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DIPLOMOVÁ PRÁCE

Economics of environmental protection in the European Union

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Prohlašuji, že jsem diplomovou práci vypracovala samostatně a použila pouze uvedené prameny a literaturu.

I do hereby declare that I have written this thesis independently and that I have used only the sources listed.

Prague, 17th January 2005 ……………………….

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ABSTRAKT

Cílem diplomové práce je seznámit čtenáře s problematikou ekonomického pohledu na ochranu životního prostředí. Podíváme se blíže na vývoj enviromentální ekonomie, jako nového směru vznikajícího v minulém století slučováním poznatků z ekonomie a ekologie, vysvětlíme základní pojmy, se kterými tento obor pracuje a představíme ekonomické nástroje, které lze k ochraně životního prostředí použít. Dále se zaměříme na politiku ochrany životního prostředí v Evropské Unii, která prošla od počátku integrace dynamickým vývojem a v současné době významně ovlivňuje nejen legislativu a instituce v jednotlivých členských zemích, ale sehrává i stále aktivnější úlohu na mezinárodním poli. Hlavním cílem práce je analýza vztahu mezi mírou znečištění ovzduší (vyjádřené emisemi CO_2, SO_2 a NO_x) a úrovní hospodářského rozvoje. Pomocí metody nejmenších čtverců (OLS) otestujeme hypotézu o snižování znečištění s rostoucím HDP na hlavu pro země OECD, EU a Českou republiku jako nový členský stát. Tento vztah je znám jako Enviromentální Kuznetsova Křivka (EKC). Následně analyzujeme proměnné ovlivňující znečištění ovzduší emisemi SO_2 v České republice. Na základě výsledků se pokusíme vyhodnotit budoucí trend znečišťování ovzduší v EU a České republice.

ABSTRACT

The focus of this diploma thesis is to introduce the topic of environmental protection to the reader. We give an overview of development of the environmental concept in economic theory, discuss the basic terms and the link between the environment and economics. We describe economic instruments of environmental protection used in the developed countries. Then we focus on the environmental protection policy in the European Union, which has been a dynamically developing field during the integration process. Nowadays, the EU is having an increasing impact on policy making not only in the Member States but also at the international level. The key part of the thesis deals with estimation of the Environmental Kuznets Curve (EKC) – an inverted U-shaped relationship between pollution and the level of economic development. We run the regression for several pollutants (CO_2, SO_2 and NO_x) using ordinary least square method (OLS) and data sets for OECD countries, the European Union and the Czech Republic. Then we bring up the model detecting what factors have an impact on the level of SO_2 pollution in the Czech Republic.

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Termín státní zkoušky: zimní semestr 2004/2005

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Cíl :

Daná diplomová práce by měla seznámit čtenáře s problematikou ekonomického pohledu na ochranu životního prostředí v Evropské unii a České republice jako novém členském státě. Enviromentální politika EU prošla od počátku integrace dynamickým vývojem a ovlivňuje významně nejen legislativu a instituce v jednotlivých členských státech, ale v posledních letech sehrává stále aktivnější úlohu na poli mezinárodním. Od počátku 90.let, kdy tuto roli převzala po USA, je EU dokonce považována za nejsilnějšího a nejprogresivnějšího aktéra globální enviromentální diplomacie. Důvodem zvyšujícího se zájmu Evropské unie o tuto oblast je nejen snaha zamezit zvyšujícímu se znečišťování, ale i skutečnost, že otázky ochrany životního prostředí, jako je například redukce emisí kysličníku uhličitého (CO_2), se silně promítají nejen do mezinárodního obchodu, ale i do energetické, dopravní či zemědělské politiky.

Podepsáním Kyotského protokolu (1997) a důsledným dodržováním pravidel regulace emisí CO_2 se Evropská Unie dostala do konfrontace s USA a dalšími zeměmi. Rozšíření EU na východ a přijímání environmentalních „acquis“ v nových členských zemích zásadně změnilo podstatu ochrany životního prostředí a přispělo ke změně pravidel hry například při obchodování s „pollution permits“.

V enviromentální politice EU můžeme najít dva odlišné přístupy. Prvním je použití příkazových regulačních nástrojů, které se snaží regulovat zdroje potenciálního znečištění a mají za následek detailní legislativu založenou na nejlepší dostupné technologii a na kontrole emisí. Další možností je použití mikroekonomických nástrojů enviromentální politiky, například ekodaní. Výhodou tohoto přístupu je flexibilnější výběr nástrojů, které fungují samostatně bez nutnosti kontroly. Dalším příkladem „nepříkazových“ nástrojů je přístup veřejnosti k informacím či dobrovolné dohody s výrobci.

Rozšíření EU o nové členské země významně ovlivní politiku ochrany životního prostředí. Noví členové sice převzali legislativu EU v této oblasti, ale v budoucnosti by se měli také aktivně podílet na tvorbě enviromentální politiky. Společně s počtem zemí roste totiž nejen spektrum problémů, ale i množství přístupů a nástrojů převzatých z národních kontextů členských zemí.

Ve své diplomové práci budu testovat hypotézu o přímo úměrné závislosti mezi úrovní ekonomického rozvoje země, vyjádřené mírou růstu HDP na hlavu, a mírou znečištění životního prostředí (ŽP) (vyjádřené emisemi: CO_2, NO_X a síry), a to jak pro průměr původních členských zemí EU, tak i pro nový členský stát - Českou republiku. Tato souvislost, které se v ekonomické literatuře někdy říká enviromentální Kuznetsova křivka (Environmental Kuznets Curve) ukazuje mimo jiné trend emisních politik různých zemí.
Na základě modelu, v kterém odvodím modifikovanou Kuznetsovu křivku s použitím různých vysvětlujících proměnných např. HDP na hlavu, příjem na hlavu, nezaměstnanost, migrace na úrovni regionů apod., které budu korelovat s různými faktory znečištění životního prostředí, porovnám obecné trendy pro EU a ČR a pokusím se zodpovědět otázku, do jaké míry je situace v oblasti znečišťování životní prostředí v České republice podobná situaci v ostatních členských zemích EU. Podle výsledků modelu také učiním odhad budoucího trendu znečišťování životního prostředí v České republice a budu diskutovat o dopadu ekonomických nástrojů na ochranu životního prostředí používaných v EU, které musela Česká republika jako nový členský stát zavést.

S tímto souvisí také správnost použití společných postupů při ochraně ŽP pro všechny členské země. Na jedné straně máme dopady činnosti různých ekonomických subjektů na životní prostředí, které určitě přesahují hranice jednotlivých zemí a je tedy nutné je koordinovat na mezinárodní úrovni. Na druhé straně ovšem mohou hrát roli rozdílná míra ekonomického rozvoje a úroveň znečištění.

Osnova:

1. Introduction
2. Environmental thought: a historical perspective
3. Economic instruments of environmental protection
4. Environmental policy of the EU: basic approaches
5. Environmental Kuznets Curve (EKC) and the factors leading to reducing of the pollutants' emissions: the empirical study of the Czech Republic
6. Conclusions

V Praze 25.10.2004

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1 Introduction

This diploma thesis is to deal with environmental policies in the European Union and the Czech Republic as a new Member State. Environmental protection policy has always been one of the main objectives on the road to the Common Europe. The feeling of the responsibility for the nature protection, which undoubtedly has its own impact on the health and life of each of us, goes hand in hand with the process of industrial development and growth of the European Union and the creation of Single Market within its boundaries.

Previous ideas of short-term economic gains being possible at the expense of the environment have been replaced by the attitude where competitiveness and efficiency form the basis for a more sustainable long-term economic pattern, both within EU and internationally. In recent years there has been a new tendency to seek sustainable, harmonious economic growth that respects the environment as a priority consideration. The new principles of the so-called “sustainable development principle” formulated by the UN commission lead by the Norwegian former prime-minister Mrs. Gro Brundtland in Stockholm in 1972 are entering the decision-making process of the makers of the European legislation, creating the new frameworks for the sustainable economic development. But it’s to be said, that still a great information effort will have to be made to secure general acceptance of the principle and to give effect to it everywhere; there are still threats to the environment, notably from waste pollution, atomic energy threats, acid rains and many other things, created by the human effort to have more at less expenses, not taking into account the environment we all live in.

We have divided our diploma thesis into the four main sections. We do realise that there might be different points of view and approaches to the issue, but we think that this structure will enable the reader to find its way in the text and understand the idea of the thesis. Due to the better understanding of our line of argumentation and presented outcomes of the model calculated tables and figures have been included to the text, while the data used for the calculation are presented to the reader in the Annex.

In the first part (section 2) of our thesis we introduce the topic of environmental protection to the reader. The section deals with the historical background of the protection of the environment, gives an overview of the development of the environmental concept in economic theory and the literature of this topic and discusses the roots of the environmental thinking together with the link between the environment and the economic. Here we also attempt to find out what are the differences between two main approaches: “environmental” and “ecological” economics. At the end of this chapter we explain the term “sustainable development”.

The section number three describes the instruments of environmental protection used in the developed countries. There exist many types of instruments that can be used, but we focus mainly on the economic instruments, which are now commonly used. We discuss the reasons why the market-based instruments are better for environmental policies than the traditional approach, i.e. to control environmental pollution and damages by regulations. We give a classification of the economic instruments, describe the differences among them and discuss the advantages and disadvantages of their usage.

