UDC 504.064.3:502.33 **JEL Classification: B41, D62, Q50**

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CHARACTERISTICS AND CRITICISM OF CONVENTIONAL ECO- AND ENVIRONMENTAL ECONOMICS MODELS

The aim of the article. The aim of the article is to introduce basic theories of environmental economics, dealing with environment factors, and to present critical view on them.

The results of the analysis. The necessity to create a new economic paradigm or to elaborate a new approach to economics can most efficiently be justified by providing a critical analysis of conventional economic theories. Following this view, the material introduces basic theories of environmental economics belonging to the branch of economics dealing with environmental factors and based on conventional or neoclassical foundations (problems of public welfare, Pigouvian taxes, the Coase theorem, optimal utilisation of natural resources, the standard price theory) and presents critical views related to these issues.

Conclusions and directions of further researches. The conventional economics is based on fundamental assumption of neoclassical welfare economics according to which the primarily aim of economics is obviously to achieve Pareto optimal conditions. This optimum can be in two meanings: if Pareto optimum means Pareto norms, it reflects relevant conditions for economic policy. If Pareto optimum is linked with marginal analysis when a determined fictitious economic optimum is sought for in a perfect competition situation, it an instrument used for formal analytical analysis.

According to this allocation of resources or the volume of production is optimal if there is a situation in which it is possible to make any individual better off without making someone else worse off.

Keywords: conventional environmental economics, public goods, prisoner's dilemma, Pigovian tax, Coase theorem.

Introduction. Natural goods like clean air or a healthy ozone layer are considered to be resources by theoretical economics and theoretically the principle of sustainability should be adapted to them. However, it seems that to focuse only on the economic approach itself is not enough to apply management that gives priority to environmental values, because conventional theories, as a matter of fact, create economically optimal ecological disasters.

Most conventional theories mentioned in the technical literature follow the methodology of neoclassical economics when dealing with environmental pollution, explaining allocation problems and providing solutions to them. The neoclassical economics approach is known to have been developed by the end of the 20th century, and in comparison with the classical economic theory, it has a specific feature of mathematical formalization. Taking into account the basis of classical physics, the followers of the neoclassical economics elaborated various theories to explain economic phenomena. They assume that an economic entity is well informed of the undergoing economic processes while acting as an individual, targeting maximum economic profit and returns. The only coordinating institution of economic processes is the market behaving as a "black box", operating "smoothly" and having no additional transaction costs.

Analysis of recent research and publications. The problems of conventional eco-and environmental economics models were shown in the works of such scientists, as H. Bonus [1], R. Buttgereit [2], D.Cansier [3], R.Cansier [4], P.Ekins [7], D. Pearce, R. Turner [10] and others.

The object of the article is to introduce basic theories of environmental economics, dealing with environment factors, and to present critical view on them.

Main material. *Problem of public goods.*Depending on the nature of consumption, the goods consumed by members of a society can be classified in several ways. Theories dealing with public goods make a distinction between public and private goods and state that public goods, in contrast to private goods, can be consumed by several individuals at the same time without triggering any rivalry between people. Technically, not even one competing consumer can be excluded from the consumption of public goods. Public goods also include goods that a consumer can technically be excluded from utilizing, but this move would not be desirable for political or social reasons [11]. Natural assets, the distribution of which can be difficult to imagine, usually belong to this category. Putting limitations on access to health care or other services of public welfare is impossible owing to social factors.

According to neoclassical theory, the environment supplies the economy with public consumption goods without receiving any compensation in return. While conducting an analysis in conventional environmental economics, the neoclassical economics focuses on natural resources, the monetary values of which can be measured. In its analysis it ignores whether the analyzed natural goods are used as direct inputs in the producing of products or act as pollution-absorbing medium, because according to environmental economics they are consumption goods in both cases. Natural goods whose values cannot be quantified (such as landscape value) are generally neglected.

