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A STATISTICAL ASSESSMENT OF THE ECOLOGICAL DIMENSION OF THE ROMANIAN ECONOMY

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ABSTRACT. Starting from the available statistical information this paper proposes an analysis of the ecological dimension of the Romanian economy. Considering the crucial importance of reducing carbon dioxide emissions to diminishing greenhouse effects an econometrical model has been conceived so as to study the correlation between these emissions and their main determinants. Some major difficulties in detailed environmental data collection and constructing long time series have been revealed on this occasion.

1. Introduction

The environmental quality in Romania is mainly affected by the irrational exploitation of the natural resources, the negative impact of many economic activities, inadequate urban structures – sometimes in conflict with human settlements development, transborder pollution, etc. The relation between the socio-economic system and the ecological equilibrium can be analysed starting from the objectives of the environmental protection strategy, which concentrate on the available natural resources, the level of the socio-economic life and the quality of the environmental factors. It induces the need of measuring the influence of economic activity upon environmental factors and the quality of these factors, the financing capacity of environmental protection, the impact of environmental conditions on human life.

The *major difficulty* of such a research is *data collection*. As previously mentioned, the available statistical data sources are insufficient, only partially covering the environmental issues. On the other hand the structure of the published information is frequently modified, even from a year to the next one, making it even more difficult the construction of complete statistical distributions, as needed for analysing various evolutions and elaborating econometric models.

2. The ecological dimension of the Romanian economy: an analysis based on the available statistical information

Considering the available data for 1998, Romania can be described as a country of 22.503 million inhabitants, with a density of 94.3 inhabitants per square km, the GDP per capita of 4244 USD and the average life expectancy (in 1997) of 68.95 years.

The state and the evolution of the environmental factors can be understood firstly considering the major changes occurred over the last years. Before 1990 Romania was a country characterised by an economic activity industry dominated (with a contribution of more than 50% to GDP). The main industrial activities used to concentrate on machinery building, chemistry, construction materials, etc. The industrial development exerted a big pressure on the available natural resources, which were abusively exploited, with considerable repercussions on the natural environment. Industrial giants – huge energy consumers, changed the ecological equilibrium in many geographical areas. The pollution and the ecological protection were not seriously considered. As a result, the health state of population was deeply affected: in 1989 the mortality rate was 10.7‰, the child mortality 26.9‰ and the average life expectancy at birth of 69.56 years.

Since 1990 the economic activity has recorded a significant decline in all sectors. The different dynamics by sector has induced important changes in the GDP structure by category of resources, mainly reflected by the decrease in the share of industry and agriculture and the service share increase (Table 1).

Table 1

GROSS DOMESTIC PRODUCT BY CATEGORY OF RESOURCES

Resource	1990	1992	1995	1997
Structure (%)				
Agriculture	21,8	19,1	20,4	17,7
Industry	40,5	38,3	32,7	35,5
Construction	5,4	4,8	6,6	5,2
Services	26,5	40,6	38,0	41,6
Indices (%)				
Agriculture	100	76,5	94,2	89,1
Industry	100	79,2	83,1	83,5
Construction	100	76,1	128,9	103,5
GDP – total	100	79,4	89,8	86,8
- per capita	100	80,9	91,9	89,5

Source: *Romanian Statistical Yearbook*, 1998, p. 340 - 342

Agriculture. In 1997 the agricultural area represented approximately 62% out of the national territory (14794 thousand ha). The decline of the agricultural activity has been associated with a weak land use and even its abandoning in some cases, leading to an important deterioration of the agricultural land. Large surfaces are affected by different factors limiting the productive capacity (Table 2). Some of these factors have a large extension, between 40% and 50% out of the total surface: frequent drought (48%), water
soil erosion (43%), soil compaction owing to inadequate works (44%), small and very small humus deposit in soil (49%), very weak and weak ensuring with mobile phosphorus
(43%).

Table 2

AGRICULTURAL LAND AREA AFFECTED BY DIFFERENT LIMITATION FACTORS OF THE PRODUCTIVE CAPACITY, IN 1997

Limitation factor	Affected area (thou ha)
Frequent drought	7100

Frequent water excess in soil	3781
Water soil erosion	6300
Landslide	702
Wind soil erosion	378
Excessive skeleton from soil surface	300
Soil salt	614
Soil compaction owing to inadequate works ("plough sole")	6500
Soil natural compaction	2060
Crust formation	2300
Small and very small humus deposit in soil	7304
Strong and moderate acidity	3420
High alkalinity	220
Very weak and weak ensuring with mobile phosphorus	6289
Weak ensuring with nitrogen	4883
Deficiency of microelements (zinc)	1500
Soil chemical pollution due to different socio-economic activities	900
Pollution with oil and salty water	50
Pollution with wind carried substances	147

Source: *Romanian Statistical Yearbook*, 1998, pg.48

The soil arrangement works – irrigation, draining, fighting soil erosion, were not significantly modified over the last ten years and did not have a positive influence on the agriculture productivity. Some positive influences on the environment have had the decreasing use of chemical substances (Table 3).

