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Assessment of sustainable development in transition

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The article deals with changes induced by the transformation of centrally planned economy relations into a market economy. The article provides an analysis of economic transition experiences over more than a decade. Implementing an economic transition and structural adjustment policies involves complex irreversible economic, ecological and social processes. Such policies rarely appear to be adequate for meeting the main goals of sustainable development. Countries of the former Soviet Union are today expected to perform the reforms of institutional structures and the market system within a few years that have taken Western countries centuries to develop. The short and systemic collapse of the command or centrally planned economy enables one to revise the knowledge of how socio-economic systems react to a sudden rise of external and internal changes.

However, scientists that assess the processes in question encounter serious difficulties. Direct analysis of the aggregated indicators rarely reveals the correlation of the processes and explains their changes. Recently, new and more complex models have been applied; usually they are more sensitive with regard to potential observation errors, and their application lowers the complexity of forecast and the uncertainty of outcomes. The article presents the models of the aggregated indicators that assess their correlation and time-related alteration.

Our analysis is based on empirical data on pollution variation, income, energy consumption and some social indicators of Lithuanian residents; also, it examines the ecological, economic and social components of development. The analysis is grounded on models and examines their evolution and the compatibility of the processes with the priorities of sustainable development.

Key words: sustainable development, transition economy, air polution, socio-economic indicators

INTRODUCTION

Transition from command economy relations to market economy relations is a long-term and very complicated process that covers all fields of life. It disrupts the old system and alters a society at every level: from the economic policy pursued by the state to the perception of oneself and of a society. These changes and the creation of the new system are accompanied by major social and economic shocks. In this period, it is particularly difficult to maintain the balance and sustainability of the processes that take place. Sustainable development is here understood as *the pursuit of an even socio-economic development that does not cause damage to the environment, does not waste natural resources nor builds up tension within society*. Sustainable development is often related to the issue of the quality of the earth that future generations will inherit (Thomas et al., 2000). The concept of sustainable development includes the way to match two different and sometimes contradictory attitudes, e.g., "development-progress-growth" and "stability-security-environment". The UN Commission (Brundtland Commission) has brought forward this dilemma by stating: "Sustainable development is the process that meets present requirements without compromising the ability of future generations to meet their own needs' (WCED, 1987). The ways used in the pursuit of the priority goal of a modern society differ, depending on the level at which they are analysed. At the international level, e.g., the World Commission on Environment and Development (WCED, 1987), United Nations Environment Programme (UNEP) attention was paid to growing populations, increasing wealth gap, and poverty and environmental degradation. At the international level, in response to international requirements, most states have drawn up their strategies for sustainable development (e.g., the Government of the Republic of Lithuania approved the National Strategy for Sustainable Development in 2003) on the grounds of guiding principles in Agenda 21.

The National Strategy for the Sustainable Development of Lithuania emphasises that one of the major tasks of decision-making at all levels of governance is to ensure the continuity of social development, integrity of social, ecologic and economic fields and the efficiency of decisions that are being made. Some of the present-day problems in Lithuania have been inherited from the past, while some of them are brought by poor political decisions or social or environmental policies that are being pursued in a wrong way. Their relations are complex and often difficult to determine (Burinskienė, Rudzkienė, 2004). One of the possible ways to finding a solution is to divide the indicators that characterise the situation into individual logical clusters and to assess their relations, alteration dynamics and likely methods for process management.

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FORMS OF MODELLING COMPLEX DYNAMICS OF TRANSITION PROCESSES

Development of advanced computer-based modelling, analysis tools and global environmental, economic and social challenges have expanded interest in the application of computational models and approaches to the study of human systems. Direct measurements of many influencing factors are not sufficient to provide an understanding of the forces driving change and forecasting possible trends and fluctuations. The progress achieved in the analysis of dynamical systems over the last two decades has reinforced the interest in dynamic models. The promising class of models is multi-agent system models. Agents are the fundamental component of these models, and they have been used to represent a wide variety of entities, including organizations, people, biological cells and atoms (Janssen, Jager, 2000; Epstein, Axtell, 1996). Agents are autonomous; autonomy means that they have control over their actions and the internal state in order to achieve their goals. Agents are modelled according to the principle of rationality, and they are supposed to determine the actions in such a way that the goals are maximized.