The next part (section 4) brings an essay on history of the environmental protection policy at the EU level. In addition to discussing the development of environmental policy at the EU level, its legislation and financial framework, we focus on principles of the EU environmental policy, in particular the polluter-pays principle and the precautionary principle, and on the Environmental Action Programmes of the European Community. We emphasise the last two Programmes setting out environmental policy objectives, priorities and Community action plan for the period 1993-2010. We also mention the role of the European Union as an international actor in the field of environmental protection. We have not planned to exploit the topic of environmental protection in the European Union to the depth, i.e. every Directive and Regulation dealing with the environmental protection cannot be taken into account. This is also the reason why have decided not to describe the environmental policy in the Czech Republic. The topic is so broad and the progress the country has made in that direction is so advance that a whole diploma thesis could have been written on that topic. In our thesis we will concentrate on estimating the Environmental Kuznets Curve for the Czech Republic and drawing some conclusions from our results.

In the last section (5) of our thesis, which we consider to be the key one, we estimate the Environmental Kuznets Curve – the relationship between the environmental pollution and the GDP per capita representing the level of economic development in the country. We run the regression for several pollutants: emissions of carbon dioxide, sulphur dioxide, nitrogen oxides and suspended particles. Using the data sets for OECD and EU countries we estimate whether there exist an inverted U-shaped relationship between the environmental pollution and the economic development or, in other words, whether the environmental quality is improving with rising income after a certain level of GDP per capita. The assumption is that the environment is income-elastic commodity and people start to value the environment more only after a certain level of income per capita covering their basic needs. In the second part of this section we estimate this relationship also for the Czech Republic as a new member state of the European Union and bring up the model detecting what factors represented by the unemployment level, GDP per capita, environmental protection investments, population density, the amount of agriculture and forest area and the number of internet users have an impact on the level of pollution in the Czech Republic.

In the conclusion of the diploma thesis we bring together the results of the environmental protection experience both in the EU and in the Czech Republic, discuss the compatibility of the economic techniques used for the “old” EU Member States and the “newcomers” represented by the Czech Republic and come up with the recommendations for the environmental policies strategies in the Czech Republic.

2 Environmental thought: a historical perspective

2.1. Introduction

The term "environment" today brings to mind many associations as climate change, greenhouse warming and ozone layer, air and water pollution or biodiversity and wildlife conservation. The issue has gained a great public interest during the second half of the twentieth century, where many people all around the world have recognised that the consumer economy had an unavoidable and harming consequence: pollution. Yet in 1950s, the term "environment" denoted just limited conditions at home or at work. But in following years the concept of environment developed to include the complex interactions between man's activities and all components of the natural environment. This modern concept includes ecological, economic, aesthetic and ethical concern.

The term "environment" refers to the quantity and quality of natural resources. It includes the ambient environment, which consists of the landscape, water, air and the atmosphere, and is a crucial determinant of human quality of life, as well as supporting human life. The state of the environment is a critical determinant of the quantity, quality and sustainability of human activities (Panayotou 1993a). The economic growth and development during the last century has put an enormous pressure on ecosystems and modified natural areas on the Earth. Together with increased global human activities, most of the original habitats have been destroyed.

Ecosystems and biodiversity provide four types of services to people. Nature's first service is as a supplier of resources, both renewable and non-renewable, and energy inputs. The second service is as a receptor for waste products. The nature recycles human wastes from production and consumption. The third one is that nature serves life-support functions such as the maintenance of the quality of atmosphere, the maintenance of climate and temperature and recycling of water and food. And last service is as a supplier of amenity, educational, religious and cultural values to individuals and society.

But human action, e.g. production and consumption, causes many environmental damages. As regards the economic and social costs of environmental damage, they can be divided into three categories: health costs, productivity costs and amenity costs. The first group includes health consequences of environmental damage, such as sickness or premature death. Productivity cost relates to the reduced productivity of natural resources and human-made capital, violation of environmental services such as the natural cleansing of water or the yield from fisheries but it can be also spending more time on cleaning and maintaining house and other buildings in polluted areas. The examples of amenity costs, i.e. the loss of environmental quality, are a loss of biodiversity, a mature forest, a clear view or clean and quiet neighbourhood and so on.

We have two possibilities how to protect the nature. The first one is to preserve nature by placing limits on its use, e.g. to declare particular areas as national parks or nature reserves. An alternative way is to encourage sustainable use of nature. This means exploiting natural assets in such a way that their stocks do not diminish. Over the last decade, sustainable development has become a common term in environmental economics. It refers to the long-run mutual dependence of environmental quality and resource availability on one hand, and economic development on the other hand.

2.2. Environmentalism in politics and international relations

The journey toward sustainable development had already been initiated at the Stockholm Conference on the Human Environment in June 1972, which was a milestone in the development of international environmental policy. The conference resulted in the establishment of a new organisation, the United Nations Environment Programme (UNEP), and the creation of national environmental protection agencies. The aim of the UNEP was to co-ordinate environmental activities among various UN agencies. The conference also offered a basis for developing a convention on the dumping of waste into the ocean and approved a 10-year moratorium on whaling. But the real value of the Stockholm conference was that it pointed out many environmental issues. Very few countries had developed the infrastructure needed to deal with problems of the environment, and particularly in the developing world, there was no organisational basis to tackle the environmental problems.

In 1980, The US Global 200 Report appeared to confirm environmental forecasts about the consequences of the neglect the global "common interest" and the over-exploitation of open-access resources (Pearce and Turner 1990). In 1984 the World Commission on Environment and Development, the chairman of which was Dr. Gro Harlem Brundtland, former Prime Minister and Environment Minister of Norway, was selected in co-operation with and approved by the United Nations Secretary General. The Commission, often called as " Brundtland Commission", is known for its broad use of public hearings in various regions of the world to discuss its findings and probe public opinion about them. And in 1987, its report

“Our Common Future” elaborated on the concept of sustainable development was published. This report highlighted many environmental themes, such as the rejection of the physical limits to growth thesis, the appropriate role of the market forces in the development process, the role of poverty in natural resource degradation and the need to recognise and build on common interests. The term “sustainability” has appeared in a range of contexts and probably most prominently in the *World Conservation Strategy.*[1] Underlying some sustainability thinking is an increased recognition that knowledge accumulated in the natural sciences ought to be applied to economic processes.

In 1991, Global Environment Facility (GEF), which serves as the official funding mechanism for several international environmental agreements, including the Framework Convention on Climate Change and the Convention on Biodiversity, was established.

The 1980s and 1990s have seen an increased importance of environmental problems that have a global reach. While the United States had taken the lead in the Stockholm conference in 1972, during the next conference the European Union and Japan took the leadership role.

The United Nations Conference on Environment and Development (UNCED), also called the Earth Summit, was held in June 1992 in Rio de Janeiro, Brazil, with the participation of more than 170 national state delegations. It was the first international conference to deal at the highest political level with global environment and development issues in a comprehensive and forward-looking way. The Rio conference highlighted growing concern about the global environmental disaster and the need for ecologically sound sustainable development.

One of the major documents produced by the UNCED is the Agenda 21, a plan of action for sustainable development. It consists of 40 chapters and at its roots consist of 27 principles. There are four broad sections, which cover a range of issues: social and economic dimensions, conservation and management of resources for development, strengthening the role of major groups and implementation. The Agenda 21 stipulates that countries should develop national sustainable development strategies and report to the newly formed United Nations Commission on Sustainable Development (CSD) on progress made toward implementation. But no reporting standards were adopted.

Other important documents adopted in Rio are the Framework Convention on Climate Change (FCCC) and the Convention on Biodiversity. The Climate Convention pointed out the potential dangers that would result from the uncontrolled emissions of greenhouse gases

[1] IUCN, 1980

(GHGs), e.g. those that affect the balance within the atmosphere, such as carbon dioxide, methane, oxides of nitrogen, etc. Climate change has become one of the most important areas of research in the field of the environment. The emission of GHGs into the atmosphere, and the following change in climate, is likely to have a significant impact on the planet in a number of areas including human health, the ecosystem and industrial production. The FCCC went into force in March 1994 and specified, as a voluntary target, a reduction of carbon dioxide (CO_2) emissions to 1990 levels by the end of the decade.

The Convention on Biodiversity calls for the conservation and sustainable use of biodiversity, and for the benefits of its use to be shared fairly. The last document adopted in Rio summit is the Declaration on the sustainable development of forests.

In years following Rio summit, nations around the world had been trying to construct an action-forcing instrument. The states of the European Union wanted immediate and decisive action to limit greenhouse gases, while the United States, Canada, Japan, Australia, and New Zealand favoured a go-slow process, fearing that fast action would lead to economic dislocations. The world 's nations agreed to meet in Kyoto, Japan, to negotiate an action-forcing protocol. In response to the problems posed by climate change, an international environmental agreement, the Kyoto Protocol, has been established under the Framework Convention on Climate Change. The agreement on a number of goals was reached in December 1997 and it paves the way for mitigation and adaptation policies, including the use of emissions trading, the clean development mechanism and joint implementation. The Kyoto Protocol is the first substantial agreement to set GHGs emission limits. A group of 39 industrialised countries agreed to limit their annual average greenhouse emissions during the 2008-2012 time period to a specified percentage of their 1990 emissions. The average target reduction in this period is 5%. European Union countries, Switzerland and most of the Central and Eastern European countries agreed to reductions of 8%, while the target of the United States was 7%. Some countries were allowed net increases in emissions of the greenhouse gases under consideration, notably Australia which was allowed an 8% increase.