Table 3

CHEMICAL SUBSTANCES USED IN AGRICULTURE

Year	Chemical fertilisers (kg/ha)	Pesticides (kg/ha)
1989	78	4,8
1990	75	3,5
1991	32	1,8
1992	29	1,7
1993	37	1,6
1994	33	1,5
1995	32	1,4
1996	29	1,2
1997	27	1,1

Source: *Romanian Statistical Yearbook*, 1998, pg. 454 - 455

Industry. The decline of the industrial activity during the transition period has determined a decrease of polluting emissions. One of the activities of the highest impact on the environment is the energy sector, which discharges big quantities of polluting substances (sulphur dioxide, nitrogen dioxide, carbon dioxide, etc.) as a result of coal, petroleum, natural gas combustion. In 1992 the electric and thermal energy production was 15% lower than in 1990, respectively 7% lower in 1997. The energy production is more and more based on coal use whereas the available primary resources have been dramatically decreased, by 33% for liquid fuel, 25% for solid fuel and more than 45% for gas fuel (Table 4).

Table 4

RESOURCES OF PRIMARY ENERGY FOR CONSUMPTION

thou tone C.F.

Resource	1990	1995	1996	1997
Liquid fuel	27354	19255	18766	18796
Solid fuel	17828	15497	15347	13918
Gas fuel	40960	27891	28255	22911

Source: *The Environment in Romania. Annual Bulletin*, National Commission for Statistics, Bucharest, 1988, p.30

Transport. The transport activity affects the environment through emissions eliminated by the transport means and also by the nature of transported goods. The volume of transport means has increased, particularly for road transport. The number of cars increased in 1997 by 63.6% compared to the level of 1992 (the majority are second hand, imported cars, not observing the pollution standards). The number of merchandise motor vehicles has also increased by 39.3%. In the same period an increase in the volume of transported goods – harmful to the environment (especially chemical and oil products), has been recorded for both rail and road transport.

The changes recorded in the economic activity have induced *changes in the quality of the environmental factors* as well.

Air quality. The maximum admitted concentration is currently exceeded in some localities for a couple of high frequency substances, having a constant upward dynamics between 1990 and 1997, in spite of the overall decrease of the polluting emissions generated by the economic activity decline. According to the frequency of exceeding the maximum admitted concentration the worst situation was recorded for lead (69.5%) and sulphur dioxide (47%).

Water quality. The waters hold approximately 3.7% out of the total territory. Around 50% of the Romanian surface waters are of a high quality (first quality category) whereas by 14% are included into the third category (the poorest quality). The 1990-1997 trend indicates a decrease in the length of polluted sectors and an increase in the percentage of the first category rivers.

Soil quality. In 1997 the surfaces affected by pollution, erosion, drought, salting, etc. represent a significant percentage out of the total agricultural area (Table 1). The soil quality has been damaged as a result of irrational natural resource exploitation, incorrect irrigation solutions, pesticide treatments superficially controlled.

Forest quality. The forest surface represents approximately 28% out of the national territory, being dramatically reduced over the last fifty years. At present, even though the volume of the exploited wood does not increase, the irrational exploitation generates a serious negative impact on the environment and human security (frequent floods, material and human loses). The forest quality is mainly expressed by the percentage of forests affected by tree defoliation. In 1997 by 57% out of the forest area was not affected by this phenomenon, 26% was slightly affected, 15% was in the average defoliation class whereas about 2% was drastically affected or already dead. However, in general terms the quality of Romanian forests can be considered in accordance with the European quality standards.

Waste administration. The economic activities released around 328 million tones of waste in 1994 (mainly industrial waste). The storage creates particular problems to the environmental protection: soil damage, air and water pollution.
In the cities household wastes reached in 1994 5.8 million tones. They are usually stored near the human settlements and the surface waters, without clear control rules and measures for preventing pollution. As a consequence, waste administration remains one of the most serious problems of the environmental management in the next years.

The environmental protection expenditures are mainly oriented to activity sectors like electric and thermal energy, gas and water (40%), manufacturing (25%), waste treatment (10%). The structure by specific activity of environmental protection is the following: pollution prevention and control – 88.4%, natural environment protection – 7%, research, development and training – only 2.2%, general environmental administration – 2.4%. In all cases the current expenses exceed by two times investment expenses. The situation described reveals a limited perception of the environmental issues, of the ecological equilibrium, subordinated to the production resource provision rather than to ecological constraints.

