disposal, which complement each other. These are regulation, taxation and the establishment of a market for emission allowances. The choice of one or the other policy regime depends on various factors, such as the costs or the willingness of the state to achieve an unlimited reduction of externalities or a reduction to a certain predetermined level.

Ideally, environmental policy should achieve an efficient allocation of resources that maximizes net benefits or, equivalently, where the marginal social benefits from policy implementation are exactly offset by the marginal social costs. Evaluating benefits is always complex process, especially the case with global warming due to the grey areas that weaken scientific predictions. Therefore, before it is possible to analyze specific policy proposals, it is necessary to consider the dilemma of evaluating the potential benefits of any initiative to control climate change. To illustrate how benefit assessment is at the root of the global warming policy dilemma, let's look at the results of several research papers. A report prepared by the OECD Environment Committee estimates the expected benefits from controlling global warming in the United States. The values presented on the estimated damages associated with climate change are based on two global warming scenarios. The first estimate assumes the conventional prediction of a 2.5-degree Celsius temperature increase, while the second presents estimates based on a 10-degree Celsius temperature increase over a very long period of time [8–10].

According to the results, the benefits of controlling global warming based on the conventional projections would be 61.6 billion USD, or about 1.1 per cent of GDP, as high as 338.6 billion USD, or at least 6 per cent of GDP, over a very long period of 250–300 years. Many economists argue that not only is the damage from global warming difficult to estimate, but even if the worst predictions are accurate, most are insufficient to justify the high costs of mitigation [3–7]. The EPA report that estimated the net effect of global warming on US agriculture to be between a net gain of 10 billion USD and a net loss of 10 billion USD. The net gain is possible because some parts of the nation would enjoy longer growing seasons, enhanced by increased rainfall and fertilizations from increased CO_2 concentrations. At the other extreme, even if the maximum estimated loss of 10 billion USD occurs, this is only about 0.2 per cent of US GDP [3, 11].

The recent studies estimate that the net benefit to the US from addressing climate change would be 0.1 per cent of GDP, while others put the comparable figure at around –0.5 per cent of GDP, with a net cost to society [3, 11]. Thus, in a more recent assessment presents significantly different estimates.

Although these studies share a common perspective – that assessing benefits is critical to developing climate change policy – the implications are different. The OECD study suggests that long-term benefits may be more relevant for evaluating global warming initiatives. The other studies, which use a more short-term approach, identify much lower benefit estimates that may not outweigh the associated costs. This means that policy development could take a very different direction if time is explicitly taken into account. At any case, these analyses point to the need for further research and help explain the challenge policy makers face in deciding how to respond to global warming concerns.

In the face of this challenge, economists argue for market-based policies that aim to take into account the benefits and costs of government controls. Although there are many types of instruments that use market forces to work, they can all be motivated by modeling the cause of global warming, rising greenhouse gas emissions, as a market failure.

So environmental policies should be formed and perused appropriately according the problem in order to solve it.

The analysis of scientific publications on environmental factors was used, in particular on marginal social, private costs and benefits factors that affect the market outcomes and climate policy, economic analysis of climate policy, foundations and needs for a climate policy.

Consequently, according to a review of the literature, competitive market cannot solve the environmental issue by itself, hence it is necessary a public policy to solve the problem [8–10].

The analysis of the literature proves the impacts of climate change on ecosystem, therefore other participants of it will experience more severe consequences due to their inability resist the negative influence. Thus, assessing the environmental problem and addressing its consequences properly will save time, therefore the cost in developing a policy towards elimination environmental consequences. Thus, it is possible to deal with the problem effectively and efficiently and this facilitates proper economic allocation of recourses in a market.

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Despite numerous and continues studies in this field of knowledge, it should be noted that the problem of determining an effective approach to assess the negative impact of the environmental problem on the competitive market remains not enough studied. It appears as an unresolved part of the overall environmental problem since the absence of well defined, clear and transparent, automated rational response method, which led to feasibility of further research by the author of the article.

5. Methods of research

General and special research methods were applied by the author:

– analysis and synthesis – for preliminary analysis with the formation of the problem, setting goals, identifying features of the environmental problems and analysis of a competitive market under the influence of environmental factors;

– analogies and comparative comparisons – for determination of the characteristics and potential negative effects of environmental factors on the market;

– decomposition method – for decomposition of research of influence of environmental factors on a market and describing stages of modeling the process.

6. Research results

The process of assessing the negative impact of the environmental problem on the competitive market is complex and multifactorial, since market conditions are unstable and depend on numerous factors of internal and external influence. In the economic literature there are such basic methods of estimating negative impact of an externality problem as graphical, matrix and computational [12]. Considering the existing methods, it is possible to say that the process of assessing the negative impact of the environmental problem on the competitive market is a complex concept that should cover all aspects of market activities. The main task is to determine the effective and most appropriate method for this assessment.

Based on the fact that the analysis of the negative impact of the environmental problem on the competitive market assessment has different degrees of depth and scale of research, in addition, there is no single economically feasible approach that simultaneously analyzes all aspects of the market, the author recommend her own approach. The assessment should combine integrated and systematic approaches.

To achieve this goal, the author represented that several constructive methods should be used at the same time, supplementing them with an economic analysis of the environmental issue as an externality problem then modeling market failure.

Thus, the author of the article proposed the following basic principles of formalizing the process of assessing the negative impact of the environmental problem on the competitive market:

– conducting an economic analysis of the environmental issue as an externality problem and compiling a database of indicators, duplication should be avoided; it is necessary to include direct indicators of environmental issue in combination with the basic indicators of its market activity, thus to consider complex influence of factors of the certain period.