There are two cardinal different tendencies to apply when looking at fluctuations of social economic variables. The linear method assumes that socio-economic fluctuations can be explained as a phenomenon, i.e. distributed by exogenous stochastic shocks. On the other hand, fluctuations may be explained as generated endogenously by non-linear properties of the system. Many scientists assess socio-economic fluctuations as a result of the interaction of market forces, social changes, and technologies and preferences (Feichtinger, 1996; Lorenz, 1993).

Modelling the transition processes in a simplified form can be based on some broad, partly overlapping categories of models: mathematical equation-based, system dynamics, statistical, expert systems, and/or evolutionary or hybrid. By applying these models, the possibility of discontinuous transformation of quantity into quality (that can arise during the initial transformation phases) should be suggested. The non-linear dynamic phase is expected when the old system enters a period of crisis. Such a dynamic period can also be observed after an economy has hit the bottom and begun to grow again (Rosser, 2002).

The hierarchical structure of the global complex system as well as feedback loops among the different hierarchical levels induce non-linear behaviour of the system. Such systems are composed of a large and an increasing number of components and have the ability to adapt to new changing conditions. Complex system theory establishes that sometimes smooth and continuous behaviour is possible, but it is not always like that (Nicolis, Prigogine, 1977). This is because positive feedback loops might generate self-reinforcing mechanisms. Non-linear behaviour of a system and for equilibrium situations leads to the existence of a multiplicity of stable states or attractors. An attractor represents a region in which the behaviour exhibited by the system is coherent and organised. Once the system reaches the attractor, it fluctuates around it at least for a certain period of time (Kay et al., 1999). If the system is on an "attractor point", some change parameters (e.g., GDP) will not always lead to adequate changes in other variables. This situation leads to "bifurcation" points in which, for given boundary conditions, there are many stable solutions. When the parameters go beyond a critical threshold, the system becomes most sensitive and is therefore unstable (Faber, Proops, 1998; Dyke, 1994). Any crises of the system are preceded by corresponding changes in the adequate indicators of the system. Qualitative measurement of these indicators may lead to the forecast of the economic or social crises. The assessment of technological development implies adaptability in a complex system. Further improvement can be achieved with the use of information knowledge, organization and the introduction of new processes.

The mutual interaction between the system and its surrounding is immanent for any system. The changes in the interaction rate will affect the safety of the system. For example, sudden change in the environment can lead to social disturbance.

Complex models (Zavadskas et al., 2004, Turskis et al.,2006) are more sensitive with regard to potential observation errors, and their application lowers the complexity of forecast and the uncertainty of outcomes. As the article analyses short-time lines, their analysis is carried out using probability models of the aggregated indicators that assess the correlation of variables and approximate time-related alterations.

CHARACTERISTICS OF REFORMS AND DEVELOPMENT PROCESSES: LITHUANIAN EXPERIENCE

Economy analysts give a rather positive assessment of Lithuania's economic development. The European Bank for Reconstruction and Development acknowledges that Lithuania has achieved impressive progress and has overtaken many neighbours. Such assessment is based on very good macroeconomic indicators: a rapid growth of gross domestic product (GDP) (in 2003 it was 9.0%), an exclusively low inflation level (in 2003 deflation was 1.3%), and a reduced current account deficit (in 2003 GDP was 6.6%). Export has also been increasing (by almost 20% annually). Economists were concerned only about the fact that while national economy was growing, the growth of national income was slow (Melnikas, 2005).

Since economic growth is analysed as a positive indicator by itself, to create economic grounds for sustainable development the Brundtland Commission recommended a 5–6% growth for developing countries within the immediate 30 years, and 3–4% for industrialised countries. This growth should be based on the installation of new ecological technologies, and its impact on the environment should be subject to strict regulation.