One key characteristic of public goods is that they have no formal market and therefore no market prices exist for them, despite the fact that their resources are finite. Natural goods to which the principle of excludability from the consumption or use can be applied and due to the private ownership this can even be achieved are not considered public goods and are not looked at as environmental problems to be resolved by environmental economics.

As for public goods, one of the fundamental problems arises from the so-called free rider phenomenon, the evolution of which can be illustrated by the following game theory (Table 1).

Table 1 – **Cost-benefit analyses in the prisoner's dilemma,** (developed by author)

Society / Individual	Eco-friendly	Non-eco-friendly
Eco-friendly	**I** Gain: 20 Cost: 10 Net profit: 10	**II** Gain: 0 Cost: 10 Net profit: -10
Non-eco-friendly	**III** Gain: 20 Cost: 0 Net profit: 20	**IV** Gain: 0 Cost: 0 Net profit: 0

It is obvious that the data given in the table are fictitious and demonstrate a virtually set proportion between costs and benefits. Let us imagine that some people protect the environment while others pollute it (3rd case). The social benefit of this is insignificant because of the principle of non-excludability. The opposite of this is also true. If there is only one individual who behaves in a non-environmentally friendly way, but the whole society does, this itself does not decrease the total beneficial value. (See the difference between the 1st and 2nd cases). However, this kind of behaviour means that the non-polluter has to bear extra

costs (additional costs, time loss, inconvenience, etc.), while his behaviour does not have a perceivable impact on the scale of environmental burden.

In order to explain the free rider phenomenon we should assume that everybody behaves in an environmentally friendly way (1st case where the net benefit is positive). Then one of the agents realizes that it is not worth doing things in an environmentally-friendly way because if he behaves in a non-environmentally friendly way, he will not have to bear additional costs (2nd case, free rider phenomenon).

There is an interesting contradiction here, as – according to the neoclassical economic approach - environmental awareness would be irrational in this case, because it would come into contradiction with the principle of benefit maximalization. As a result, more and more members of the group concerned would behave in a "rational" way (3rd case). Finally, nobody is willing to pay for environmental protection on a social level and we come to the 4th case. Similarly to every model, this one is also a simplified version of the reality. However, as the assumptions described in the model express realistic tendencies, we can draw correct conclusions from them.

Pigovian tax. Cansier [4] distinguishes public and private goods taking into account the presence of externality impacts: public goods are characterised by their presence and private goods by their absence.

According to Pigou, in the interest of regulating externalities governments should levy taxes on those who generate negative externalities and provide subsidies to those who generate positive ones. The level of taxes and subventions should be calculated so that the negative externality generator should be interested in conducting business activities with Pareto optimal outcome. Thus, government imposes taxes on the negative externality generator which are as high as the values of marginal external costs. The marginal external costs are any additional costs incurred by a third party (not participating in the economic transaction) and arising from the pollution generated by the additionally produced product unit. With the application of this principle the production can theoretically be decreased to an optimal level.

External effects related to environmental damages are extremely difficult to measure for different reasons. Endres [8], among others, also deals with above mentioned reasons. According to estimates a significant proportion of externalities – as well as environmental pollution linked to them – are caused by production activities. For simplicity, the tax effects on pollution activities are conveyed in the following figure (Figure 1).

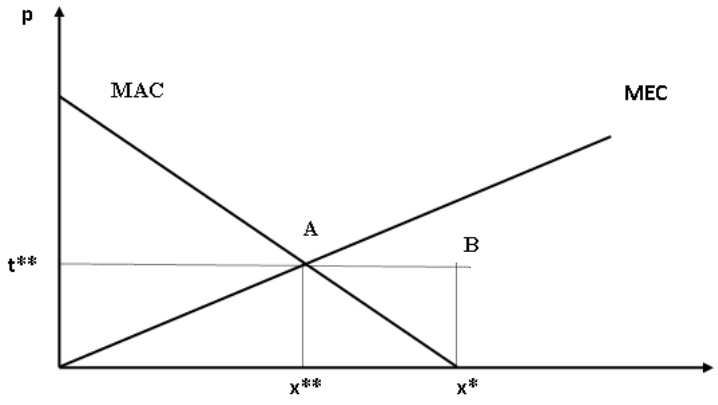

Figure 1– **Determination of the pollution optimal level** [8]

Before the introduction of the Pigovian tax the estimated amount of emission was *x*,* but the socially optimal emission would have been *be x**,* where marginal costs of abatement work were as high as marginal external costs (MAC = MEC). Marginal abatement costs are any additional costs incurred during a remedy against the pollution generated by the additionally produced product unit.

