Environmental Protection Network in the Context of Covid-19

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Abstract

The paper proposes a model of dot-matrix approach to financial management as part of an environmental management. Presentation of all the matrices that will lead to development source-destination matrix (matrix funding integrative) constitutes a first attempt to approach the environmental financial management.

The paper aims to identify sectoral interdependencies from the perspective of pollution, in terms of environmental costs and investments and the development of a mathematical model in which all links can be established and estimated statistically.

The network is an integrated element of communication between interconnected elements in multiple dimensions, and networking is an adaptive response to the need for rapid development. Each node of the network is important because there is no hierarchy in the network, the emphasis being on relationships, not situations, on goals, roles played, on the nature and intensity of contacts between the elements that make up the network nodes. The specificity of the network is to ensure continuity between the micro macro and the world economic level. The negative impact of the COVID-19 pandemic, as well as the policies adopted to combat it, have left their mark on the environment. Network financing is done to balance the damage to the environment.

Key words: environment, negative impact, matrix, management, costs
J.E.L. classification: Q01, Q52, Q58

1. Introduction

In order to study the financial effects of environmental damage, the network approach of environmental factors, connections and co-determinations of pollutants is used.

The model brings together in a network of environmental protection, environmental factors, pollutants, pollutants, environmental risks, financial flows, financial instruments of environmental protection as well as decision makers in this field. It offers the possibility to determine the areas of induction of environmental damage as well as the poles for transmitting the negative financial effects, thus ensuring the focus of the instruments and flows involved in environmental protection.

The model, developed as a matrix application, is based on the balance between the costs of pollution (both causal and those induced by one sector to another), on the one hand, and the investments needed to protect the environment, on the other.

This type of matrix approach is increasingly used in developed countries as it is easier to adapt, being applicable both at the level of the national economy and in small areas, respectively at the level of sectors, industries or even enterprises, as the use of sophisticated computers and software makes the analyst's job much easier.

2. Theoretical background

In all situations the analysis procedure is similar. The cost of pollution is represented in the form of a vector, which describes in quantitative terms the relationship between the financing need and the funds allocated for this purpose. The interdependence between the different polluting sectors (or industries) is described by a set of linear equations, which expresses the balance between the total cost and the total investment of each sector and as a whole.

The use of the matrix in order to achieve the relevant, was based on the following aspects:

- the matrix is more than a way of presenting or storing information in tabular form, it is above all an analytical tool;
- the analysis with the help of the matrix ensures a relatively easy and pragmatic understanding, proving to be a useful means of evaluating the financial interactions that characterize the economy in general;
- by applying the matrix analysis of pollution costs, the public and private sectors have the opportunity to better assess the repercussions that the decisions and actions of the government, economic agents, etc. They have them on different sectors;
- the matrix captures both the sources of change and the magnitude and direction of change. Changes in pollution costs may be related to changes in environmental conditions;
- the matrix allows the realization of forecasts regarding environmental costs and investments, through a better understanding of the forecasted changes.

The present model is a useful, at least theoretical, way to approach the balance of costs generated in the process of environmental protection and funds from different sources, necessary to cover the costs generated in the process of environmental protection and funds from different sources, necessary to cover costs.

The principles underlying this model are the following:

- The conservation law applies not only to energy but also to pollution, in the sense that if one sector does not pay its pollution debts, another sector must bear at least part of those costs. This is a consequence of the fact that by not acting in the sense of reducing pollution, it is reduced by itself to an insignificant proportion, with air, water and soil having limited self-cleaning capacity;
- The environment is seen as an interconnected system, as are the polluting sectors, so that structural and cost changes have mutual implications.

3. Research methodology

The model takes into account both the direct or causal costs, respectively the costs that the respective sector has to bear in order to reduce the pollution so that it falls within the legal limits, as well as the costs induced by one polluting sector to another sector, due to lack action to limit pollution. The biggest difficulty is probably to assess the extent to which one sector incurs pollution costs for another. To this end, a physical assessment of the level of pollution caused by one sector by another sector would first be required, which would then be expressed in monetary terms.