INCREASE IN THE EFFICIENCY OF AN ECONOMIC SYSTEM AND DECREASE IN THE ENVIRONMENTAL IMPACT

One of the priorities of the National Strategy for Sustainable Development is reduction of the impact of major branches of the economy on the environment. One of the key indicators that reveal the efficiency of an economic system is the amount of energy consumed for production. Many researches reveal that electricity consumption changes when socio-economic structures are being devised or fail (Suri, Chapman, 1998; Schneider, Kay,

1994; Beckerman, 1992) After analysing empiric data of the USA and other countries, Hall (Hall et al., 1986) established that the correlation between the GDP and the consumed fuel was about 99%. No doubt, this could reflect a trend of a certain period, and this relation is not necessarily linear. The relation between energy consumption and economic growth is important not only for its impact on the further development of the economy, but also for its close connection to problems of sustainable development (Spangenberg, 2004; Giampiero, Pimentel, 1991).

An interdependence of changes in the two indicators is clearly seen in their common trend (Fig.1), which expressly shows that the function that links them is saltatory and depends on the periods in question.

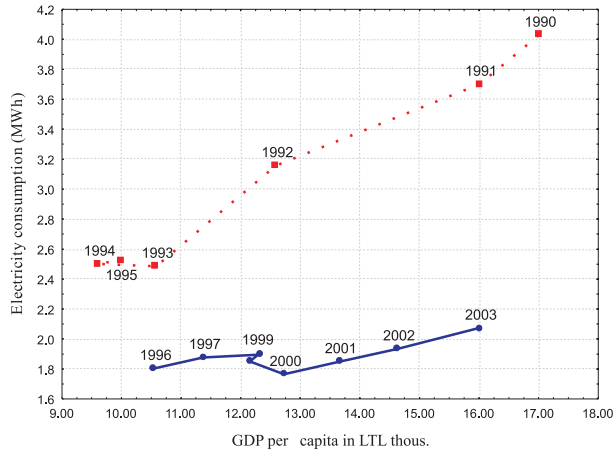

Fig. 1. Diagram of the final change in electricity consumption (MWh) and GNP at constant prices 2000 per capita in thousand Litas in 1990–2003

The correlation of these two aggregated indicators and the form of the correlation show a direction in which EC (electricity consumption) is the GDP function, and both these indicators are the time function: $EC = f(GDP(t))$. With the help of the linear regression model we may assess the analytical form of the function *f*. This diagram clearly shows that the function *f* that relates EC and GDP jumps and in the course of ana-lysis is divided into two series at different levels.

The relation between the final change in electricity consumption (MWh) and GDP at constant prices in the year 2000 per capita in 1000 LTL in 1990–2003 could be expressed by an equation:

$$y_i = \begin{cases} 0.21x_i + 0.41 & \text{in } 1990\text{-}1995; \\ 0.04x_i + 1.36 & \text{in } 1996\text{-}2003. \end{cases} \quad (1)$$

In both cases, statistically significant determination coefficients are obtained: the upper line $R^2 = 0.98$ and the lower line $R^2 = 0.58$.

These results may serve as the basis for stating that the decline in transition economy lasted six years, from 1990 to 1995. At that period the GDP kept rapidly decreasing. At the same time, changes were also observed in electricity consumption: with the decrease in GDP, electricity consumption (MWh) on the average decreased by 21%. Since 1996, the decrease in GDP resulted in an insignificant growth of electricity consumption: with the decrease in GDP, electricity consumption (MWh) on the average decreased by 4%.

The obtained results show that a markedly lower level of electricity consumption was characteristic of the growth in GDP that started in Lithuania in 1996. With regard to the consumed electricity, the smallest value between these two levels at the same GDP is approximately one MWh. To explain these results, we may use the theory of dematerialisation of economies, based on the hypothesis that at the beginning of the development of economy an increase of incomes was achieved due to the growing consumption of materials and energy. However, at a certain level it could be expected that a lower amount of energy and materials will be consumed for an increase of incomes (Malenbaum, 1978). It could be assumed that structural changes of the transit economy have provided conditions for a more intensive reduction of energy consumption. This was undoubtedly influenced by the increased prices and in the changed consumption pattern.

