

AIR POLLUTION IN A TRANSITION ECONOMY: THE CASE OF THE CZECH REPUBLIC

W. Heijman¹, M. Krčálková², G. Jandová²

¹*Wageningen University, Department of Social Sciences, Wageningen, The Netherlands*

²*Czech University of Agriculture, Faculty of Economics and Management, Prague, Czech Republic*

In the past twelve years transition economies in Central and East Europe faced many difficulties in remedying the environmental damage caused by the previous socialist regime. This paper focuses on the problem of air pollution in the Czech Republic. It concludes that in the nineties the emission of particulates and polluting gasses (SO₂, NO_x and CO) has diminished substantially in all regions of the country because of technical changes and changes in the economic structure.

transition economies; Czech Republic;; air pollution; emissions; technical change; economic structure

Introduction

It was believed for a long time that air pollutants, once released, were eventually diluted to negligibly low concentrations in the atmosphere. However, experience of the last 20 to 30 years has shown this belief to be erroneous and incomplete (Stanners, 1995). The main consequences of exposure to ambient air pollutants are increased morbidity and mortality of humans, damage to vegetation and ecosystems as a whole, and also damage to buildings and materials. These effects occur at various concentration levels including concentrations considered as "low" (Fiála et al., 2002).

The relationship between economic activities and the environment is complex. Concentrating on air pollution, it can be said that "Single pollutants are related to more than one environmental problem, and an environmental problem is often induced by more than one pollutant" (Fig. 1).

With respect to pollution Kolsstad (2000) asks two basic questions: "What is the right amount of pollution and how can we get the polluters to control their emissions?" He answers the second question by giving many possibilities for solving: from state regulation to firm's options, such as modifying the production process and characteristics of the product, relocating the productive activity, investing in research and development, etc.

The answer to the first question is complex. The problem is that growing wealth is associated with two major effects: growing material consumption and decreasing environmental quality on one hand and a growing concern for the environment on the other. This can be observed in the more advanced transition countries like Hungary, Poland and the Czech Republic, where the increase in private car ownership is putting a renewed pressure on urban air quality (especially NO_x) and is aggravating traffic congestion (Ichikawa, 2002). At the same time, environment is often viewed upon as a luxury good, meaning that the growing wealth of peo-

ple causes bigger concern for the environment, which increases the willingness to pay to reduce air pollution.

In the nineties transition countries in Central and East Europe faced serious environmental problems due to decades of neglect of the environment resulting in insufficient investment in environmental quality. Simultaneously, economic growth is a major concern for the transition economies in Central and Eastern Europe because of the growing unemployment rates (Zylicz, 1997; Ready et al., 2002). This period became characteristic by the effort to find a balance between these two pressures (Neužil, 1991; Keller, 2001).

In this paper we will study the air quality in the case of the Czech Republic during the nineties. It is organized as follows: in Section 2 the structure of the Czech economy will be sketched and the main causes of the emissions in Czech republic will be discussed. In Section 3 Czech air quality is evaluated. In Section 4 the relationship between production and air pollution is explained in two linear regression models. Conclusions of the analysis are drawn in Section 5.

Economic structure and environmental legislation

The Czech Republic is an industrial country for a long time. It already has been the main industrial center of the Habsburg Monarchy at the beginning of the 20th century. The establishment of communism in 1948 emphasized this. The economy mainly specialized in heavy industry like coal mining, steel production, heavy machinery, and bulk chemicals. The industrial specialization remained, also in the post-communist period starting in 1989, the year of the so-called "velvet revolution" (Table 1).

As it can be seen in Table 1 the share of industry in gross value added in the Czech Republic has decreased in 1988–1998. Figs 2 and 3 indicate the development of total and industrial production, respectively. Fig. 2 shows the development of GDP and the annual growth in the