The Kyoto protocol stipulates that greenhouse gases should be treated as a basket and does not single out carbon dioxide. In addition to emission of gases, consideration was also given to sinks of greenhouse gases, processes such as growing trees, which remove carbon from the atmosphere. But the enforcement of the Protocol was not easy. For the Kyoto Protocol to come into force the ratification by the countries was necessary. But the US decided to step away from its signature in 2001. Russia ratified the Protocol only in 2004.

The Johannesburg Summit in 2002 – the World Summit on Sustainable Development – was the last one of the large international conferences intended to deal with environment and development. But it failed to recover the political will to move in a clean manner to implement sustainable development strategies. It was a development rather than an environmental conference. The political climate had changed and development and human health issues had clearly become more important. Governments did not support the reducing of ever-growing energy consumption and the encouragement of development of alternative, environmentally friendly technologies. The unwillingness has been particularly evident in the United States, where greenhouse gas emissions have increased by 14% since 1990. On the other hand, Germany, the Great Britain and other EU countries introduced such environmental policy instruments as road pricing, progressive CO2 taxes and mandatory targets for adoption of renewable energy technologies. They also adopted many directives, which directly aim resource input and waste generation, for example, with its packaging directive and mandatory recycling of old cars and electronic equipment.[2]

2.3. The environmental concept in economics

Modern economic theory, as we know it, has always had a respect to the environment, but the problem was that many issues, which later found their way into the economic analysis, had often been ignored or overlooked.

The environment had often been regarded as a “side-effect” or “externality”. The pollution of the air due to the emissions, dumping waste as a side-product of manufacturing or other form of economic activity has long been looked at as “externalities”.

With the raise of ecological awareness and building it the environmental-protection legislation into the founding basics of the international and global organisations and unions (such as the UN or the EU), the environment and its value has slowly found its way into the mainstream economics.

The history of environmental concept of economics dates back to the Classics, who were in fact the first to work on these issues. During the last decades the environment has become a scarce resource. Since economics is about how to tackle scarce resources, it can often be useful when dealing with environmental problems. This is one of the main reasons why we use economics in environmental policy. Economics should help us to ensure that the costs and the benefits of environmental measures are balanced. Although it is not easy to

[2] For more information about EU environmental policy see chapter 4

estimate costs and benefits, there is an increasing demand that this is done before the environmental policy is decided. Because a combination of institutional, market and policy failures result in the underpricing of scarce natural resources and environmental assets.

2.3.1. From the classical to the neo-classical

Classical economists, such as Adam Smith, David Ricardo or Thomas Malthus, were interested in standards of living and the process of economic growth. They were influenced by limits to growth but from a different perspective than modern theories that call for sustainable development. Natural resources were seen as determinants of national wealth and growth. Moreover, differences in resource endowments were seen as influencing income differentials between economies. Since land was fixed in supply, and was a necessary input in production, classical economists ranged from being actually pessimistic about the future mankind (the Malthusian viewpoint) to taking the less strict view that economic progress was necessarily limited in the long run (Perman, McGilvary and Common 1999).

The common key aspect for these classical economists was the growth of population. While the population growth was the driving force, absolute resource constraints were irrelevant. Economists of the next generation were using this model as a standpoint. John Stuart Mill (1857) recognised the potential of non-renewable resources to act as constraints on economic growth independent of population pressures. He also stressed the threat of unrestrained economic growth for natural wilderness, self-determination in natural ecosystems, and the importance of natural beauty. Mill argued that technology could postpone constraints imposed by resource scarcity (Mill 1857).

The first part of the twentieth century was a period in which many economists showed no interest in resource exhaustion or environmental issues. The exception is normally given as Hotelling (1931) and his theory of the mine describing optimal non-renewable resource depletion.

In general, the literature in the first part of the twentieth century can be regarded as developing concerns in economics about conservation issues related to agriculture and forestry and establishing a theoretical approach to non-renewable resource depletion which is still fundamental to resource economics. However, such topics were no longer the concern of central figures in economic philosophy but they were already relegated to specialists in sub-disciplines. The mainstream economics, which most of environmental economics is based on, is neoclassical economics. It is founded on the concepts of economic efficiency and optimality, using the tools of marginal analysis. Mainstream economics developed theories that by assumption implied economies could operate independently of either natural resource constraints or assimilative capacity and so further marginalized environmental issues. Thus, the theories of the optimal depletion of the natural resources are based on neoclassical economics. Environmental economics extends the framework of neoclassical economics to account for the role of natural resources in contributing directly to human welfare, and in contributing to the production of goods and services. However, the assumptions used in neoclassical environmental economics, e.g. regarding the substitutability between natural and man-made resources, have been criticised as leading to unrealistic conclusions as to the extent to which natural resources can be depleted and substituted for by alternative investments.

2.3.2. Resource and environmental economics

Environmental economics follows the mainstream neoclassical economics in having as its central concern the efficient allocation of scarce resources among competing uses. It brings scarce environmental resources into mainstream economic analysis. It also addresses issues of pollution control, the efficient setting of emissions standards, waste management and recycling, the industrial activity of environmental externalities, the conservation and valuation of natural resources, and so on. The aim of environmental economics is to identify policies, which will move the economic system towards an efficient allocation of natural resources.

Concerning the evolution, the resource economists of the 1950s (see for example works of Kapp 1950 or Ciriacy-Wantrup 1952) regarded the environment as a source of materials, which required some specialised management due to characteristics differentiating them from manufactured goods. These economists can be viewed as within the neo-classical school of economics. Resource economics is generally based upon the study of abstract mathematical models describing the “efficient” and “optimal” use of forests, fisheries and minerals (Spash 1999).

Ciriacy-Wantrup and his work in the 1950s stimulated the development of environmental economics. One of his contributions is the concept of a safe minimum standard, which can be seen as a bridge between economists and ecologists. Another important contributor of this time is Kapp (1950), who noted that the consequences of an environmental disruption and benefits from an environmental improvement are highly heterogeneous and cannot be compared quantitatively with one another. He rejected even the principle that social costs and benefits were quantitatively comparable. However, thought on environment-economy interactions within economics was moving in the opposite direction to Kapp.

The Paley Report, published in 1952 and showing the US worries about exhaustible resource depletion, led to the foundation of Resources for the Future (RFF) which was responsible for promoting environmental cost-benefit analysis. During the 1960s, environmental economics appeared in the US as a distinct and defined sub-discipline, which was concerned with the growing pollution problems, those becoming obvious to the general public.

In the late 1960s and early 1970s, the laws of thermodynamics[3] were rediscovered as concepts with considerable implications for economics. This led to the development of materials balance theory (see for example Kneese, Ayres and d'Arge 1972). The implications of this materials balance working hand in hand with general equilibrium modelling is that all the prices in the economy are incorrect in terms of efficiency because everything has an associated environmental externality (Spash 1999).

Following trends in mainstream economics, mathematical modelling took on a powerful role in the development of theory and in particular optimal control theory was adopted to model fisheries, resource depletion and pollution control. This mathematical approach gave credibility to the new sub-discipline within mainstream economics but, on the other hand, removed it further from the actual management of environmental issues of the day and may therefore have restricted its growth and wider appeal.

Outside of the US, only a few academics can be regarded as even addressing the subject area at this time, e.g. E.J.Mishan in the UK and Karl-Göran Mäler and Peter Bohm in Sweden.

The 1970s were a period of consolidation. A major steps in that regard was the foundation of the Association of Environmental and Resource Economists (AERE). In May 1974, the "*Journal of Environmental Economics and Management"* (JEEM) was established by Ralph d'Arge and Allen Kneese and the Association later became the organisation controlling the journal. The Association and the Journal gave credibility to environmental economics and encouraged further specialisation. Despite the fact that the JEEM developed into the theoretical journal of environmental economics and the practical policy content was lost amongst mathematical models, the influence of JEEM on the sub-discipline was very strong for many years.

[3] The First Law of Thermodynamics states that in a closed system the total quantity of energy and matter remains constant. The Second Law of Thermodynamics states that in any thermodynamic process, the entropy of a system plus its environment must either increase or remain unchanged. (Markandya et al. 2001)

Resource economists concentrated upon fisheries, forestry and mineral extraction, while environmental economists dealt with pollution control and cost-benefit analysis[4]. Together, they explained how neoclassical models were imperfect in their neglect of the resource base and waste sinks. They generally claimed corrections to markets could be made to avoid these problems and achieve efficiency gains (Spash 1999: 416). While popular environmentalism of the time was arguing in favour of legal restrictions and zero pollution, these economists favoured market-based instruments and optimal pollution levels determined by taking costs and benefits into account.