If the polluter pays a taxes of *t*** per each unit of pollution and does not reduce the amount of emission, the additional costs will account for *x*t***. It is obvious that the polluter can reduce his costs by decreasing emissions. Thus, his additional abatement costs will be administered as expenditures and are deductible. In this way, savings on taxes can be achieved.

The polluter is interested in decreasing the level of pollution until *MAC<t**,* that means till*x***. The amount of costs saved equals *ABx** of a triangle surface area. Thus, externalities are "internalized". Of course, the illustrated internalization process assumes ideal circumstances. Regulation of polluter(s) in a monopoly or oligopoly position via imposing taxes on them gives rise to several practical problems related to internalization and is interesting from a theoretical economic point of view.

After conducting analyses of the effect mechanism of Pigovanian taxes and works [7; 9; 10], we can form the aggregated product market of the industry branch, causing a particular type of pollution (Figure 2). For its illustration we need the product supply function *(S=S(p))* and the demand function depending on the price *(D=D(p)),* which expresses marginal willingness to pay (the amount which a consumer wishes to pay for an additional unit of an assumed product).

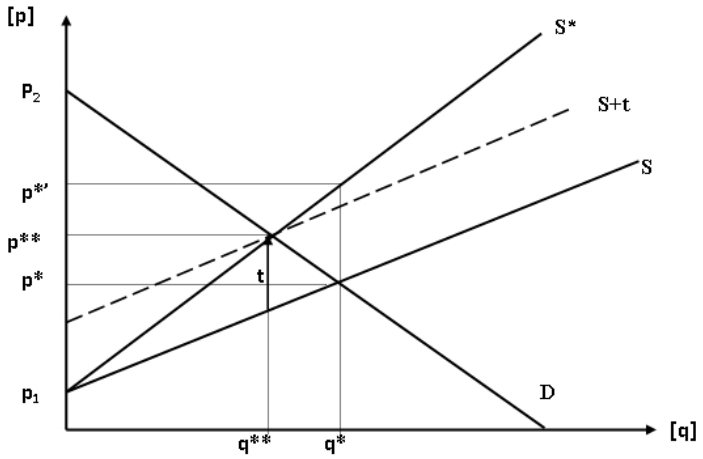

Figure 2 – **Industry-level impacts and tax-driven internalization of externalities** [7]

Finally, there is a marginal social cost function *(S*(p)),* which summarizes the supply function and marginal external cost function. If during the production of the above-mentioned product there were no external costs and *S** is equalled *S*, the determined equilibrium point (*p*, q**) would mean Pareto-optimum production level. Let's see what happens if, instead of the individual supply curve (*S*), the marginal social cost function is considered to be the supply function. We obtain q^{**}, p^{**} market equilibrium. The area within the price curve

($p^{**}(q)= p^{**}$), the demand curve and the axis p reflect the difference between the price the customer is willing to pay and the current market price, that is the customer surplus, which can be calculated as follows: $\int_{p^{**}}^{p_2} D(p)dp$ .The producer surplus can be calculated in the same way and it is the difference between the current market price and the price the producer is willing to sell a certain amount. This is as follows: $\int_{p^1}^{p^{**}} S*(p)dp$. By adding the producer surplus and the customer surplus we obtain the welfare indicator, the value of which is maximum at the point of equilibrium that is at the point of intersection.