EMISSION OF POLLUTANTS AND GREENHOUSE GAS INTO THE AIR

Due to a more intensive use of energy resources and economic recession, pollutant emission into the air from 1990–2003 decreased almost three times. The National Strategy for Sustainable Development emphasises that it is very important to find out whether pollution in countries in transit decreased only because of the transformational economy depression and whether that was influenced by a reduced use of resources. The highest decrease, approximately 5 times, was observed in pollutants emitted by stationary sources (industry, energy sector). In spite of a clear increase in the number of vehicles, transport sector emissions into the air decreased almost two times. However, tendencies in the change of individual pollution indicators are not completely the same. A functional relation between some indicators (namely, solid pollutants, carbon monoxide and nitrogen oxide) and the GDP reminds us of the above-analysed case when in the period 1995–1996 there was a refractive point. Other pollution indicators (e.g., chlorine, sulphur dioxide, etc.) have no direct relation with changes in the GDP. At this stage of analysis, we will examine the GDP of an economy in transit at constant prices 2000 per capita and the processes of certain emissions into the air. According to data of the Ministry of Environment (Statistical Yearbook of Lithuania, 2003), in 1990 the amounts of emissions were as follows: 59.7 thous. tons of solid pollutants, 91.5 thous. tons of carbon monoxides, and 35.2 thous. tons of nitrogen oxides. Pollution indicators in question clearly differ in their amounts. To compare the trends of changes in these indicators, we will standardize them by applying relative values. To that end, we will transform the initial values of indicators according to the formula $G_i = y_i / y_0$, where y_0 is the indicator level of 1990. The trends of changes in the estimated relative pollution indicators, depending on GDP at constant prices 2000 per capita in 1000 LTL, are shown in a diagram.

Although in 1992 the amount of the emitted carbon monoxide and nitrogen oxide increased, the increase in GDP per capita in 1991 to 1994 was followed by a relative decrease in pollution by about 10%. Moderate alterations in pollution levels starting from 1995 levelled out and since 2000 its changes have been

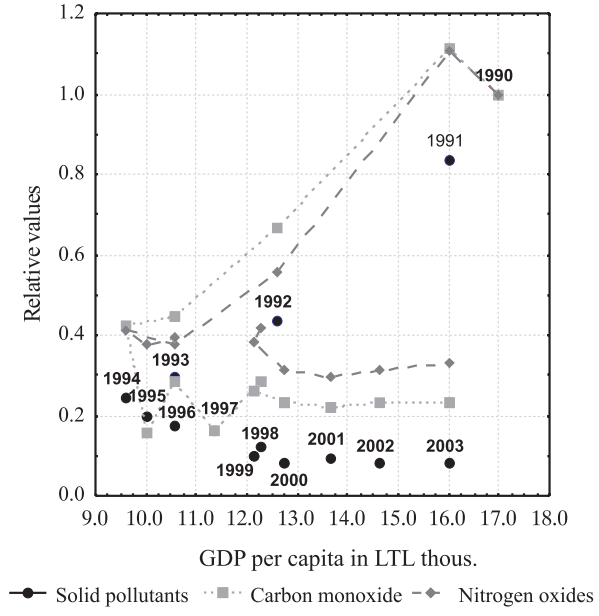

Fig. 2. Diagram of changes in the relative values of solid pollutants, carbon monoxide, nitrogen oxides and GNP alteration in 1990–2003 versus 1990

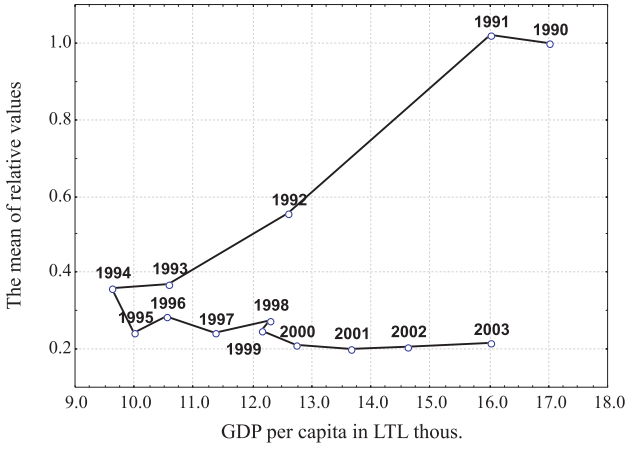

Fig. 3. Changes in average relative values of solid pollutants, carbon monoxide, nitrogen oxides depending on changes in GNP at constant prices 2000 per capita in thous

insignificant. Having estimated the average relative values of these three indicators, we would get a general shape of their change (Fig. 3).