After the popular revival of environmentalism in the late 1980s, Europe started to follow the footsteps of the US. In 1991, a European Association of Environmental and Resource Economists (EAERE) was established and also an associated journal "*Environmental and Resource Economics"* (ERE) was started. The organisation and journal have been strongly connected with academics in the Netherlands and Italy.[5]

The society has highlighted the view of environmental and resource economics as a science, and this has been reflected in mathematical modelling and following the trends set by mainstream economics. This more formal spread of an apparent environmental concern within economic circles in Europe was welcomed as another opportunity to get the message across to politicians and economists that the environment and economy interact in fundamental ways. However, neither has seemed particularly moved by what environmental economists have been saying. At the same time, in areas where environmental economics has been regarded as open to criticism, for failing to address certain issues, the models have been extended. For example, environmental valuation methods have moved far from their original concentration on the direct use values of mainstream microeconomics into areas where questions relating to future generations and the existence of species are discussed.

We can say that environmental economics is rapidly developing field. It is reflected in a large number of textbooks, monographs, journals and conferences. Also the variety of issues covered by environmental economics is increasing, e.g. pollution, global and climate change, biodiversity, monument conservation and international negotiations etc. This rise in scope, to some extent, refers to different economists from various sub-disciplines of economics studying environmental issues and contributing to its progress. In addition, the

[4] The distinction of resource, environmental and ecological economics will be provided and analyzed later on in this chapter.
[5] The presidents of the organization were for instance such remarkable scientists as: Henk Folmer, Rudiger Pethig, Domenico Sinescalco or Aart de Zeeuw.

multidisciplinary nature of many issues raised in environmental economics research has caused an increase in the interaction between economists and other scientists.

2.3.3. The raise of ecological economics

Ecological economics is a transdisciplinary approach to economics, which emphasises the relationships between economic and ecological systems. Human beings are considered to be a major element of the overall economic-ecological ecosystem, rather than being the dominant and central element. The core of ecological economics can be associated with the goal of sustainable development, the view that the economy is a subsystem of a larger local and global ecosystem that sets limits to economic growth and a methodological approach based on the use of physical indicators and broad systems analysis.

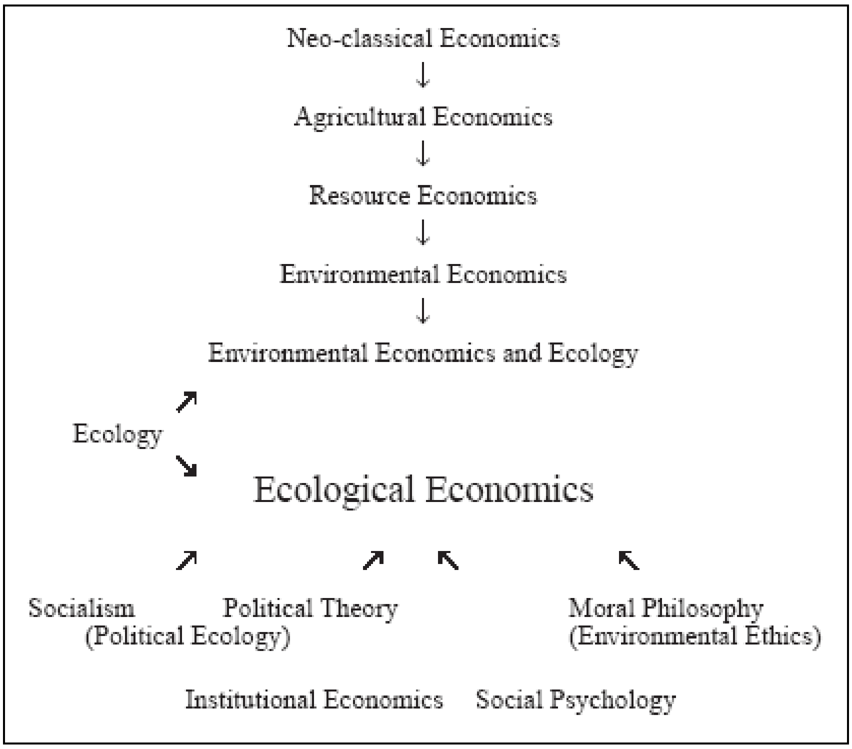
Ecological economics explains not only the financial constraints on consumption, as in neoclassical economics, but also the natural constraints implied by the limited ability of the environment to provide natural resources, and to absorb the wastes of production and consumption. These constraints, which do not bind in the present but may reduce the capacity of the economic-ecological system to provide for human wellbeing in the future, are particularly relevant to sustainability and sustainable development. Sustainable management of the economic and ecological system is one of the major focuses of ecological economics, and the time frame of the analysis is typically longer than that considered in traditional economic analysis. The economists K.E. Boulding, H.E. Daly, and N. Georgescu-Roegen, and the ecologists C.S. Holling and H.T. Odum are considered to be the intellectual founders of ecological economics.

As regards the evolution of ecological economics, it was founded upon the concerns of the 1960s and early 1970s for limits to growth and the study of the flow of energy and materials in the economy based upon the work of Georgescu-Roegen (1971). In addition, the management of environmental externalities as social costs and the resulting restrictions on the applicability of cost-benefit analysis reflect the studies of Kapp (1950). However, the ecological critics of economics failed to find a collective institutionalised academic position that would establish a new discipline. The formal establishment of the field known as "ecological economics" happened at the end of the 1980s. In 1987, the International Society for Ecological Economics (ISEE) was born in Barcelona. The association was formally established in the USA in 1988 and has expanded from there to Europe, Canada, Australia, China, Russia and many other countries all over the world. Now, the ISEE has almost 2000 members in 81 countries and the society journal "Ecological Economics" is published every month.

Ecological economics as an international association was founded on the idea of uniting two groups of academics, ecologists and neo-classical economists. The subject of ecological economy would widen the overlap between neo-classical environmental economics and ecological impact studies and also encourage new ways of thinking about relations between ecological and economic systems. The following chart shows the hierarchy and the development of the environmental thinking in Economics.

Figure 2.1 The development of Environmental thinking in Economics

ENVIRONMENTAL THINKING IN ECONOMICS



Source: Spash, L., Clive (1999): The Development of Environmental Thinking in Economics, Environmental Values, Cambridge University

The methodology of ecological economics is still open. The European branch tends more to socio-economics and political economy while the American one inclines scientific approach. In 1996, the European Society for Ecological Economics (ESEE) was formally established in France. The association has quite different aims than those stated in environmental economics associations such as the EAERE or AERE. As in the International Society for Ecological Economics, the main objectives are to combine knowledge across the specialist areas of ecology and economics and also to see that policy advice on environmental problems is formulated on this basis. In addition, the ESEE encourages analysis of the social aspects of environmental policy and wider consideration of the place of humans within the environment. This implies a different methodology from mainstream economics. A characteristic feature of the European movement is the search for co-operation with philosophers, sociologists and psychologists to explore ethical, social and behavioural fundamentals of human well being. Ecological economists believe that an effective environmental policy formation requires linking natural and social sciences. That is, studying environmental problems without any regard to economics is viewed as misguided in the same way as excluding the natural science perspective has misguided the economic approach. On the other hand, the critique is that much of neo-classical economics is a barrier to further development.

A possible direction for ecological economics is learning from a past experience, accepting that how the way economic systems interact with nature means moving away from old approaches and developing new paradigms rather than accepting neo-classical theory as basically sound and developing mathematical models linking it with ecology. As a result, ecological economics is internally much more heterogeneous than environmental economics, where the neoclassical paradigm defines the direction of research.

In "Environmental Values" Giuseppe Munda (1997) outlined his opinion of what forms some of the key concepts. These were that ecological economics is worried about the policy consequences of its arguments, openly claims ethical positions rather than neutrality, accepts that values can be disputed and incommensurable, recognises distributional issues as a primary concern and sees the ecological concept of scale as limiting material growth.

An important aspect of ecological economics is an evolutionary dynamics. It stresses that economic and environmental systems are interacting and changing, often unpredictably, rather than being static. This implies analysing non-deterministic processes rather than optimal paths to static equilibrium.

2.3.4. Environmental versus ecological economics

We would like to discuss also the difference between environmental and ecological economics, which relates to a number of issues. Environmental economics is distinct from ecological economics to the extent that it adheres more closely to conventional, neoclassical economics. That is, it emphasises the desirability of attaining environmental objectives by means of using market mechanisms, like adjusting price signals, in order to influence the behaviour of households and firms.

The core of environmental economics is the theory of externalities, which implies that the environmental problem is cast in terms of interaction between economic agents. Thus, nature and environment are described only implicitly. On the other hand, ecological economics is more interested in explicit description of people-environment or economic-ecological relations. This is due to the fact that ecological economics is more closely related to traditional "resource economics", notably concerning renewable resources like fish, forests and water, than to environmental economics in a narrow sense, i.e. "economics of pollution" (Turner, Perrings and Folke 1997).

Another important difference is between scale and allocation. Environmental economics is aimed at optimal allocation and thus an efficient use of scarce resources. The objective is to find the optimal level of an externality, which ensues from attempt towards optimal social welfare or Pareto efficiency.[6] Environmental economics considers natural resources, e.g. fish, wood, oil or gas, environmental quality, services provided by the environment, and nature as scarce resources to which allocation theories are applicable.