If externality effects appear during production activities, the marginal social cost function will differ from the supply cost function. The market equilibrium point (p^*, q^*) will not be Pareto optimum for the society because of the welfare fail, that is, the lost part of the consumer surplus and the producer surplus. The loss results from the consumers' willingness to purchase additional goods despite the fact that social costs (S^*) exceeded consumers' paying willingness (D) long ago. Producers manufacture an additional quantity to be sold, although the achieved market price does not cover the total costs. So neither the producer nor the consumer surplus can be skimmed.

As a result of the above mentioned factors the tax to be levied in order to achieve an optimal production level has to be as high as the marginal external costs at the socially optimal production point, which is illustrated in the figure where the tax is represented by vector t. A constant tax of t level shifts the supply curve by vector t. This is illustrated by $S+t$ broken line. The new obtained market equilibrium point will be $p^{**}q^{**}$. In this case, both consumer and producer surpluses are maximal and show Pareto optimum conditions.

Nevertheless, we must admit that actually, we have not solved the problem. Firstly, the future of the money raised from levying taxes has not been decided on, since some amount of money, which will not be spent on covering administrative and interventional costs is still available, and takes the form of subventions received by companies for not emitting pollution and for investing in environmental-friendly issues. Thus, the optimal point (q^{**}, p^{**}) does not equal Pareto optimum, because the conditions of some economic players can be improved (without causing unfavourable effects on others) if the used taxes are ploughed back into the economic system in the form of subventions.

The second reason is even more plausible: if government wants to define the Pigovian tax very optimally, it has to know both the marginal external cost ("marginal damage" costs) and the abatement cost functions very well. This involves a high level of infirmity, the lack of which results in failure to calculate the Pigovian tax precisely in practice. Most types of damage are difficult to quantify and calculate, as they include psychological, health and even aesthetic issues. In addition, the number of polluters and pollutees is sometimes so high that their accurate computation and linking causation and damages is especially difficult. Moreover, the whole process is extremely time consuming and the final outcome is likely to have a high margin of error.

Coase theorem. The publication of the article "The Problem of Social Cost" by Ronals H. Coase [5] has had a huge impact on the economic analysis of external effects. The author offers another possible internalization strategy. He says that in order to eliminate market deficiencies caused by externalities the state simply determines clear "frameworks", which in this case are legal positions towards players involved in eternities. If the ownership

and disposition rights are clarified, the voluntary negotiations between polluters and pollutees will have Pareto optimal outcome. Coase proves this by a model in which there are two players and no transactional costs are involved. In this case transactional costs include all costs related to build and operate a coordination mechanism (market). Of course, the assumed zero transactional costs mean that we move in a strictly neoclassical world: the whole set of ownership and disposition rights are defined free of charge, the legal system works smoothly, the negotiations between two players are not charged and both players are perfectly informed. The statements of the Coarse theory are illustrated in the Figure 3.

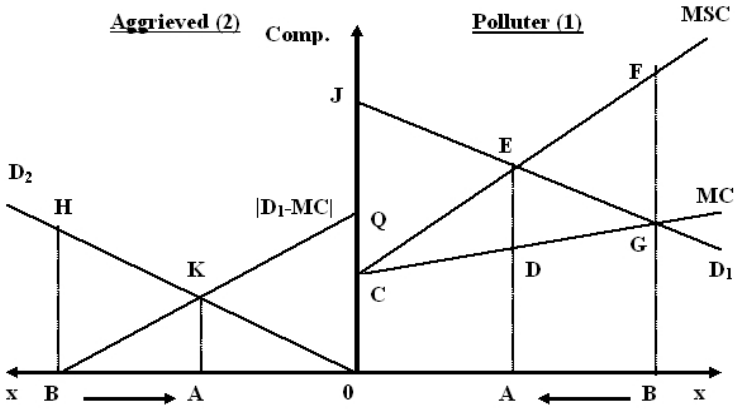

Figure 3 – **The development of the pollution optimal level through negotiation** [1]

Let us assume that the player causing externalities exercises ownership right over the activity under investigation. The state determines the disposition rights and delegates them to the player who caused the external effects (the principle of laissez-faire). In his arguments Coase stipulates that ownership rights can be sold and purchased. Since the pollute wishes to achieve a reduction in the level of the external effect, he can make the polluter do this by offering him some compensation. Of course, transferring ownership rights to polluters is an extreme case, a theoretical supposition, which hardly ever happens in practice.