In this diagram, the average relative values of pollutants (ARP) are given as the GDP function and these two indicators alter in time: $ARP = f(GDP(t))$.

Again, in this diagram two periods are evident (curves A and B), thus, the same model as used in the GDP analysis will be used in analysing the correlation of these indicators and their alteration in time.

The relation between the average relative values of pollutants ARP (indicators of 1990 equated to unit) and GDP at constant prices 2000 per capita in 1000 LTL in 1990–2003 could be expressed applying the linear regression model:

$$y_i = \begin{cases} 0.10x_i + 0.64 & \text{in 1990 - 1995;} \\ -0.01x_i + 0.38 & \text{in 1998 - 2003.} \end{cases} \quad (2)$$

In both cases the determination coefficients are statistically significant: $R^2 = 0.97$ and $R^2 = 0.34$.

The coefficients of equation (2) reveal that in 1990–1995, when the GDP decreased, the average relative values of pollutants went down by 10% on the average. Since 1996, the increase in GDP has not resulted in an increase in pollution: the slope coefficient is negative, which means that with the increase in GDP pollutants kept decreasing. True, such decrease is very insignificant: with the GDP decrease, the average relative values of pollutants decreased by 1%.

Diagrams given in Fig. 3 show that the increasing GDP does not generate a rapid increase in pollution indicators. Thus, it could be assumed that the recovering economy uses modern and environment-friendly technologies.

The average values given in Fig. 3 do not necessarily reflect the extent of pollution, because due to active human activities pollution usually concentrates in certain places. The greatest pollution sources are concentrated in cities. The economy in transit has seen a rapid migration of the population from regional centres and rural areas to cities. This deteriorated the ecological situation of Vilnius, Kaunas and Klaipėda, the major cities of Lithuania. With the rapid growth of housing prices and construction companies aiming at maximum profits, cities became higher and denser. Multi-storey dwelling houses that are being built in or close to the centre of cities are destroying green areas of a city and increase transport flows. The rapidly growing number of motor vehicle fleets has had a critical impact on the deterioration of the quality of air. In places that suffer from the potentially highest pollution values of certain indicators, these exceed the permitted values several times. For example, the amount of nitrogen oxide in Vilnius has risen from 30 mg/m^3 to 43 mg/m^3 in 2003.

SOCIAL CHANGES

Due to the low income level, uneven development and a comparatively high income differentiation in Lithuania, the number of people with very low earnings and the number of households at social risk that are sustained by social allowances have been growing. According to data of the Ministry of Social Security and Labour, the number of such households increased from 12.6 thousand in 1996 to 18.5 thousand in 2002 and the number of children in such households increased from 29.9 thousand to 40.0 thousand. Statistical surveys carried out in Western Europe at different periods reveal that the future dysfunctional behaviour of a child could be forecast on the grounds of numerous socio-economic indicators such as low family earnings, large families, bad living conditions, teenager mother, making use of social allowances / welfare and unemployed parents. For example, a survey carried out by Cambridge University (Farrington et al., 1998) states that low family earnings, a large family (four and more children), and a low socio-economic status of a family (but not necessarily bad living conditions) are important indicators that allow forecasts of later dysfunctional behaviour.

In Lithuania, the same as in other countries in transit, the population number is being reduced not only by emigration but also by the declining birth rate. The birth rate started declining in 1992. In spite of the GDP rise, which started in 1995, the number

of births continued to decrease: 15.4 per 1,000 population in 1990, 11.4 in 1995 and 8.9 in 2003. The number of registered marriages per 1,000 population decreased by half: from 9.8 to 4.9.

Unfortunately, differently from energy or ecology, in the social sphere GDP growth had hardly any impact on the birth rate or marriage registrations.