Ecological economics has chosen sustainable development as its central concept. This is consequently approached with particular attention for spatial scales. On the other hand, within environmental economics, sustainable development is generally regarded as being identical to sustainable growth, which is viewed with general and abstract models without any reference to historical and spatial aspects. But we have to argue that nowadays the objective of sustainable development is broadly supported by environmental economics, too, although definitions and interpretations are not always consistent with those adopted by ecological economics.

Another thing is that ecological economics generally assumes a longer time period than environmental economics and pays more attention to cause-effect chains, interactions and feedback between natural and human-economic systems.

Also the main criteria for evaluating developments, policies and projects differ between environmental and ecological economics. The dominant criterion of environmental economics is "efficiency". In addition, whereas in environmental economics distribution and equity are secondary criteria, ecological economics highlights basic needs, North-South welfare differences and the complex link between poverty and environment. Environmental

[6] Pareto efficiency is defined as a situation, in which an improvement in the welfare of any individual cannot be achieved without a welfare loss for someone else.

economics is best characterised by the “precautionary principle”, linked to the environmental sustainability. It is closely related to a concern for instability of ecosystems, loss of biodiversity, and environmental ethical considerations. On the contrary, efficiency is just a secondary criterion in ecological economics. “Distribution” is often considered as a more important criterion for evaluating policies and changes than efficiency.

Environmental economics focuses on valuation, particularly, utility and welfare in theory, and costs and benefits in practice. Ecological economics, unlike neoclassical economics, does not regard a total valuation of changes in ecosystems as the sum of private values. EE is tending to add criteria to the economic values in the context of decision-making concerning the management and changes in ecosystems.

Next, ecological economics criticises social objectives such as those formulated within environmental economics, in particular the utilitarian approach to intergenerational welfare. Alternatives are a Rawlsian principle of justice (Rawls 1972) or a minimum welfare level encompassing basic needs (Stern 1997). In addition, ecological economics seems to reject consumer sovereignty when giving priority to the interest of systems above the freedom of choice of individuals.

Ecological economics proposes an extensive integration of economics with insights from ecology done by ecological-economic modelling at local, regional and global scales (van den Bergh and de Mooij 1996).

Ecological economics has often shown dissatisfaction with the strict and fixed assumptions in mainstream economic theory with regard to individual behaviour. They are usually summarised in the assumption of “unbounded rationality” and models of maximisation of profit and utility. Van den Bergh (van den Bergh, Ferrer-i-Carbonell and Munda 2000) discusses the neoclassical approach and presents a first analysis of the implications of alternative models of individual behaviour for environmental policy. Such models include ‘satisfying’, lexicographic preferences, relative welfare, habits and routines, imitation, reciprocal behaviour, changing and endogenous preferences, and various models of behaviour under uncertainty. In literature, we can also find an opinion that lexicographic preferences offer an explanation for some of the problems met in economic valuation studies, notably that certain people are sometimes unwilling to make trade-off between income compensation and environmental change (Blamey and Common 1999).

The table below summarises the main differences between environmental and ecological economics. But still there is a significant overlap between environmental and ecological economics.

Table 2.1 Differences in emphasis between Environmental and Ecological economics	
Environmental and resource economics	***Ecological economics***
Optimal allocation and externalities	Optimal scale
Priority to efficiency	Priority to sustainability
Optimal welfare or Pareto efficiency	Needs fulfilled and equitable distribution
Sustainable growth in abstract models	Sustainable development
Growth optimism and "win-win" options	Growth pessimism and difficult choices
Deterministic optimisation of intertemporal welfare	Unpredictable co-evolution
Short to medium term focus	Long-term focus
Partial, monodisciplinary and analytical	Complete, integrative and descriptive
Abstract and general	Concrete and specific
Monetary indicators	Physical and biological indicators
External costs and economic valuation	Systems analysis
Cost-benefit analysis	Multidimensional evaluation
Applied general equilibrium models with external costs	Integrated models with cause-effect relationships
Maximisation of utility or profit	Bounded individual rationality and uncertainty
Global market and isolated individuals	Local communities
Utilitarianism and functionalism	Environmental ethics
Source: Jeroen C.J.M. van den Bergh: Ecological economics: Themes, Approaches, and Differences with Environmental Economics, Tinbergen Institute Discussion Paper, 2000	

2.4. The relationship between environment and economics

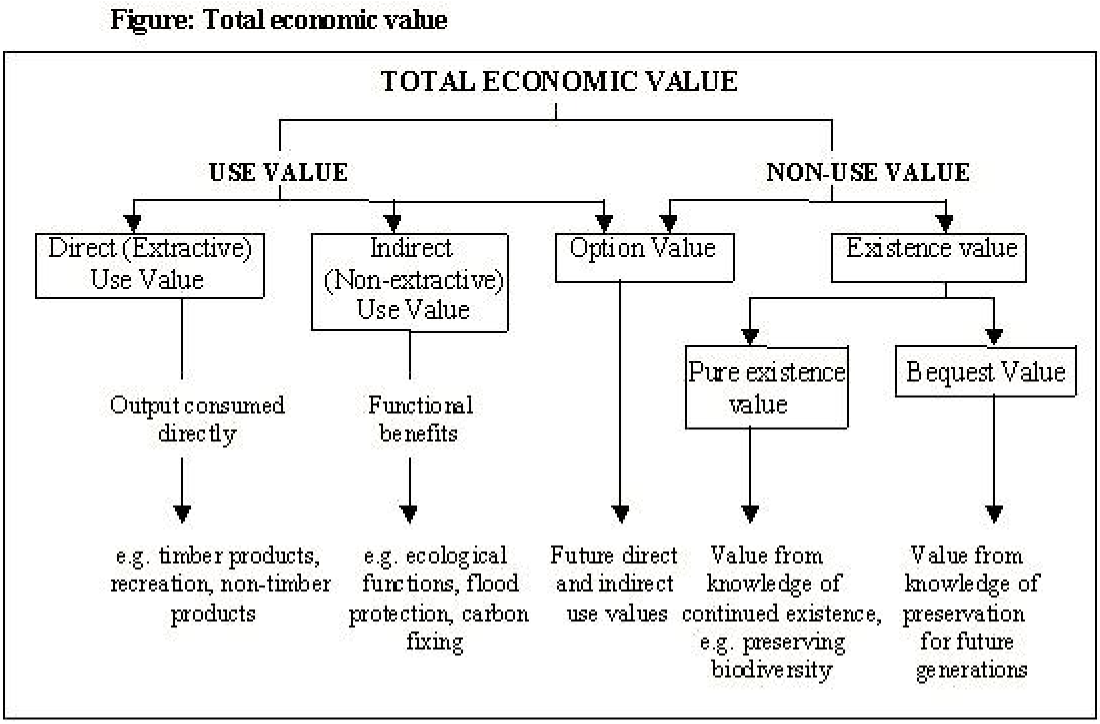
2.4.1. Economic and environmental values

There exist several interpretations of the term "value", but economic theory has concentrated on monetary value as expressed through individual consumer preferences. On this basis, value only occurs because of the interaction between a subject and an object and, in terms of this explanation, is not an intrinsic quality of anything.

The environmental literature has identified three basic value relationships, which seem to underlie the policy and ethics adopted in society: values expressed through individual preferences, public preference value which finds expression through social norms and functional physical ecosystem value (Pearce and Turner 1990).

The economic value of environmental assets has several components. It is widely accepted that two broad categories of values exist: “use values” and “non-use values”.

Figure 2.2 Total economic value



Source: Pearce and Turner (1990)

In the figure we can see the classification of total economic value of environmental goods. Total economic value is concerned with the valuation of preferences held by people. It does not include any value, which may intrinsically stay “in” environmental assets.

Use values are defined as those benefits that derive from the actual use of the environment in consumption and production activities. “Direct-use value” derives from direct use of or contact with biological resources or an ecosystem. Many, but not all, direct uses can be valued in markets. An example of a direct use value is the use of the reserve of a species for scientific research or to attract tourism. “Indirect use value” derives from the role of ecosystems in supporting human activity, for example the support given to agriculture by forests that regulate the hydrological cycle or carbon fixation and soil formation done by tropical forests. Use values also include “option value”, i.e. the additional value placed on a natural resource by those people who want to have the option of using the goods and services in the future. An example of option value is the value that people place on preserving ecosystems and landscapes that may wish to visit in the future. But in the present, option value is in fact a non-use value. In the economic literature it has been suggested that option value represents a difference between *ex ante* and *ex post* valuation, where the terms *ex ante* and *ex post* refer to the amount of information that is available. *Ex ante* relates to the situation where the state of the world is still unknown, while *ex post* refers to the situation after this state has been revealed (Ready 1995).