Next, a matrix model for approaching financial management is proposed as a component part of ecological management. The presentation of the matrix set that will lead to the elaboration of the source-destination matrix (the integrative financing matrix) is a first attempt to approach the matrix of ecological financial management.

With the help of the matrix formalization, an instrumental matrix of the financial network architecture can be made, highlighting on the lines the institutions, on columns the financing sources, and at their intersection representing the existence or non-existence of financing, as well as the intensity of using these sources.

4. Findings

Formalizing matrix the characteristic elements of the attributes of ecological management at the level of each social entity, results the primary matrix (Table no.1) which highlighted the stratified structure of environmental damage (air pollution, water pollution, waste pollution, groundwater and groundwater biosphere pollution), on columns the environmental protection measures, and at their intersection were represented the scores "xij" given to each measure against environmental damage depending on the degree of intensity with which it manifests itself at each level. Such a matrix was exemplified in Table no.1: D- depollution, E- purification, C- collection, R- reduction, G- management).

Table no. 1 Primary matrix

Measuring Environmental factors	**D**	**E**	**C**	**R**	**G**
Air	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}
Water	x21	X_{22}	X_{23}	X_{24}	X_{25}
Waste	x31	X_{32}	X_{33}	X_{34}	X_{35}
Ground	X_{41}	X_{42}	X_{43}	X_{44}	X_{45}
Bios	X_{51}	X_{52}	X_{53}	X_{54}	X_{55}

Source: author data

Where xij = the numerical value of the score of the environmental protection measure "i" at the level of damage status "j", xij = [1,5] where the score 1 is given for the low intensity with which the attribute "i" is manifested at the level "J" of damage stratification, and score 5 is given for a strong intensity

Using the measures of ecological management in terms of environmental protection, the weight matrix shown in Table no.2 can be highlighted.

The two primary matrices (Table no.1) and (Table no.2) are the result of some political decisions of the managers at different levels: ministry, local administrations, etc.

At the same time, these decisions are adopted according to the objectives of the environmental protection policy of the respective area, decisions that may vary from one period to another.

Table no. 2 Matrix of instrument weights when carrying out measures for environmental protection

Tools/ Measures	**Tariffs and taxes**	**Pollution permits**	**Subsidies**	**Agreements**	**Consignment systems**
D	Y_{11}	Y_{12}	Y_{13}	Y_{14}	Y_{15}
E	Y_{21}	Y_{22}	Y_{23}	Y_{24}	Y_{25}
C	Y_{31}	Y_{32}	Y_{33}	Y_{34}	Y_{35}
R	Y_{41}	Y_{42}	Y_{43}	Y_{44}	Y_{45}
G	Y_{51}	Y_{52}	Y_{53}	Y_{45}	Y_{55}

Source: author data

Yij = the share of environmental protection instruments "i" in the implementation of environmental protection measures "j"

By multiplying the two matrices (Table no.1) and (Table no.2) the derived matrix will be obtained (Table no.3- intensity matrix), the coefficients of the matrix "zij" highlighting the value of the intensities with which the ecological management tools "i" are manifested at the stratification level. damage "j".

Table no. 3 Matrix of intensities with which environmental management tools act

Tools/ Hierarchical level	**Tariffs and taxes**	**Pollution permits**	**Subsidies**	**Agreements**	**Consignment systems**
Air	Z_{11}	Z_{12}	Z_{13}	Z_{14}	Z_{15}
Water	Z_{21}	Z_{22}	Z_{23}	Z_{24}	Z_{25}
Waste	Z_{31}	Z_{32}	Z_{33}	Z_{34}	Z_{35}
Ground	Z_{41}	Z_{42}	Z_{43}	Z_{44}	Z_{45}
Bios	Z_{51}	Z_{52}	Z_{53}	Z_{54}	Z_{55}

Source: author data

Where $Z11 = X11 \cdot Y11 + X12 \cdot Y21 + X13 \cdot Y31 + X14 \cdot Y\ 41 + X15 \cdot Y51$

. . . .

$$Z55 = X51 \cdot Y15 + X52 \cdot Y25 + X53 \cdot Y35 + X54 \cdot Y45 + X55 \cdot Y55$$

The intensities with which the deterioration of the environment manifests itself at different levels of stratification at a given time are reversed as the social entity moves to a new stage of development or changes its objectives in terms of environmental protection.