Changes in the number of births per 1,000 population depending on GDP at constant prices 2000 per capita in 1000 LTL from 1990–2003 could be expressed by the following equation:

$$y_i = \begin{cases} 0.46x_i + 7.91 & \text{in 1990 - 1994;} \\ -0.47x_i + 15.87 & \text{in 1995 - 2003.} \end{cases} \quad (3)$$

In both cases the determination coefficients are statistically significant: $R^2 = 0.84$ and $R^2 = 0.89$.

As is seen from equation (3), in the social sphere, differently from the cases of electricity consumption and emission of pollutants and greenhouse gas into the air, no positive changes were noted in 1990–2003. The negative social trends that started developing in 1990 are still present. The decreasing trends of births during the whole period in question were stable. Formula (3) shows that the coefficient describing the extent of the change in the number of births has not changed: in 1990–1994 its value was 0.46, while in 1995–2003 it was 0.47. This equation also reveals that in 1990–1995 major changes occurred in the social sphere: if in the case of equations (1) and (2) the slope coefficients were 0.21 and 0.1, in this case its value was 0.46.

Formula (3) shows that the coefficient that describes the extent of changes in the number of births has not changed: in 1990–1994 its value was 0.46, while in 1995–2003 it was –0.47.

A sharp decrease in the number of births and marriages is characteristic of all economies in transit. In Lithuania, the indicator of total fertility (the average number of children per one woman) has been declining since 1990. While in 1990 one woman gave birth to 2.03 children on average, in 2003 it was only 1.26 children (Statistical Yearbook of Lithuania, 2004).

If the situation does not change (and no tendencies of change have been observed), the next generation will be smaller by one-third than the present one, and securing social welfare for elderly people will become a heavy burden.

Another sore social problem is emigration, which was predetermined by the low income level and the uneven development of Lithuania's regions. Estimation of the exact numbers is practically impossible, but different sources indicate 10% to 15% of population to have emigrated to other countries.

Currently, the public policy covers much more than education or health protection. Besides these two traditional keystones of the public economy policy, there are two new fundamental poles: life quality and human freedoms. Having analysed the previous economic processes, global economists have understood long ago that market must be regulated, and that not only the state needs the market, but also the market needs to be regulated by the state in order to involve population into economic processes and enable them to enjoy fruits of the economic growth. However, politicians, being proud of the economic growth of Lithuania, usually do not know whether the economic policy pursued by them reduces poverty, whether accumulated money is distributed in the way that improves life quality of ***the whole*** population rather than of its one or more layers. All this cannot be learnt from popular macro-economic indicators such as gross domestic product (GDP), inflation level and current account deficit, export. To know how the pursued economic policy impacts all population layers, it is necessary to move from macroeconomic indicators to microeconomic ones, to ***individual*** households, and to have reliable household surveys available.

CONCLUSIONS

1. The mathematical models of aggregated indicators presented in the article and adapted to the analysis of processes of 1990–2003 had to reveal how quickly the socio-economic system reacted to sudden external and internal changes and to assess the impact of rapid changes in GDP per capita on the technologic, ecologic and social spheres.

2. Economy subsidies started six years after the transfer from the planned to the market economy had started. Technological progress was revealed by vivid improvements in the field of electricity consumption. Structural changes in the transit economy provided conditions for a more intensive reduction of energy consumption.

3. In the transition period, the environmental pollution decreased, and the increasing GDP did not generate a rapid increase in pollution indicators. This implies that the recovering economy uses modern and environment-friendly technologies.

4. In the transit period, major changes were observed in the social sphere. In spite of the fact that the reduction of unemployment, poverty and social exclusion is one of the key priorities of the National Strategy for Sustainable Development and regardless of improving economic results, social changes remain misbalanced. Because of the low income level and uneven development, a continuous decrease in birth rate and a large wave of migration were observed. The dramatic wealth differentiation resulted in the increased criminality.

5. Taking account of achievements in the economic, technological and environmental fields, it should be acknowledged that the strict fiscal and structural adjustment policies (favoured by the IMF and World Bank) in the social field had negative outcomes, and their elimination is difficult. To correct them, a scientific assessment of the existing situation and trends is necessary in order to outline the urgent measures.