The external effect (or externality) is a consequence caused by one economic agent (companies, households, or the State) on the activity of another economic agent without the latter receiving compensation. The term negative external (or negative externality) effect is used when this consequence is detrimental to the other economic agent.

Pollution is a negative externality because it is mainly caused by business firms and is harmful to other economic agents (such as households) without them receiving compensation from the polluter. On the other hand, the pollination of apple trees by bees is a positive externality of the beekeeper's action on the farmer. The farmer benefits from the presence of bees pollinating its apple trees, without paying compensation to the beekeeper. In order to illustrate the externality problem and model a negative environmental externality, let's proceed these steps [3–5]:

1. Define the market of a product that generates negative externality, suppose it is a refined petroleum.

2. Set an assumption: the market is competitive, where Supply is the marginal private cost (MPC) and Demand is the marginal private benefit (MPB). Since production generates pollution, modeled as a marginal external cost (MEC). It is known that MPC+MEC=MSC. MSC stand for the marginal social external costs.

3. Define the problem: Producers (refineries) have no incentive to consider the externality and analyze.

As long as the magnitude of the environmental risk is unknown, the benefits of policy corrective measures are also uncertain, but what is clear is inefficient competitive solution. Consequently, it is not possible to rely on market mechanism by itself and need regulations, hence public decision-makers face the challenge of justifying the social costs of policy measures with reliable information on the comparative benefits.

A successful solution depends crucially on engagement, in the best case is international engagement supported by national initiatives. Some successes have already been achieved in this area, nevertheless, there are still important issues to be addressed and developed. There many countries lack the financial resources and technology to renew the causes of global air pollution, however their cooperation is crucial given the expected industrial and economic growth in these countries and the associated impact on the global environment [3]:

– modern approach requires the dominance of intangible assets. Market participants are forced to form new competitive advantages under unfairable environmental condition (climate change) associated with a high image, qualified staff, long-term relationships with suppliers, intermediaries and consumers. Therefore, the methods of assessing the environmental issue as an externality problem on the competitive market should be supplemented with a base of indicators that characterize the human resources in the enterprise, its image and organizational culture, etc.;

– the method should be reliable (if possible, expert assessments should be avoided or minimized in the analysis of statistically significant samples of information), practical, systematic, comprehensive and algorithmic, inexpensive. At the same time it should visualize the outcomes in order to facilitate the process of construction a plan of alternative solutions.

Today, the implementation of such principles can be effectively carried out by neural network technologies.

Therefore, the author of the article proposed to use the Hopfield network for the rational assessment of the negative impact of the environmental problem on the competitive market by means of mathematical and computer simulations, which will facilitate the work of specialists responsible for making decisions under conditions of uncertainty, lack of time and limited information resources [13, 14].

The given list of principles concerning formalization of procedure of estimation is not final as conditions of functioning of the market and their participants are short-lived and cause dynamic change of priorities for criterion selection.

7. SWOT-analysis of research results

Strengths. The strengths of research and application of modeling the process of identifying negative impact of environmental factors on a market are that these measures can identify and further eliminate the negative impact. Compared to other approaches of determining the negative impact of the environment, this can be done by ensuring transparency and predictability of possible factors and appropriate actions.

Thus, the proposed methods allow to develop effective methods of minimizing losses associated with the study of the impact of environmental problems on the market. Compared with analogues, the proposed study allows to predict possible risks and losses, thus eliminating the factor of surprise.

Weaknesses. The analysis of the mentioned process is dynamic and heterogeneous. Thus there is the risk factor associated that a market under the influence of environmental issues cannot be entirely studied. Therefore, the above risks include the following groups of risks: economic, technological and organizational and managerial. The analysis revealed its shortcomings, in particular, the weakness of the proposed approach is applied on competitive market but existing markets are not perfectly competitive and conditions are changing over time.

Opportunities. It should be noted that in the future the process of identifying the negative impact of environmental factors on the market can be supplemented by modules of problem-oriented software packages, which are usually based on the developed mathematical apparatus. Such mathematical software can be upgraded, including elements of adaptive algorithms, and used mobile to solve a wide range of problems related to the flexible management of the process of identifying the negative impact of environmental factors on the market.

Threats. The threats to the process of identifying the negative impact of environmental factors on the market include the fact that, even, the proposed approach does not avoid all possible losses due to the impact of various risks. In particular, due to the negative impact on the object of study of exogenous factors and unpredictable events. The situation is complicated by the fact that not all threats can be identified and minimized in advance.

8. Conclusion

1. Economics analysis of environmental factors on the ecosystem and the market, as well as foundations and needs for a climate policy in order to improve the situation, are conducted.

The process of identification of environmental factors on market is complex and requires recourses (time, financial, knowledge, experiences and etc.). Despite the difficulties, it is necessary the progress made in identifying the relevant environmental problems, recognizing the unknowns and exploring solutions.

2. The assessment of the negative impact of the environmental problem on the competitive market is complex and there is no single economically effective approach that simultaneously analyzes all aspects of the market, the author set own recommendations towards such approach. This approach, according to the author, allows to form an effective method of assessing the negative impact of the environmental problem on the competitive market.

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Olena Zhytkevych, *PhD, Associate Professor, Department of International Economic Relations, Business & Management, Ukrainian-American Concordia University, Kyiv, Ukraine, ORCID: https://orcid.org/0000-0003-2042-8795, e-mail: elena.zhitkevich@gmail.com*