"Non-use values" are those that individuals derive from natural resources without using them either directly or indirectly. Non-use values are also described as existence values by many authors. The argument behind existence value is that people care about the environment not only because they or their heirs can get some benefit, or can avoid some sort of loss, by using or preserving environmental assets. Furthermore "existence value" is the value that people place on the knowledge that a particular species or ecosystems exists. They wish to maintain or improve environmental assets for their own sake. Existence value involves a subjective valuation as it is based on the satisfaction which individuals experience from knowing that a certain natural asset exists, for themselves and for others, without being used now or in the future (Wills 1997). There is therefore an "intrinsic" value, a value that resides "in" something and that is unrelated to human beings altogether (Pearce and Turner 1990: 135). "Bequest value" is the value that people place on having an environmental resource or general environment quality available for future generations. It is based on the will to exchange current value for the increased well being of one's heirs. Bequest values are considered as a "non-use value" of a resource, even though the value derived results from the future use of a resource.

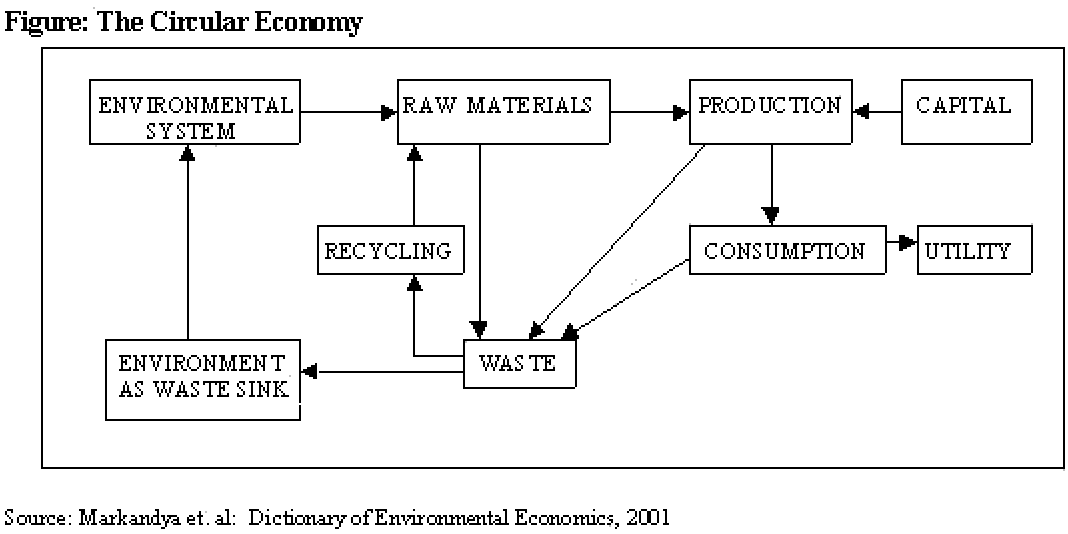
Natural goods and services often have no price tag because they are not fully captured in markets. However, it can be useful to estimate the value of natural goods and services. The justification for a valuation of nature lies in the fact that it offers a method of measuring the ecological consequences of economic activities. The often-used concept of total economic value is an aggregate measure of nature valuation (Turner, Pearce and Bateman 1994).

Despite this concept of total economic value, economic theory has not been very successful in capturing all ecosystem functions in an economic valuation. This concept fails to reflect the life support service of an ecosystem, which is essentially the existence, functional operation and maintenance of the entire ecosystem that are behind the assigned values of natural assets.

2.4.2. Linkages between environmental and economic systems

Ecosystems provide four types of services to people. The first one is that nature is a supplier of resources and energy inputs. The second service is that nature recycles human wastes from production and consumption. A third service is as a supplier of amenity, educational, religious and cultural values to individuals and society. Finally, it serves life-support functions to the economic process, such as the maintenance of the quality of atmosphere, the maintenance of climate and temperature and recycling of water. The interactions between the economy and nature are dynamic; in other words they are changing (Hanley, Shogren and White 1997).

Figure 2.3 The circular economy



Source: Markandya *et al.* (2001): *Dictionary of Environmental Economics*

As we can see in the figure environmental and economic systems are closely linked. We can describe this linkage as the "circular relationship", where everything is an input into everything else. Environmental resources contribute to economic productivity and welfare. The interdependence between the environment and the economy arises from the fact that the environment provides the raw materials for economic activity as well as directly providing welfare, and because the way in which the economy is managed impacts on the environment. Thus, environmental damage caused by economic activity will in turn affect both welfare and the performance of the economy.

Stocks of environmental resources, including energy, raw materials and agricultural outputs, provide inputs to the productive process. The abstraction of natural resources, depending upon the rate of abstraction and renewability, may result in a source-conservation problem. The extraction of raw materials leads to production, but also produces waste. Consumption, which follows the production process, leads to more waste as well. Thus, the end product of consumption is waste material. The waste can be either recycled into a raw material again and it goes back into the production cycle or it is dumped into the environment, which provides waste-disposal services for the productive process, absorbing and, as far as its capacity allows, recycling waste products and pollutants. As a result, production and consumption involve the transformation and use of materials which create wastes which, returned to the environmental system, may result in an environmental pollution problem.

It is evident, that other things being equal, i.e. resource-output and waste-output ratios, in other words without inventing new technologies, economic growth results in faster rates of natural-resource depletion and higher levels of waste disposal. In addition, with given limits to the stock of natural resources and the capacity of the environment to assimilate increased wastes, continuing economic growth eventually stops to be sustainable. This reasoning underlines the approach of the "limits-to-growth" school which was presented in the late 1960s and, in a modified form, more recently (see Meadows et al. 1970 and Meadows et al. 1992). It was used to suggest that there was an inherent conflict between the economic growth and the maintenance of environmental quality.

2.4.3. Sustainable development

The term "sustainability" has appeared during the 1980s. It has been recognised that knowledge accumulated in natural sciences should be applied to economic processes. It is because modern mainstream economics lacks a guarantee that any economic optimum is associated with a stable ecological equilibrium. The Pareto optimal allocation, for example, does not have to be associated with ecological sustainability.

The term "sustainable development" has become a common term in environmental economics and it is often used synonymously with sustainability. But there is a difference between them. While sustainability implies that well being can be at least maintained over time, sustainable development implies in addition that the factors that determine quality of life, such as literacy, health or human rights improve over time. In other words, the use of the term "development" in conjunction with sustainability requires that the issues crucial to human development must be taken into account.

The concept of sustainability has already a long history and we can find a lot of different definitions in literature. Probably the most well known definition of sustainable development is given by the Brundtland Commission, which defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"[7].

Goodland (1995) distinguishes several types of sustainability: environmental sustainability, economic sustainability, social sustainability and sustainable development. Sustainable development should integrate these three types of sustainability and use them to start to make development sustainable. Pearce and Turner (1990) say that sustainable development implies maintenance over time of aggregate resource stocks, such that the potential to generate welfare is not allowed to fall bellow the current level. In economic growth theory sustainable development is often translated into intergenerational equity. This is usually interpreted as a constraint on growth, namely non-decreasing welfare (Pezzey 1992). However, there are also other perspectives possible. Each of them uses its own subjective choice for a certain welfare concept and its own trade-off between present and future generations. Thus, sustainable development is in fact a normative concept.

How can we measure the extent to which development is following sustainable path? In 1995, the Commission on Sustainable Development adopted a work programme on initial 130 indicators of sustainable development. These include social, economic, environmental and institutional factors which all facilitate sustainable development. Social indicators include poverty, population demographics, education or health, e.g. unemployment rate, population density, health expenditures, life expectancy, etc. Economic aspects of sustainable development include national income measures, consumption patterns, debt servicing, environmental expenditures and measures of technology transfer and capacity building, e.g. GDP per capita, public debt, inflation rate, foreign debt, foreign trade balance, etc. Environmental indicators are for example measures of water, land, natural resource and atmosphere use, as well as measures of waste generation. Institutional aspects comprise measures of the integration of environment and development in decision making, scientific capacity, legal mechanism, information dissemination and the use of NGOs.

Generally we can say that sustainable development refers to the long-run mutual dependence of environmental quality and resource availability on one hand, and economic development on the other hand (van den Bergh and Hofkes 1997). Economic development and natural resource maintenance are related in the following way: Up to some level of

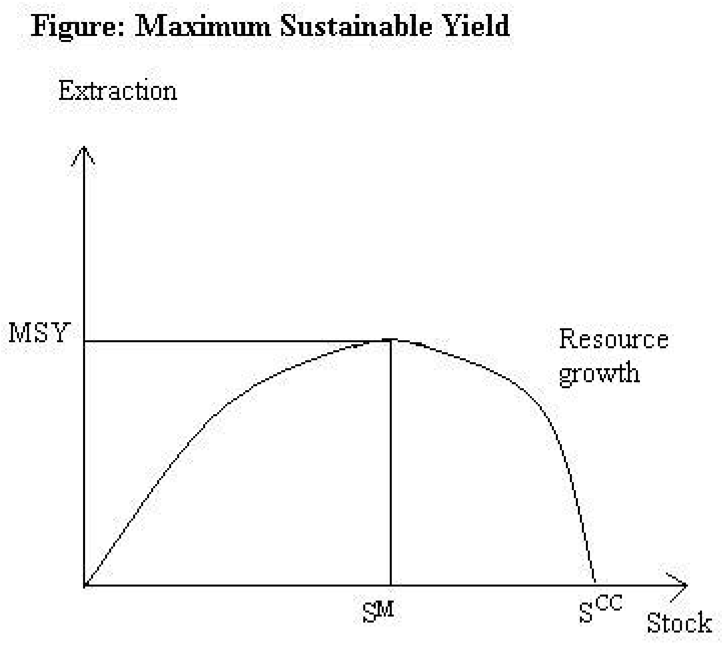
[7] World Commission on Environment and Development, 1987

resource's use there is a complementary relationship, i.e. there is a trade-off between development and the services of the resource base. But beyond this level, economic development is likely to involve decrease in one or more of natural environment functions, e.g. as production inputs, amenity provision or waste assimilation function.