6. Currently, the public policy covers much more than education or health protection and includes life quality and human freedoms. However, politicians, being proud of the economic growth of Lithuania, usually do not know whether the economic policy pursued by them reduces poverty, whether the accumulated money is distributed in the way that improves the quality of life of ***the whole*** population. To know the effects of the pursued economic policy on all population layers, it is necessary to move from macroeconomic indicators to microeconomic ones, to ***individual*** households, and to have reliable household surveys available.

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References

1. Beckerman W. 1992. Economic growth and the environment: Whose growth? Whose environment? *World Development*. Vol. 20. P. 481–496.
2. Bruyn S. M. 2000. *Environmental Growth and the Environment: An Empirical Analysis.* Kluwer Academic Publishers.
3. Burinskiene M., Rudzkiene V. 2004. Comparison of spatial–temporal regional development and sustainable development strategy in Lithuania. *International Journal of Strategic Property Management*. Vol. 8. No. 3. P. 163–176.
4. Burinskiene M., Rudzkiene V. 2004. Presentation Strategy of Data Analysis and Knowledge for Web-based Decision Support in Sustainable Urban Development. *LNCS 3183.* Berlin: Springer Verlag. P.150–155.
5. *Counties of Lithuania, Economic and Social Development.* 2003, 2004. Vilnius: Department of Statistics of Lithuania.
6. Dyke C. 1994. From Entropy to Economy: a Thorny Path. In: P. Burley, J. Foster (eds.). *Economics and Thermodynamics. New Perspectives on Economic Analysis*. Kluwer: Boston.
7. Epstein J. M., Axtell R. 1996. *Growing Artificial Societies: Social Science From the Ground up*. Washington, DC: Brookings Institution Press.
8. Faber M., Proops J. L. R. 1998. *Evolution, Time, Production and the Environment*. Berlin: Springer Verlag.
9. Feichtinberg G. 1996. Chaos Theory in Operational Research. *Int. Trans. Op. Res.* Vol. 3. No 1. P. 23–36.
10. Giampero M., Pimentel D. 1991. Energy efficiency: assessing the interaction between humans and their environment. *Ecological Economics*. Vol. 4. P. 117–144.
11. Gilbert N., Troitzsh K. G. 1999. *Simulation for the Social Scientist*. London: Open University Press.
12. Hall C. A. S., Cleveland C. J., Kaufmann R. K. 1986. *The Ecology of the Economic Process: Energy and Resource Quality*. New York: John Wiley & Sons.
13. Janssen M. A., Jager W. 2000. The human actor in ecological economic models. *Ecological Economics*. Vol. 35. No. 3. P. 307–310.
14. Kay J. J., Regier A. H., Boyle M., Francis G. 1999. An ecosystem approach for sustainability, addressing the challenge for complexity. *Futures*. Vol. 31. P. 721–742.
15. King A., Schneider B. 1991. *The First Global Revolution. A report by the Club of Rome.* London: Simon & Schuster.
16. Lorenz H. W. 1993. *Nonlinear Dynamical Economics and Chaotic Motion*. Berlin: Springer Verlag.
17. Malenbaum W. 1978. *World Demand for Raw Materials in 1985 and 2000*. New York: McGraw-Hill.
18. Melnikas B. 2005. Urban development and property management in the context of societal transformations: strategic decision-making. *International Journal of Strategic Property Management*. Vol. 9. No. 4. P. 247–268.
19. *National Report on Sustainable Development.* 2002. *From Rio to Johannesburg, from transition to sustainability.* Vilnius. 147 p.
20. Nicolis G., Prigogine I. 1977. *Self-Organization in Nonequilibrium Systems*. New York: John Wiley & Sons.
21. Rosser M. V. 2002. Experience of economic transition in complex contexts. *International Journal of Social Economics*. Vol. 29. No. 6. P. 436–452.
22. Schneider E. D., Kay J. K. 1994. Life as a manifestation of the second law of thermodynamics. *Mathematical and Computer Modelling*. Vol. 19. No. 6/8. P. 25–48.
23. Spangenberg J. H. 2004. Reconciling sustainability and growth: criteria, indicators, policies. *Sustainable Development*. Vol. 12. P. 74–86.
24. *Statistical Yearbook on Candidates and South-East European Countries*. 2004. Eurostat.
25. *Statistical Yearbook of Lithuania*. 2004.
26. Suri V., Chapman D. 1998. Economic growth, trade and energy: implications for the environmental Kuznets curve. *Ecological Economics*. Vol. 25. P. 195–208.
27. Szargut J. 2004. *The Exergy Method and its Application in Ecology*. Wit Press.
28. Tisdell C. 2001. Transition economies and economic globalization. Social and environmental consequences. *International Journal of Social Economics*. Vol. 28. No. 5/6/7. P. 577–590.
29. *Third to Sixth United Nations Survey on Crime Trends and Operations of Criminal Justice Systems Combined*. URL: http://www.uncjin.org/
30. Thomas V., Dhareshwar A., Lopez R. E., Wang Y., Kishor N., Dailimi M., Kaufmann D. 2000. *The Quality of Growth*. World Bank; Oxford University Press.
31. Turskis Z., Zavadskas E. K., Zagorskas J. 2006. Sustainable city compactness evaluation on the basis of GIS and Bayes rule. *International Journal of Strategic Property Management*. 2006. Vol. 10. No. 3. P. 185–207.
32. Zavadskas E. K., Kaklauskas A., Vainiūnas P., Šaparauskas J. 2004. A model of sustainable urban development formation. *International Journal of Strategic Property Management*. Vol. 8. No. 4. P. 219–229.
33. Ziliak S. T. 2002. Some tendencies of social welfare and the problem of interpretation. *Cato Journal*. Vol. 21. No. 3. P. 499–513.
34. World Commission on Environment and Development (WCED). 1987. *Our Common Future* (*The Brundtland Report*). Oxford: Oxford University Press.