The illustration of these three matrices (Table no.1, Table no.2 and Table no. 3) was part of a foreground, that of ecological management.

The transition to a secondary plan of financial management will be achieved through the cost matrix, where on the lines are presented the ecological functions, on columns the types of costs involved in performing ecological actions, and at their junction will highlight the share of cost "i" at performing the action "j" in total cost "i" (Table no.4).

Table no. 4 Cost matrix

Cost Activity	Cost de D	Cost de E	Cost de C	Cost de R	Cost de G
D	f_{11}	f_{12}	f_{13}	f_{14}	f_{15}
E	f_{21}	f_{22}	f_{23}	f_{24}	f_{25}
C	f_{31}	f_{32}	f_{33}	f_{34}	f_{35}
R	f_{41}	f_{42}	f_{43}	f_{44}	f_{45}
G	f_{51}	f_{52}	f_{53}	f_{54}	f_{55}

Source: author data

Where to fix the share of the cost "i" in carrying out the action "J", in total cost "i".

The result of the multiplication of matrices M3 and M4 will be concretized in the exemplification of the derived matrix M5 (Table no. 5) which will contain on lines the types of social entities, on columns the types of costs required to carry out ecological actions, and at the intersection of lines and columns is the coefficient cost "i" at the hierarchical level "j"

Table no. 5 Cost matrix on hierarchical levels

Cost Hierarchical level	Cost de D	Cost de E	Cost de C	Cost de R	Cost de G
Economical agents	b_{11}	b_{12}	b_{13}	b_{14}	b_{15}
Local communities	b_{21}	b_{22}	b_{23}	b_{24}	b_{25}
Regional communities	b_{31}	b_{32}	b_{33}	b_{34}	b_{35}
County communities	b_{41}	b_{42}	b_{43}	b_{44}	b_{45}
National Communities	b_{51}	b_{52}	b_{53}	b_{54}	b_{55}

Source: author data

Where bij = the cost coefficient "i" at the hierarchical level "j".

As the ecological financial management is mainly oriented towards the adoption of decisions regarding the financing of ecological activities and actions at the level of each entity, it is necessary to introduce in the presented matrix series a matrix in which the costs of carrying out ecological actions will be highlighted. on columns the financial sources necessary for the financial support of the ecological management.

The conjunction of the lines and columns will lead to the illustration of the coefficient cij - the coefficient of the financing source "i" in the cost "j".

Where cij = coefficient of the source of financing "i" in the cost "j".

Table no. 6 Matrix of funding sources

Sources Costs	Tariffs and taxes	Pollution permits	Subsidies	Agreements	Consign-ment systems
Cost D	C11	C12	C13	C14	C15
Cost E	C21	C22	C23	C24	C25
Cost C	C31	C32	C33	C34	C35
Cost R	C41	C42	C43	C44	C45
Cost G	C51	C52	C53	C54	C55

Source: author data

Knowing the absolute value of the total sources of financing by categories of origin and the total costs of depollution, treatment, collection, pollution reduction and management, the cij coefficient can be determined as follows: cij = (Total source i) / (Total cost j)

The multiplication of the last two matrices (figure 5 and figure 6) will lead to the matrix of the source-destination coefficients illustrated in figure 7. From the "cascade" multiplication of the six matrices resulted the matrix of coefficients, which will contain on social lines funding sources, and at their intersection is the source coefficient "i" at the hierarchical level "j".

Table no. 7 Matrix of coefficients source destinations

Sources / **Hierarchical level**	**Tariffs and taxes**	**Pollution permits**	**Subsidies**	**Agreements**	**Consign-ment systems**
Economical agents	S11	S12	S13	S14	S15
Local communities	S21	S22	S23	S24	S25
Regional communities	S31	S32	S33	S34	S35
County communities	S41	S42	S43	S44	S45
National Communities	S51	S52	S53	S54	S55

Source: author data

Where sij = the coefficient of the financing source i at the hierarchical level j.