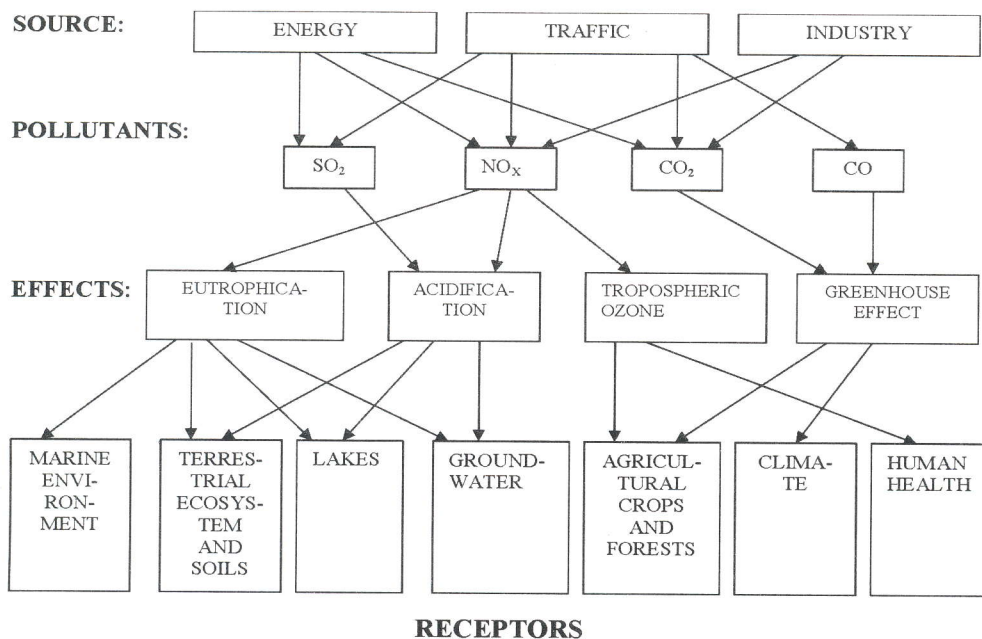


Fig. 1. Main relationship between dominant sources, emitted compounds and their various receptors
Source: Schmie man (2001)

Table 1. Share of industry in gross value added – international comparison between 1988 and 1998

	1988 (%)	1998 (%)
Austria	32.4	33.1
Belgium	33.0	28.7
Czech Republic	48.8	43.7
Hungary	32.3	33.8
Poland	43.6	36.5
Portugal	35.4	35.7

Source: OECD (2000), (www.sourceoecd.org)

nineties, where Fig. 3 presents the decreasing relative importance of the industrial sector.

The Ministry of Environment was founded immediately after the revolution. The first integrated report about the state of environment in the former Czechoslovakia was published in 1990. Environmental conditions were, according to this so-called "BLUE BOOK", catastrophic. Based on this the government developed an environmental recovery program for the Czech Republic: the Rainbow Program. It caused a substantial increase of the expenditures for environmental protection in the years 1990–1993 (Table 2).

National Environmental Policy was developed in 1995. This mainly reflected the efforts to join the OECD and the European Union and to meet the commitments resulting from agreements and conventions signed by the

Czech Republic. The new versions of the National Environmental Policy, respectively from the years 1999 and 2001, are linked to the National Program for the Preparation of the Czech Republic for Membership in the EU. They are focused mainly on issues concerning accession to the European Union, adaptation of equal environmental standards to sector policies and bigger emphasis on enforcement of new legislation. As a result of this the expenditures on environmental protection in the Czech Republic are higher than in some states of European Union (Table 3).

It is estimated that in order to meet all requirements the necessary expenditures will equal to 3% of GDP in 2001 (National Environmental Plan Policy, 2001).

Air quality

As a result of the environmental policy the air quality improved significantly since 1990 (Fig. 4). It can be said that generally speaking, the emissions have been reduced to levels, which are in accordance with EU standards.

In 1990 in industrial areas air pollution was serious in the Czech Republic. Emissions of air pollutants decreased in the period 1990–1999. The most marked improvement is the decrease of SO₂ (Moldán, Hák, 2000). At present we can state that the emissions of basic polluting compounds are not among the highest in the countries of OECD. In 1998 and 1999 air quality stan-

Table 2. Expenditures for environment protection in the Czech Republic (1990 prices)

Indicator	1990	1991	1992	1993
GDP in billions of CZK	567.3	716.6	791.0	910.6
Total investments in environmental protection in billions of CZK	6.0	9.4	17.0	19.9
Investments in environmental protection as a share (%) of GDP	1.06	1.31	2.15	2.19

Source: Ministry of Environment, Czech Republic (1997), (www.env.cz)