As it can be seen in the figure 3, there are two players: a polluter with an x activity and a pollutee of externality. Before negotiations start, the polluter produces a B amount of pollution. According to the demand function the pollutee is willing to pay the polluter money amounting to HB in order to make him decrease the production. As this sum is a great deal higher than the compensation money expected by the polluter ($D_1 - MC$), this will motivate the players to conduct volunteer bargaining, as they both will increase their profit. The pollutee can afford this and wishes to offer compensation as high as A, that is until Pareto optimum. At this point the marginal paying willingness equals the marginal profit reduction of the polluter ($KA=ED$). Further bargaining does not lead to better results, as any further shift in either direction would harm one of the players' interests.

Starting from the principle of laissez-faire we can get to the optimal production level. The similar triangle surface areas on the polluter's (EFG) and on the pollutee's sides (BHK) result in welfare growth achieved by negotiations and its distribution between partners is defined by the power relations. If the compensation offered to the polluter by the pollutee amounts only to EDG money covering the income losses arisen from reducing the production, the pollutee

skims the whole welfare growth. In the opposite case, if the polluter manages to obtain from the pollutee not only the EDG, but the whole EGF surplus; he will receive the whole welfare growth as well.

Coase also discusses this case. It is the pollutee who is entitled to be awarded ownership rights. The starting position for bargaining is that the polluter is not allowed to pollute, so the production and the emission levels are zero. If the polluter wishes to exercise ownership rights over a part of the available natural resources, he has to purchase them from the owner, that is from the potential pollute. This is called the Polluter Pays Principle. In the Polluter Pays status the polluter has no legal basis for continuing his activity. Nevertheless, both players are motivated to continue bargaining. The polluter is willing to pay the amount covering the JC area so as to obtain the right to produce. Since in this case the marginal external costs (D_2) are extremely low, the parties reach A production point by bargaining. At this point the production, the willingness to pay and the compensation expectations coincide. In this way we can get to Pareto optimal level starting from conflicting ownership rights.

The illustrated model depicts the problem of environmental pollution – in a way similar to Pigovian approach – in a clear neoclassical "environment". If we know or become familiar with other Coase's works, we will be surprised, because he is considered to be one of the founders of the institutional economics since he wrote his famous article about transaction costs. It is astonishing that the author who attempted to prove the existence of transaction costs in 1937, twenty-two years later designed a model of externality internalization excluding transaction costs from its world. In fact, his objectives were not to offer solutions to problems of environmental pollution, but to criticize the neoclassical approach showing the existence of problems. He illustrates that in an idealized model any internalisation strategy is effective (sharing taxes or pollution rights through bargaining), therefore conducting a comparative analysis of different coordination mechanisms is not possible. In this case coordination mechanisms are cognitive processes such as levying taxes, setting norms, trading with pollution rights, and so on. Actually, in neoclassical models externalities do not give rise to environmental problems since they are internalized in spontaneous ways. That is the reason why environmental problems can be interpreted correctly only if the existence of transaction costs and asymmetric information division is taken into account.

Optimal utilization of natural resources. The model elaborated by Hotelling in 1931 and made known by Costanza et al. [6] shows the utilization of intertemporal resources. The intertemporal resource utilisation model is primarily used in the case of extraction of exhaustible natural resources, the basic characteristic feature of which is that their availability is finite and is not renewable. The starting point is that the owner of natural resources has two options:

– he extracts the natural resources belonging to him, invests the generated profit and draws income from the earned interest;

– he does not utilize the resources, expecting dramatic and sustainable growth in their value.