Maintaining the services and quality of the stock of resources over time implies acceptance of the following rules:

1. Renewable resources must be used efficiently and their use should be kept to a level that is compatible with regenerative capacity of renewable resources over the long term. This level can also be called a maximum sustainable yield.

Figure 2.4 Maximum Sustainable Yield



Source: Markandya *et al.* (2001): *Dictionary of Environmental Economics*

As we can see in the figure, maximum sustainable yield refers to the maximum yield that can be reaped or collected from a renewable resource stock without reducing the size of the stock. Renewable resources such as fish stock usually grow at an increasing rate as the stock size increases, and then reach a maximum before falling again to zero once the stock level reaches the carrying capacity of its habitat. The MSY corresponds to the stock level at which the growth rate of the resource is maximised. The figure shows the growth function of a renewable natural resource stock. The net growth rate initially increases with the stock size, reaching a maximum at S^M and falling to zero at S^{CC}, the carrying capacity of the resource's habitat. MSY indicates the maximum sustainable yield of the resource stock (Perman, McGilvary and Common 1999).

2. Also non-renewable resources must be used efficiently and their use should be limited to levels which can be compensated by their substitution by renewable resources or by other forms of capital.
3. Pollution must not exceed assimilative capacity of environment; the emissions of hazardous or polluting substances to the environment must not exceed its assimilative capacity and concentrations must be kept below established critical levels for protecting human health and the environment.
4. Irreversible adverse effects of human activities on ecosystems should be avoided.

2.4.3.1. Strong versus weak sustainability

In the last decade, the opposition between strong and weak sustainability has received much attention. Environmental economics starts from weak sustainability, which highlights a large degree of substitution of inputs in production and the economy as a whole. This opinion has been criticised by ecological economics,[8] which emphasises strong sustainability achieved through different goals, such as protection of critical ecosystems, maintenance of biodiversity, and so on.

As regards strong sustainability, an economy is said to be strongly sustainable if the stocks of each of its capital assets, including its natural capital assets, are non-decreasing. Under this concept, different types of capital, i.e. economic, natural and social should be maintained independently and there is not allowed any substitution between them. Natural capital includes resources, environment and nature, and economic capital consists of machines, land, labour and knowledge. The leading assumption of the concept of strong sustainability is that natural resources are necessary inputs in economic production and consumption and that they cannot be substituted for by physical or human capital. This is in contrast with weak sustainability, which allows decreases in the value of one type of capital, for example natural capital, to be compensated for by increasing stocks of another type of capital, for example economic capital (Perman, McGilvary and Common 1999).

In general, weak sustainability requires that the value of aggregate capital stocks, defined as a sum of economic and natural capital, must not decline. It means that reduction in the level of natural capital, for example due to the depletion of a country's oil stocks, must be compensated for by investment in an alternative capital stock.

3 Economic instruments of environmental protection

3.1. Introduction

As have been already stated, a concern with protecting the environment for the benefit of present and future generations is among the highest-ranked priorities of international agenda. Awareness of the extent of the damage done to the environment through unsustainable economic activities is steadily growing. In particular there is growing awareness of the need for international actions to implement realistic and workable solutions for the reduction of these man-made environmental impacts, which can be made through various instruments.

The traditional approach to environmental problems, e.g. excessive pollution or over-use of natural resources, has been to control them by regulations. The regulatory instruments can take many forms (Artis and Lee 1995), for example:

- setting maximum limits for the abstraction of natural resources (e.g. minerals extraction or fish catches);
- setting levels of allowable emissions of pollutants, i.e. emission standards;
- prohibiting the abstraction and use of elements and products that are considered to be environmentally damaging (e.g. discharge of particular radio-active substances);
- defining the technology processes or the materials that may be used.

The regulations are important for toxic and dangerous materials or health-related pollutants. But there are several problems with the regulatory approach. The first one is that uniform emission standards for every polluter are not the most cost-effective methods for improving environmental quality because each polluter faces different options and therefore different abatement costs. There is also a problem of compliance. Weak implementation and enforcement can limit the impact of regulation. Moreover, regulations provide only limited incentives to cost-reducing innovations in pollution-control technology. Basically, the regulatory approach tends to be aimed at the symptoms of environmental problems rather than at their socio-economic causes (Artis and Lee 1995).

As it has been already mentioned in section 2, environmental problems are essentially economic in nature. Therefore economic-policy instruments should play a role in their solving. Moreover, there has been a growing interest in creating more flexible, efficient and

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[8] See "Ecological economics" vol.22, 1997

cost-effective approaches to the environmental protection. Market-based instruments seem to provide us with this option. Since these instruments include cost-efficiency, sustainability and reduction of environmental pollution achieved in a least costly way, they have started to be looked at with the growing interest. The OECD countries have started to use market-based instruments more frequently in their environmental policies since the early 1990s and their popularity continues to grow nowadays.

3.2. Classification of environmental protection instruments

As an example of a simple list of environmental policy instruments categories, OECD (2001) includes six categories currently in use: command and control (referred hereinafter as "CAC"); economic instruments; liability and damage compensation; education and information; voluntary approaches; and management and planning.

In general, environmental protection instruments can be classified according to the two criteria (Blackman and Harrington 2000):

1. whether they determine how much to abate and what abatement technology should be used or simply create financial incentives for firms and individuals to abate, and
2. whether they require the regulator to monitor emissions, pollution and the general impact on environment.

This classification, the one often used in the environmental literature, can be presented in the form of the following table:

Table 3.1 Classification of environmental regulatory instruments

	Direct instruments	**Indirect instruments**
Economic incentives	Emissions fees Tradable permits	Environmental taxes
Command and control	Emissions standards	Technology standards

Source: Blackman, A., Harrington, W., (2000): The use of economic incentives in developing countries

Regulatory instruments that dictate abatement decisions are known as command and control regulations (e.g. emissions and technology standards). These are also called "non-market based" instruments. Policies that create financial incentives for abatement by putting an explicit or implicit price on emissions but do not dictate abatement decisions are referred to as economic incentive policies (e.g. tradable permits or environmental taxes). This group is often called “market-based” instruments and it covers all instruments and incentives that work by a change of either product or factor prices. Such instruments generate income for the governments. Direct instruments require the regulator to monitor emissions, while indirect instruments do not.

The next table shows the classification of economic instruments proposed by Markandya (2000).

Table 3.2 Classification of Economic Instruments

Direct economic instruments	
Charge systems	Pollution charges User charges Access fees Road tolls Administrative charges
Property	Ownership rights land titles water rights mining rights Use rights licensing concession
Market creation	Marketable emissions permits Marketable catch permits Quota systems Tradable land permits
Liability system	Legal liability Natural resource damage liability Liability insurance
Bonds and deposit system	Environmental performance bond Land reclamation bond Deposit refund scheme
Fiscal instruments	
Input taxes, Product taxes, Export taxes, Import tariffs, Tax differentiation, Land use taxes, Subsidies, etc.	
Financial instruments	
Financial subsidies, Soft loans, Grants, Location incentives, Subsidised interest, Revolving funds, etc.	
Source: Markandya *et al.* (2000): *Political Economy of the Environment*	

3.3. Economic instruments

According to the definition used by the OECD, economic instruments are “instruments that affect costs and benefits of alternative actions open to economic agents, with the effect of influencing behaviour in a way that is favourable to the environment” (OECD 1991). In other words, they aim to use market forces to encourage producers and consumers to limit pollution of the environment and avoid the decline of natural resources.

A combination of institutional, market and policy failures results in the underpricing of natural resources and environmental assets. As a result producers and consumers do not receive correct signals about the environmental damages they cause or about the scarcity of the natural resources they consume. This gap between the production cost and the total cost to the environment cause incorrect signals. Because the social cost for exhaustion and damages are not internalised the result is an over-production and over-consumption of environment polluting and resource depleting products. There is a wide range of incentives that can be used to internalise externalities of economic activities. Every incentive that aims to cause a change of behaviour of economic agents by internalising environmental or depletion cost qualifies as an economic instrument.