The quality of life has diminished dramatically within the overall unfavourable economic situation, characterised by a continuous decrease in GDP and production volume, an unemployment rate by 10%, a high inflation rate (hardly maintained at around 50% per year), a low level of social protection, an extreme decrease in the real income, low level of consumption, of an irrational structure, poor health assistance. Under these conditions the basic demographic indicators highlight the following situation:

• a negative natural increase since 1992;

• the general mortality rate increased from 10.7‰ in 1989 to 12.4‰ in 1997;

• even though the infant mortality rate (infant death per 1000 life births) slowly decreased from 26.9 in 1989 to 22.0 in 1997, it maintains Romania at a high level among the European countries, only Albania having an infant mortality rate higher than Romania;

• the life expectancy at birth dropped from 69.76 years in 1989 – 1991 to 68.95 years in 1995 – 1997.

Taking into account the quite poor state of the environmental statistics, the influences of the environment degradation upon population's health can be hardly identified, even though these influences certainly occur. Yet, starting from the existing data, the decrease in the new severe illness cases (Table 5) can be considered a consequence of the positive evolution of the environmental quality over the last ten years.

Table 5

NEW CASES OF ILLNESS, BY DISEASE CLASS

thou persons

Disease class	1992	1995	1997
Neoplasm	45	37	35
Mental disorders	192	152	136

Diseases of the nervous system and of the sense organs	1088	901	795
Diseases of the respiratory system	6887	7439	7160
Skin and hypodermic diseases	966	983	847
Congenital malformations	4	3	3

Source: *Romanian Statistical Yearbook*, 1998, p. 229

3. An econometrical model for studying the relationship between the carbon dioxide emissions and the main factors of influence

Considering the importance of reducing the carbon dioxide emissions to diminishing greenhouse effects *an econometric model* has been conceived so as to study the relationship between the carbon dioxide emissions and the main factors of influence. Even though there are many aspects of environmental protection vital to everyday life, with immediate impact on human security, this analysis has been chosen considering that carbon dioxide emissions represent a continuous threat, of a long run impact on global warming, with all derived consequences. In this context the use of an econometric model is important to revealing stable relationships over time.

In the specific case of Romania the construction of econometric models is strongly dependent on the statistical data problem, in the following terms:

• long series of data cannot be obtained, as required by the assumptions of the parameter estimation methods;

• in some cases data are not entirely comparable;

• the poor development of the statistical system in the environmental field makes it difficult to find available data for some important variables.

Nevertheless, in the particular case of carbon dioxide emissions data series can be constructed, even though the drawbacks mentioned above make it possible to obtain data series only for 1990 – 1997. This situation has to be considered in result interpretation.

Between 1990 and 1997 the carbon dioxide emissions dropped by 20% as a result of both reducing and restructuring the economic activity and increasing environmental protection expenditures.

The model proposed has aimed to express the carbon dioxide emissions (Y) as a resultant variable depending upon two independent variables, namely the volume of industrial activity in comparable prices (I) and the number of cars (A).

Apart from the sign of restrictions derived from the economic theory, the choice of equation has been primarily based on the adjusted R-squared, t-statistic, F-statistic and DW. The OLS method has been used for parameter estimation.

Finally the carbon dioxide emissions have been expressed using the following linear function:

$$Y_t = -6235.6 + 0.023662\ I_t + 0.000935\ A_t$$

According to F-stat and t-stat the model is valid and highlights the increase in carbon dioxide emissions as a result of car number increase. It also reveals that industry is an important factor of increasing carbon dioxide emissions. Practically, excepting industry and transportation the other economic activities have a very reduced contribution. Thus the model suggests the importance of restructuring processes according to environmental restrictions so as to support those industrial branches less harmful to environment.

The information provided by the model results can be considered as a useful starting point for a proper investment structure within forthcoming environmental strategies so as to include not only aggregate indicators but also analytical structures of investment.

Under the new conditions the values of the model parameters will be certainly changed and will reflect more rational correlations.

In the construction of such models the question of data accuracy remains essential. Thus in the reports on the carbon dioxide emissions level the measurements were indicated as the source of data whereas, in fact, the emissions were estimated on the basis of fuel consumption, all models indicating a very strong correlation between these two indicators. Hence, the usefulness of the model proposed, which focuses on the importance of industrial structural changes.

Note: This paper represents a development of the author's contribution to the Romanian case study presented at the ENRICH-NES Workshop held in San José de la Montagna, Costa Rica in December 1999.