The owner would chose the second alternative only if the growth in expected profit generated from later extraction of natural resources exceeded the estimated income generated from interest rates. This behaviour is considered the rational extraction of resources. If with their behaviour the mining companies competing in the coal market could achieve that the value growth of their resources would equal interest rates, further extraction of resources would not be rational. Otherwise, they would have to either increase their extraction, since

from surplus revenues generated from additional interest income (in this case the market price of the product will decrease), or resource owners would produce less since, this would result in an increase in the market price, which would lead to growth in future revenues. It is clear that expectations play an essential part in the models and are experienced in the ratio of the expected interest rate and the future price of resource.

We would come to a surprising result if the model was applied for conducting analyses of species or ecological systems. They would be exploited until they became extinct or completely disappeared and this would be acceptable from the economics point of view. If the value increase of species or of an ecological system were slower than that of the invested money, both the species and the ecological system would die out. (In this case the invested money is the necessary instrument needed for maintaining and preserving the ecological system). While making an assessment of ecological systems or biological species, total economic value has to be taken into account, which apart from use value is made up of option value, existence value and bequest value. If these values are ignored, the ecosystem will be overexploited. This clearly shows that the Hotelling model is not applicable to economic assessment of biological and ecological systems and relevant results cannot be drawn for environmental protection policies.

The standard price theory. In order to set the right level of Pigovian tax it is necessary to possess an enormous amount of perfect information, so its practical application is quite difficult. This problem can be resolved by a standard price theory. There is a new approach that assumes that it is not the Pareto optimum that is to be targeted, but a previously defined emission norm which is to be achieved at the lowest possible costs [2]. Setting emission norms is the most frequently used tool for direct regulation of environmental policy. According to technical literature this process hinders the application of modern environmental friendly technologies, as producers are not interested in applying them.

Let us follow the effect mechanism of the theory in the Figure 4. Let us suppose there are two polluter companies. The horizontal axis illustrates the amount of pollution averted. Since there is a lack of information, the emission norms are set 'arbitrarily', thus the Pareto optimum is not satisfied. Lack of information is imperfect information about the psychological, health and aesthetics effects of environmental damages. The Figure shows the marginal abatement costs incurred by the two companies (MAC_1, MAC_2). In order to meet the target emission norm the pollution has to be reduced by X^* in the average. Firstly, the concerned authority imposes a tax amounting to *"t_o"*.As a result of this move, the first company abates A units of pollution since the cost of this abatement activity is less than the expected emission tax, because the tax levied on one emission unit is lower than the abatement cost of the said unit. The second company has lower abatement costs (MAC_2) and reduces the emissions by a larger extent, by B units. Both companies cut back on the emission of hazardous materials by X_1 in the average, which is still lower than the stipulated X^* amount. The decrease in the emission of hazardous materials can be the result of curbing production, as there is a supposed link between production and pollution, and of introducing environment-friendly technologies, which decrease emissions without harming production. The tax must be increased until the targeted amount of pollution decreases. It is clearly seen that a precisely calculated tax will result in achieving targeted norms, but at the beginning, when the tax is first introduced, this is not important. By changing the level of taxes governments can adjust targeted environmental norms.

The Figure shows that a tax amounting to t_1 has to be imposed in order to make the companies decrease the emission by X^* on the average. In this case the first company cuts back on pollution by C and the second one by D, which means both companies meet the targeted average norms.