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DARNAUS VYSTYMOSI VERTINIMAS PEREINAMOSIOS EKONOMIKOS SĄLYGOMIS

S a n t r a u k a

Straipsnyje sprendžiami pokyčiai, kuriuos sužadino perėjimas iš centralizuotos planinės ekonomikos į rinkos ekonomiką, ir pateikiama daugiau nei dešimtmečio ekonominio perėjimo analizę. Diegiant ekonominę, struktūrinę ir politinę pertvarką apimamas grįžtamųjų ekonominių, ekologinių ir socialinių procesų kompleksas. Tokia politika retai būna adekvati siekiant pagrindinių darnaus vystymosi tikslų. Per keletą metų buvusios Tarybų Sąjungos šalys tikėjosi įvykdyti institucinių struktūrų bei rinkos sistemos reformas, kurios Vakarų šalyse vyko šimtmečiais.

Staigi ir sisteminė centralizuotos komandinės ekonomikos griūtis įgalino peržiūrėti žinojimą kaip socialinė ekonominė sistema reaguoja į staigius išorinius bei vidinius pokyčius. Tačiau mokslininkai, vertinantys procesą, susiduria su keliais sunkumais. Tiesioginė agreguotų rodiklių analizė retai koreliuoja su procesais ir paaiškina jų pokyčius. Šiuo metu taikomi nauji ir labiau kompleksiniai modeliai, kurie paprastai yra jautresni įvertinant galimas tyrimų klaidas, o dėl jų taikymo pagerėja prognozės kompleksiškumas ir rezultatų apibrėžtumas.

Straipsnyje pateikiami apibendrintų rodiklių modeliai, kurie įvertina jų koreliaciją bei pokyčius laike. Analizė remiasi empiriniais duomenimis apie pajamas, energijos suvartojimą, užterštumo pokyčius ir kai kuriais socialiniais rodikliais apie Lietuvos gyventojus. Taip nagrinėjami ekologiniai, ekonominiai ir socialiniai vystymosi komponentai ir grindžiami modeliai, parengti pagal procesų kitimo ir suderinamumo su darnaus vystymosi prioritetais analizę.

Raktažodžiai: darnus vystymasis, pereinamasis laikotarpis, oro tarša, socialiniai ekonominiai rodikliai