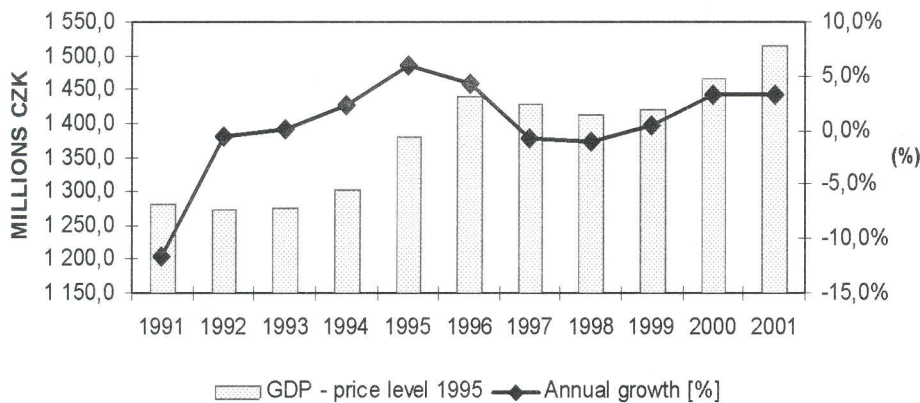


Fig. 2. Czech GDP during the nineties
Source: www.patria-finance.cz

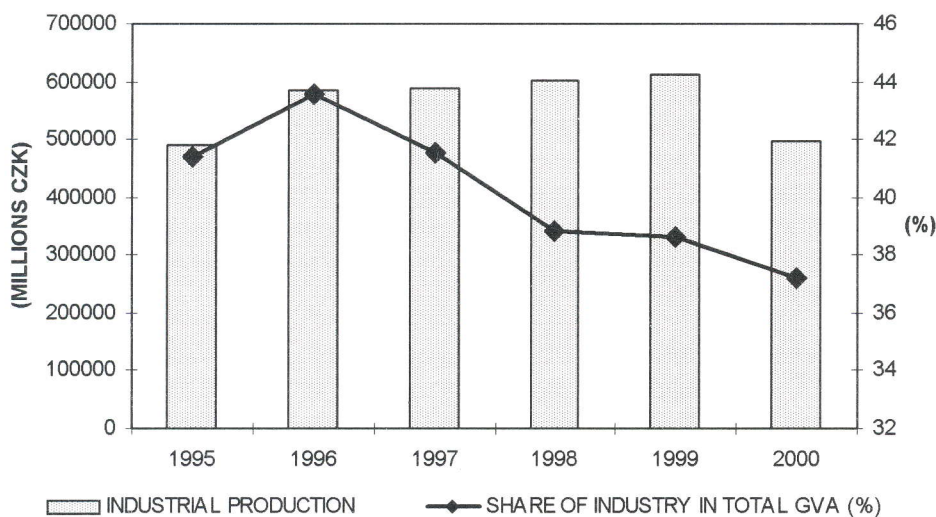


Fig. 3. Industrial production (price level of 1990)
Source: www.patria-finance.cz

Table 3. Expenditures on environmental protection

	Average EU ¹⁾	Max EU ¹⁾	Min EU ¹⁾	CR 1996	CR 1998
Annual Expenditures (% of GDP)					
Expenditures from central (state) sources	0.8	1.3 (NL)	0.4 (GB)	0.9	0.5
Expenditures in private business sphere	0.4	0.7 (A, D)	0.1 (P)	1.5	1.5
Total (% GDP)	1.2	1.8 (NL)	0.3 (GB)	2.4	2.0
Annual Expenditures (USD/habitant)					
Expenditures from central (state) sources	140	264 (NL)	59 (G)	45	66
Expenditures in private business sphere	78	108 (NL)	41 (G)	76	198
Total (USD/habitant)	218	372 (NL)	100 (G)	121	264

¹⁾ data from the years 1997-1999

A – Austria, D – Germany, G – Greece, GB – Great Britain, NL – The Netherlands, P – Portugal

Source: Ministry of Environment, Czech Republic (2000), (www.env.cz)

dards for sulfur dioxide and particulates (dust) were hardly exceeded.

