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Evolution of Concepts for Environmental Damage Economic Evaluation

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INTRODUCTION

Economic damage is defined as incremental costs to national economy and population caused by excessive pollution. Definition of economic damage is a complex interdisciplinary problem.

The logical chain of calculation of economic damage is as follows: emission of pollutants – concentration of pollutants in environment – damage in physical terms – economic damage. Different methodologies (co-ordinated on information inputs) should be used for calculation of indicator for each of these parts of the chain. To calculate "emissions – concentrations" part, meteorological, medical and biological methods should be used, to calculate "concentrations – damage in physical terms" medical-biological, physical and sociological methods should be used. Economic instruments should be used in a link " damage in physical terms – economic damage". The most difficult problem is to define damage in physical terms.

2. DETAILED DAMAGE EVALUATION METHODS.

2.1 Evaluation methods of damage in physical terms

Evaluation methods of damage in physical terms (negative social impacts like disease rate growth) could be split in 3 groups : 1) elimination of factors not pollution related; 2) method of empirical links; 3) combined method of empirical links.

The first method is based on choice of control region with such indicators that all non pollution related indicators in this and any other region will be almost the same. In this case

the difference between the regions is justified only by difference in pollution levels only. For example to define disease rate the control region should be chosen with the similar csocial factors as medical service rate, demographic composition, climate, etc. The result of this comparison is change in the recipient state (disease rate growth, etc.)

$$\Delta Y = |Y(K) - Y(3)|, \quad (1)$$

ΔY - indicator of recipient status change;

Y(3) - its state in polluted region;

Y(K) - its state in the control region.

The difference in formula (1) is an absolute value as harvest yield is higher in the control region while disease rate is lower. This method is not perfect as it is difficult to identify the compared regions and one has to agree to some assumptions due to a lot of interrelated factors.

Multidimensional classification statistical methods overcome this drawback when not 2 but N regions with M factors (exclusive pollution factors) are considered.

In this case each region can be considered as dot in M-dimension space and all information can be presented as matrix:

$$\{Xij\}(i=\overline{1,N};\ j=\overline{1,M}),$$

where:

Xij - j-factor of i-region.

Though method of eliminating factors seems very simple and attractive it can be used only for calculation of environmental damage in physical terms.

The second method – method of empirical links is based on regression analysis and provides the approximate links between status of recipient and pollution level having the other factors fixed.

$$Y = f(X,Z), \quad (2)$$

where:

Y – recipient indicator (harvest, disease rate.);

X – vector of other factors;

Z – vector of pollution level..

It is difficult to obtain reliable interlinks due to the scarce volume of background information. One of the ways to solve this problem is to reduce the quantity of factors for example to replace the pollution level vector by aggregate index of pollution.

Method of the main components is considered to be the most reliable method for empirical links.

The third method – combined empirical links is presented by formula (3)

$$\Delta Y=\psi(Z), \qquad (3)$$

$\Psi(Z)$ - function of links between damage in physical terms and pollution level factors.

The main advantage of this method in comparison with previous one is less requirement for background information to get reliable links.

2.2.Methods for economic evaluation of environmental damage

Environmental pollution generates two types of costs- preventive costs and compensation costs to recipients. Economic damage based on preventive costs is easily calculated as additional inputs required to prevent some negative impact.

Economic evaluation of damage based on compensation cost is calculated as sum of damages to different recipients such as population, housing and municipal economy, agriculture., forestry, fishery, recreational resources. The secondary pollution compensation costs also should be taken into account.

In total economic evaluation of damage is defined as follows:

$$U = \sum_{k=1}^{к} \min \{UkNk, Pk, (akUkNk + вkPk)\}, \qquad (4)$$

k и К – number and quantity of recipients;

Nk – damage in physical terms to recipient k;

Uk – monetary value of compensation of unit of environmental damage in physical terms to recipient k,

Pk – preventive cots to recipient k;

$0< ak, вk <1$.

Optimization method is used to calculate the damage to agriculture.

The aggregate method of economic damage calculation was proposed in the Temporary standard methodology for economic effectiveness of environment protection interventions and evaluation of economic damage cased by pollution to national economy in 1986. That document was constantly improved in later documents. In total all these methods are based at calculation of direct and current assessments for a range of different types

2. 3. Use of economic damage in decision making process.

Economic evaluation of damage can be used when calculating the economic effectiveness of environment protection interventions. Besides environment impact assesment part of any investment proposals could require the economic evaluation of non-compliance with environmental legislation.

On macroeconomic level this indicator can demonstrate how environment protection strategy impacts the national economy performance. Green GDP could be considered as main socio-economic indicator of national economy development in long-term perspective.

Detailed analysis of different methodological approaches for calculation of damage caused by air pollution is provided. Case study demonstrates that due to the low indexation of pollution charges preventive damage is several times higher than savings on pollution charges due to interventions implemented. Thus it is recommended in feasibility studies to use prevented damage indicator instead of pollution charges savings that is common practice now.

Conclusions

Economic evaluation of environmental damage could be carried out by different methods having their advantages and drawbacks. The modern software simplifies the process a lot. The key factor to ensure the reliability of calculations is availability of relevant data in a required format and its quantity. But if properly performed this evaluation could serve and effective instrument in decision making process for investment planning and prioritization in compliance with environmental regulations. It also can contribute to “greening” of national economy performance indicators and economic development strategy.