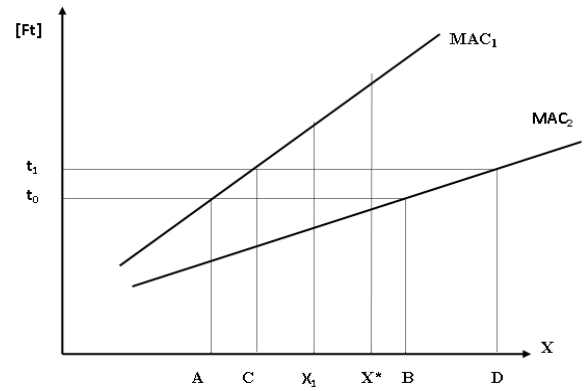

Figure 4 – **Reaching of the targeted emission standard with the adjustment of the tax level** [2]

Criticism of conventional eco- and environmental economics models. Conventional economic theories use too simple models which fail to reflect complex reality for several reasons: in real life preferences, applied techniques and technologies as well as behavioural norms are subject to continuous variation. Consequently, permanent preferences and production functions cannot be used in the models; reality cannot be characterised by conditions for perfect competition or circumstances for permanent competition. Monopolies, oligopolies and other competition barriers cause major stabilisation and allocation problems; in most economics areas decisions are not made on the basis of perfect information and involve a lot of uncertainties. Rational expectations and perfect information ensure grounds of existence for static equilibrium theories, which are not applicable for description and explanation of decisions made in sustainable non-equilibrium and uncertain conditions; the illustrated equilibrium models leave out of consideration social relationships existing in the reality. Conflicts of interests and continuous clashes are experienced in distribution of incomes and wealth, of work and production factors, issues related to quality of natural environment, competition environment and public welfare; effects of externalities are neglected in the models and are considered to be temporal problems which make economic subjects behave properly by environmental policy tools; the conventional theory considers Pareto optimal point to be a socially optimal condition. Even if the production and the distribution are believed to be socially acceptable and in line with Pareto optimum, not every allocation can be supposed socially acceptable since social legitimacy of such allocations can be queried; evolution of society is naturally dynamic and is considerably affected by social scales of values which shape institutions, human behaviour and world views. Since the equilibrium theory takes value judgment as its starting point, it fails to give an acceptable interpretation of a complex reality; the conventional economic theory takes into account only factors relying on quantitative indicators and seems an exact science, which narrows the validity area of the theory. It excludes social, ecological and psychological management dimensions in the field of raising and shooting problems; conventional economists take simple rationality problems as a starting point of complex human behaviour. A human being is an idealist and is able to do cooperative activities.

Conclusions and directions of further researches. The conventional economics lies on the fundamental assumption of neoclassical welfare economics according to which the primarily aim of economics is to achieve Pareto optimal conditions. Pareto optimum has two

meanings: if Pareto optimum means Pareto norms, it reflects relevant conditions for economic policy. If Pareto optimum is linked with marginal analysis when a determined fictitious economic optimum is sought for in a perfect competition situation, it an instrument used for formal analytical analysis.

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Характеристика та критика традиційних економічних моделей природокористування

У статті наводиться критичний аналіз традиційних економічних теорій, який доводить необхідність створення нової економічної парадигми або розроблення нового підходу до економіко-екологічних моделей. Автор представляє основні елементи екологічної економіки, що відносяться до галузі науки, пов'язаної з факторами навколишнього середовища на основі традиційних та неокласичних теорій (проблеми суспільного добробуту, теорема податків Пігу, теорема Коуза, оптимальне використання природних ресурсів, традиційна цінова теорія).

Ключові слова: традиційна екологічна економіка, суспільні блага, дилема ув'язненого, теорема податків Пігу, теорема Коуза.

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Характеристика и критика традиционных экономических моделей природопользования

В статье приводится критический анализ традиционных экономических теорий, который обосновывает необходимость создания новой экономической парадигмы или разработки нового подхода к экономико-экологическим моделям. Автор представляет основные элементы экологической экономики, которые относятся к сфере науки, связанной с факторами окружающей среды на основании традиционных и неоклассических теорий (проблемы общественного благополучия, теорема налогов Пигу, теорема Коуза, оптимальное использование природных ресурсов, традиционная ценовая теория).

Ключевые слова: традиционная экологическая экономика, общественные блага, диллема заключенного, теорема налогов Пигу, теорема Коуза.

Отримано 22.04.2014 р.