The reduction of the emissions was mainly a result of 'end of pipe' techniques (e.g. filters). On the long run this will not be enough. Technical change gradually has to move to energy saving changes in the production process. The problem here is that the Czech economy has an extremely low energy efficiency. This is partly due to the industrial nature of production and partly by the use of obsolete technologies. This is a common problem for all transition economies

(Ichikawa, 2001). Another problem is the high rate of solid fuels that is used in the generation of energy (Fig. 5). The extensive use of solid fuels reduces the dependence on imports and curb the growth of the nation's trade deficit, but aggravates the problem of low air quality (Moldán, 2001; Zbořil, 2002). Renewable energy comprised only 1.7% of the consumption of primary energy in 1998. According to the National Environmental Policy Plan (2001) this has to increase to 6% by 2010 through investment in modern technologies.

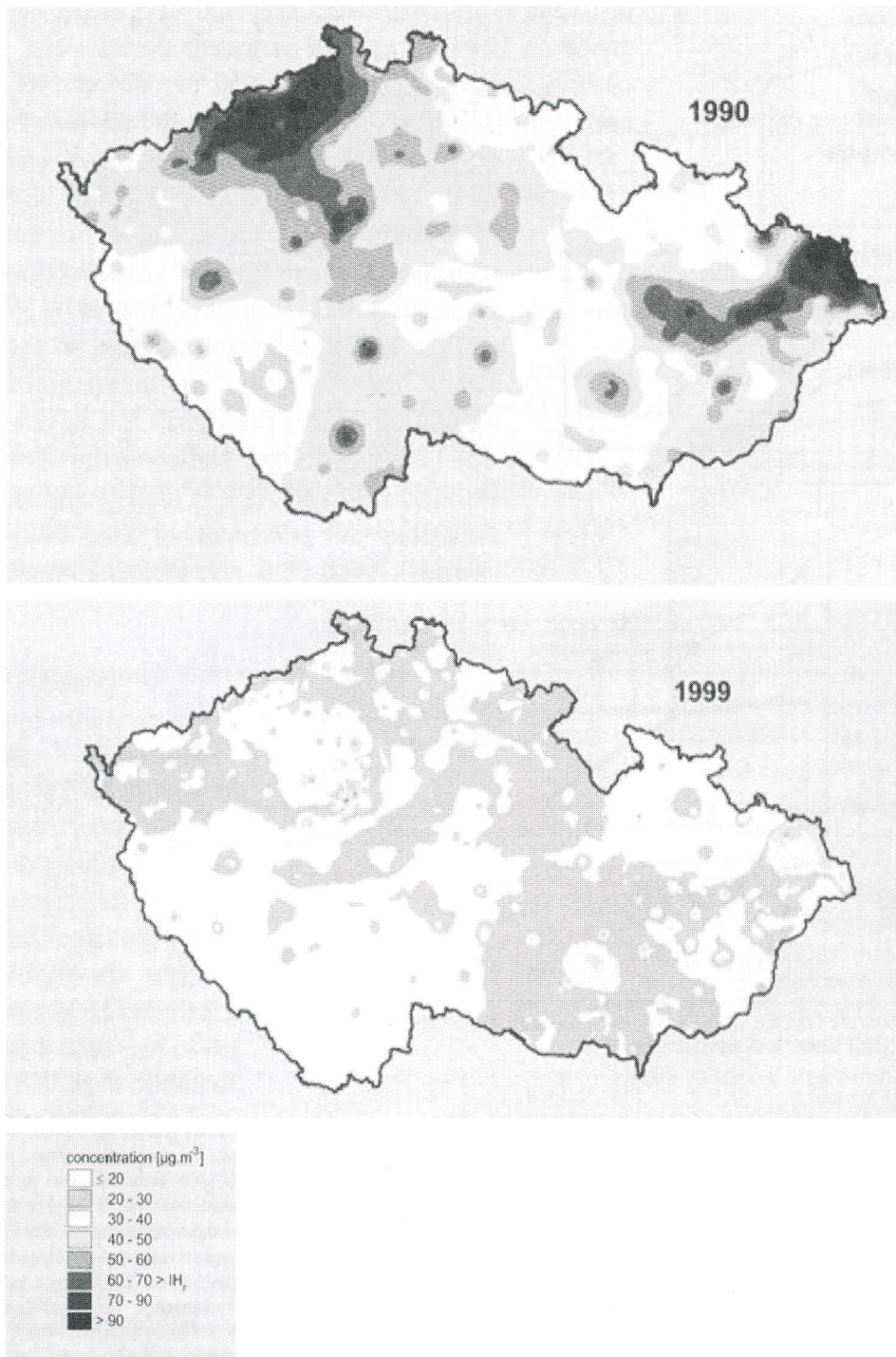


Fig. 4. Air pollution in the Czech Republic. Annual arithmetic means of suspended particulate matter concentrations in the Czech Republic in 1990 and 1999. Source: Czech Hydrometeorological Institute (2000), (www.chmi.cz)