The matrix of the source-destination coefficients, mediates the obtaining of the source-destination matrix (the integrative financing matrix). This matrix is an input-output matrix in which the elements xij represent the volume of financing resources from the hierarchical level "i" absorbed - as inputs - by the stratification level "j". The volume of the financing source of level "i" absorbed by the level "j" per unit of financing sources "j" is described by the coefficient sij (contained in the matrix M7).

Thus, an instrumental matrix can be made - figure 8, of the architecture of the financial network of environmental protection, highlighting on the lines the institutions and on the columns the instruments, and at their intersection the intensity of using this instrument is obtained.

Table no. 8 The source-destination matrix

Sources / **Hierarchical level**	**Tariffs and taxes**	**Public, central, and local budget**	**Environmental funds**	**Grants and loans**	**Total**
Economical agents	X11	X12	X13	X14	X1
Local communities	X21	X22	X23	X24	X2
Regional communities	X41	X42	X43	X44	X3
National Communities	X51	X52	X53	X54	X4
Total	X1	X2	X3	X4	

Source: author data

Where we noted: Xj = total funding sources at level j, sij = xij / Xj where it follows that xij = sij · Xj

By writing the matrix the above relation is obtained:

$$\begin{pmatrix} x_{11} & x_{12} & x_{13} & x_{14} \\ x_{21} & x_{22} & x_{23} & x_{24} \\ x_{31} & x_{32} & x_{33} & x_{34} \\ x_{41} & x_{42} & x_{43} & x_{44} \end{pmatrix} = \underbrace{\begin{pmatrix} s_{11} & s_{12} & s_{13} & s_{14} \\ s_{21} & s_{22} & s_{23} & s_{24} \\ s_{31} & s_{32} & s_{33} & s_{34} \\ s_{41} & s_{42} & s_{43} & s_{44} \end{pmatrix}}_{M_7} \bullet \underbrace{\begin{pmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \end{pmatrix}}_{X_j}$$

Knowing the matrix M7 and the vector Xj, the integrative financing matrix is determined.

5. Conclusions

The network is a practical solution for adapting to ecological requirements. It is an organizational concept in which are highlighted: the complexity of the network, the asymmetry of the network and the reliability of the network (the ability of the network to connect to other networks within the social network).

The desire to carry out a work that captures the protection of the environment from a completely different perspective from what has been achieved so far, has led to the realization of this model, which has, however, certain limits, objectives and subjective:

- The data underlying the model are insufficient, both in terms of costs and environmental investments, and their quality varies;
- The model implies simplification and as not all data are available, some information will undoubtedly be of a qualitative nature, difficult to express quantitatively;
- Given the various methods of cost evaluation, the results are difficult to compare. Moreover, even the same assessment methods can lead to qualitatively different results, so that the results of a particular environmental cost-investment study cannot be scientifically defended;
- The analysis process through this matrix is expensive, in terms of time and money, as the data underlying the analysis should be obtained either empirically or from the literature;
- The usefulness of the model is limited by the fact that it is limited only to the polluting sectors, so that other pollution factors are omitted
- Setting the limits of the model is arbitrary and controversial, taking into account the fact that the determination of the pollution cost of each sector is made according to all other sectors;
- By such an approach important effect can be ignored and wrong conclusions can be drawn; for example, the indirect effects of reducing pollution costs in a sector may be greater than the direct effects;
- Environmental cost-investment analysis is assumed to be a linear function; thus, when the cost of pollution in a sector change, it is assumed that the investments required to cover the costs change in the same proportion. For example, when the cost doubles, investments must also double; if innovative technologies allow the production of less polluting products or increase the efficiency of "depollution", the assumption of linearity of investments and sectoral costs would be totally wrong;
- The model is a static one, not surprising the dynamics of changing costs and respectively the funds allocated to cover them, which is a major disadvantage in a constantly changing world;
- Overlaps in cost estimation may occur in the model, for example mentioning the same pollution costs for both a certain type of industry and agriculture;
- Given the above-mentioned limits, the practical application of such a model is difficult to achieve, at least in Romania.

This methodology allows an estimate of the environmental costs and the funds intended to cover them at a given time. The model could be improved by introducing more advanced mathematical methods, for example, systems of differential equations, which allow dynamic analysis. years.

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