The transformation of transport had two effects on the pollution in the Czech Republic. On one hand emissions associated with vehicles have been reduced in relative terms as a result of improved vehicle technology (such as the increased use of cars equipped with catalytic converters – 19 000 in 1990 and 981 000 in 1999), lower noise levels, lower fuel consumption) and the introduction of unleaded petrol. On the other hand, increasing traffic intensity (the number of vehicles increased about 50% since 1990) outweighed these positive changes. Total emissions of CO_2 and NO_x from road transport rose between 1990 and 1999, with NO_x emissions par-

ticularly worsening quality of life in cities (Moldán, Hák, 2000).

Relationship between production and air pollution

In order to establish the relationship between production and air pollution we tested two linear regression models:

$$A_{ij} = a_i Y_j$$

$$A_{ij} = b_i Q_j$$

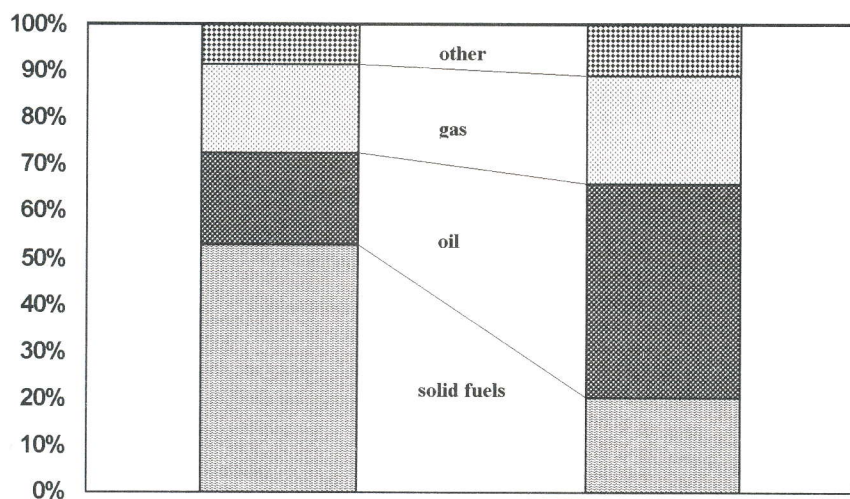


Fig. 5. Structure of energy supply by primary source, comparison of the Czech Republic and EU – 15 in 1997
Source: Ministry of Industry, Czech Republic (2000), (www.mpo.cz)

Table 4. Results of regression analysis

	Industry		Whole	
	1995	1998	1995	1998
SO				
a_i, b_i	1.07	0.48	0.34	0.12
t -test	4.57	3.58	3.08	2.19
R^2	0.27	0.14	0.42	0.28
NO				
a_i, b_i	0.34	0.17	0.11	0.04
t -test	7.04	6.71	3.75	3.23
R^2	0.34	0.33	0.44	0.6
CO				
a_i, b_i	1.53	0.8	0.45	0.14
t -test	4.21	3.61	2.58	2.04
R^2	0.19	0.14	0.16	0.14
Dust				
a_i, b_i	0.33	0.1	0.10	0.07
t -test	7.96	6.66	3.96	3.57
R^2	0.43	0.39	0.61	0.68
T -values				
Significance level	0.1	0.05	0.01	
Value	1.7823	2.1788	3.0545	

with A_{ij} representing pollution of type i in region j , Y_j for total production in region j and Q_j for industrial production in region j , a_i and b_i for regression coefficients. Industrial and total production is measured in prices of 1995. For the four types of air pollution (CO, NO, SO, dust) we calculated the regression results for the years 1995 and 1998 for 13 out of 14 regions.¹ We expected that coefficients are positive for both years, but, because of technical progress, they are lower in 1998 than in 1995 (Table 4).

¹The data for Ústecký region were missing for the year 1995.

In short, the conclusions of the regression analysis are:

1. All coefficients are positive;
2. All coefficients are lower in 1998 than in 1995;
3. All coefficients are highly significant;
4. In a number of cases levels of R^2 are not too high.

Conclusions

It appears that our hypothesis (all polluting coefficients will be lower in 1998 than in 1995) is confirmed. From the statistical analysis it appears that in a relatively short term Czech air quality improved considerably. Two aspects can be distinguished. The share of industry in production decreased (change of economic structure), and further the emission per unit industrial production also decreased (technical change). For the period described Czech environmental policy with respect to air pollution abatement can be considered as a success.

REFERENCES

- FIALA, J. – KOZAKOVIC, L. – STENDMAN, J. – STEVENSON, K.: Air quality in the Phare countries. EEA (European Environment Agency), Copenhagen, 2001.
- ICHIKAWA, N. – TSUTSUMI, R. – WATENABE, K.: Environmental indicators of transition. Eur. Environment, 12, 2002: 64–76.
- KELLER, J.: Modernizace a ekologie (Modernisation and ecology). EKO-list 2, 2002.
- KOLSTAD, C. D.: Environmental Economics. New York, Oxford University Press 1999.
- Ministry of Environment, Czech Republic: State Environmental Policy 2001.
- MOLDÁN, B.: Duhový program – Program ozdravení životního prostředí České republiky (Rainbow Programme). Ministry of the Environment, Czech Republic, 1991.

- MOLDÁN, B.: Ekologická dimenze udržitelného rozvoje (The Ecological dimension of the sustainable development). Charles University in Prague, Czech Republic, 2001.
- MOLDÁN, B. – HÁK, T.: Czech Republic 2000 – ten years on environment and quality of life, Frýdek-Místek, Czech Republic, 2000.
- NEUŽIL, V.: Znečištění ovzduší (Air pollution). Koneko, VUSTE APIS, Prague, Czech Republic, 1991.
- READY, R. C. – MALZUBRIS, J. – SENKANE, S.: The relationship between environmental values and income in a transition economy: Surface water quality. *Environ. Develop. Economics*, 7, 2002: 147–156.
- SCHMIEMAN, E. C.: Acidification and tropospheric ozone in Europe: Towards a dynamic economic analysis. [PhD thesis.] Wageningen University, 2001.
- STANNERS, D. – BUOURDEAU P.: European environment. The Dobris Assessment, EEA (European Environment Agency), Copenhagen, 1995.
- ŠTECHOVÁ, G.: O krok blíž k Evropské unii (One step nearer to the European Union). *EKO-list* 2, 2002.
- ZBOŘIL, J.: Průmysl a životní prostředí na počátku 21. století (Industry and the environment on the beginning of the 21st century). *EKO-list* 4, 2002.
- ZYLICZ, T.: Ecological economics – markets, prices and budgets in a sustainable society. The Baltic University Program, Uppsala University, 1997.
- www.sourceoecd.org
www.patria-finance.cz
www.env.cz
www.chmi.cz
www.mpo.cz
www.mmr.cz
www.czso.cz

Received for publication on February 27, 2003

Accepted for publication on May 3, 2003

HEIJMAN, W. – KRČÍLKOVÁ, M. – JANDOVÁ, G. (Wageningen University, Department of Social Sciences, Wageningen, The Netherlands; Česká zemědělská univerzita, Provozně ekonomická fakulta, Praha, Česká republika): **Znečištění ovzduší v ekonomice přechodného období: Příklad České republiky.**

Scientia Agric. Bohem., 34, 2003: 99–104.

Za posledních dvanáct let musely ekonomiky přechodného období ve střední a východní Evropě řešit řadu problémů souvisejících s odstraňováním škod na životním prostředí způsobených předešlými socialistickými režimy. Tento článek se zabývá problémem znečištění ovzduší v České republice. Dospěli jsme k závěru, že v 90. letech se emise částic a znečišťujících plynů (SO₂, NO_x a CO) podstatně snížila ve všech regionech země v důsledku technických změn a změn v ekonomické struktuře.

ekonomiky přechodného období; Česká republika; znečištění ovzduší; emise; technická změna; ekonomická struktura

Contact Address:

Prof. Dr. W. J. M. Heijman, Wageningen University, Dpt. of Social Sciences, P.O. Box 8130, 6700 EW Wageningen, The Netherlands, tel.: +31 317 483 450, e-mail: wim.heijman@alg.ech.wau.nl