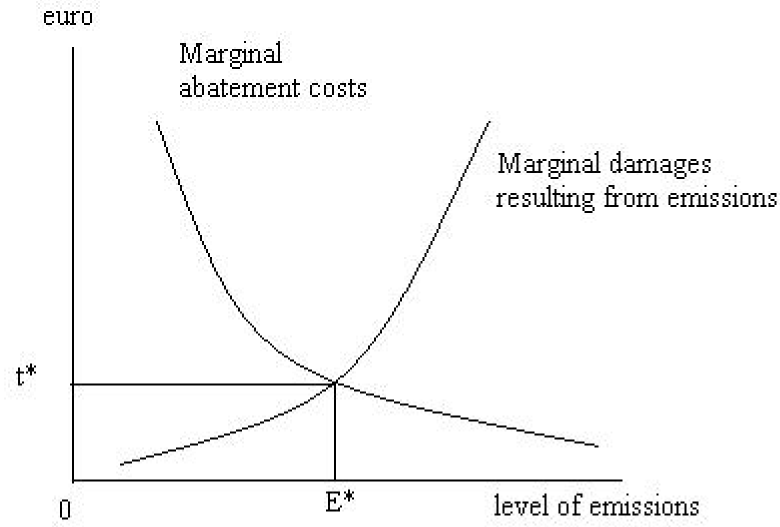
The objective of economic instruments is to reduce the gap between the private and social costs by internalising external costs to their sources, i.e. the consumers and producers of polluting and resource depleting commodities. In other words, market-based instruments are intended to help guarantee that each polluter bears the cost of pollution, in accordance with the Polluter-Pays Principle (PPP).[9] Furthermore, they can create positive incentives to companies and individuals, to not only meet thresholds established by governments, but also to extend performance beyond minimum compliance. The basic assumption of market-based instruments is that they promise to build systematic changes in consumer behaviour, by shifting prices in a way, which reflects the costs of pollution, and the promises of sustainability.

Environmental pollution is analysed in economics through the concept of externality.[10] An economic agent imposing externalities on other individuals is producing or consuming at

[9] The principle that the price of a good or service should include the cost of environmental damage that results from the production process.
[10] An externality exists when the consumption or production choices of one economic agent enter the utility or production function of another one without the second’s permission or compensation (Kolstad 2000). There is a positive externality when the “victim” experiences an increase in his welfare, while there is a negative externality in the other case.

an inefficient level, since he or she does not consider the full costs and benefits of his activity. We can describe a situation of a firm polluting the environment in the figure below.

Figure 3.1 Optimal level of pollution



Source: Agnolucci, P.: *Ex-post evaluations of CO2-based taxes: a survey,* Tyndall Centre Working Paper 52, 2004

In the case of a firm polluting the environment, we can draw a curve describing the "marginal damages resulting from emissions" (MD) to victims and a curve describing the firm's "marginal abatement costs" (MAC) for every level of emission. The socially optimal level of pollution is in the intersection of these two curves (point E^*). Thus, the efficient level of pollution is in the point, at which the marginal abatement costs and the marginal damage of the pollution are equalised. A further decrease in pollution requires a MAC to be bigger than the MD (area to the left of optimal point E^*). On the other hand, if a polluter's behaviour is not constrained, the firm will emit a maximum profitable quantity of pollution and it will operate in the area to the right of optimal point E^*, where marginal damages are higher than marginal abatement costs.

The optimal level of pollution can be achieved by using various instruments. As an example, we can use an environmental tax t^*, which equals to the marginal damage caused by the pollution when evaluated at the efficient level of pollution (in the figure we see that this means $t^* = MD(E^*) = MAC(E^*)$ (Kolstad 2000). A polluting firm facing this kind of environmental tax has two alternatives: to pay the tax or to lower emissions. A cost-minimising polluter will lower emissions as long as the MAC are smaller than the tax and pay the tax for the remaining pollution.

Very important for market-based instruments to work are reasonably well functioning and defined markets and an adequate consumer preference for environmental goods and services. To improve the environment, they need to be based on precise environmental information. There is little benefit in spending a great deal of energy and skill, in designing fiscal instruments, unless they are closely aligned to defined and prioritised environmental problems. Thus, it is necessary to improve the measurement of environmental problems and the public policy process of consultation and public support.

Economic instruments should be seen a one of several environmental management tools related to internalisation. Other tools include natural resource accounting, valuation, environmental impact assessment, environmental auditing, and many others. These tools do not work in isolation, but need to be set more closely together as part of a policy mix available to governments.

3.3.1. Charge systems

The first example of economic instruments of environmental protection is the charge system. As we can see in the table 3.2., there are various charges that can be used to lower the pollution. Effluent (including waste) charges are related to the size and/or composition of the polluting discharge to the environment. User charges are paid for the use of natural resources (e.g. water) or for the collection and treatment of municipal solid waste and wastewater emitted into sewers. Administrative charges are intended to finance direct regulatory measures (e.g. licensing or controlling). The aim is to put part of the financial burden on polluters instead of the general public. These charges will be environmentally effective if the revenue is used for improving the performance of the environmental authorities. But in practice, they are rarely added to the budget of the environmental authority, but more often they go to the general budget.

The waste charges are applied in many OECD countries, either as user charges levied by municipalities or as charges on specific types of waste. Most of them are intended simply to raise revenue for local governments, although in some countries they provide additional incentives for individuals to protect the environment. Since household wastes are commonly subject to flat-rate charges, often based on the size of the household or house and included in the residential property tax, there is no incentive to reduce the volume of refuse collected. But in a number of countries, refuse-collection charges are based on an estimate or actual measurement of volumes discharged. For example, “per bag” charges require households to pay for the number of bags or bins collected or to purchase special marked bags or stickers to place on refuse bags. Such systems can be quite effective. Such charges also increase the participation of households in recycling schemes since they are encouraged to sort out recyclable materials (paper and glass, for example) and dispose them in special sites or containers.

3.3.2. Property rights

Inadequately defined and unprotected property rights can be one of the reasons for environmental pollution and depletion. Therefore the establishment of secures and transferable property rights will lead to more appropriate pricing of the use of natural resources. In this case the cost of depletion is integral to the user of the natural resource and this fact ensures the sustainable use of his property.

If somebody pollutes or uses natural resources from somebody else, secured and tradable property rights will guarantee finding a solution to internalise the externalities by negotiating with each other. However, the designation of property rights can not solve all environmental problems. It is helpful only under certain conditions. In the case, where there are many users of an environmental commodity, such as air or water, the assignment of property rights is not feasible since exclusion of other users is technically impossible.

As regards advantages of the assignment of secure and tradable property rights, we can say that transaction and administrative costs are low, once the property rights are assigned and secured, externalities are internalised for ever and no further intervention is necessary. They adjust automatically to changing circumstances and the market distortions are also very low. On the other hand, it is difficult to distribute them and it is a politically sensitive issue. Selling them in an open market would exclude poor people from buying them and therefore would have social implications.

3.3.3. Market creation

This instrument internalises environmental damages on the production side. The government creates a market to use the environment as waste sink or issues pollution permits, which allow a company to buy or sell the rights to pollute the environment with an acceptable level of pollution. The rights to pollute can be bought and sold like any other commodity.

This instrument ensures that a specific level of pollution will be attained at the lowest cost to society and also that the environment is only affected as far as it can tolerate such impacts. The public authority provides a fixed quantity of permits, each of which contains an authorisation to emit a given quantity of wastes. Pricing the use of the environment as a waste sink would internalise the cost of waste into the product prices and therefore in the long run reduce the waste per unit of output. Thus, the motive of tradable permits for polluting emissions is to allow polluters more flexibility in allocation pollution control across different sources, while permitting government to retain a firm limit on total polluting emissions. Polluters will reduce pollution as long as the marginal abatement cost is lower or equal to the price of a permit. In such a case, a firm will sell its excess emissions permits. Once MAC is greater than the market price of permits, a firm will start to buy permits to cover its excess.

This instrument can be also used to limit the exploitation of biological resources such as fisheries and wild livestock. Quota systems involve issuing permits to all of the users of the resource allowing the extraction of a certain amount of the resource. The logic is the same as in the case of the pollution permits. The total number of permits issued among users corresponds to the maximum sustainable extraction.

Because the authorities control the total number of permits issued, an increase in emission from one source must be offset by the decrease of an equivalent, sometimes larger, quantity from other sources. When, for example, a statutory ceiling on pollution is fixed for a given area, a polluting firm can set up or expand its activity only if it does not increase the total pollution. The firm must therefore buy "rights" or permits to pollute from other firms located in the same control area which are then required to lower their emission by an equal amount.

If permits have a market price, this provides a financial incentive to all polluters to reduce their marginal abatement costs in order to lower their future permit requirements. Thus, market trading is used to facilitate cost-effective achievement of environmental standards and create financial incentives for technological innovation (Barde 2000). It is, in fact, one of the major advantages.

To achieve sustainable use of the environment by charging for polluting it, it is essential to ensure that the environment is used below its self healing-capacity, otherwise economic activities would still be continued at an unsustainable level. But it is difficult to find a threshold for the environmental pollution that is below the environment's self healing-capacity.

From an administrative point of view, pollution permits are quite easy to handle. Once they are issued, government receives revenues and it is not involved any more. Other advantage is that specific pollution standards can be obtained. The instrument is flexible because it is possible to focus on regional environmental problems and in the case the level of pollution should be reduced the government or NGOs can buy up the permits. Another important advantage is that the authorities do not need to know the marginal damage and marginal abatement costs functions of individual polluters. They just decide the level of pollution they want to achieve.

But there is a problem with the initial allocation of permits among polluters. One way to initially allocate permits is to use an auction. The other possibility is to allocate them, free of charge, to the existing holders of waste-disposal authorisations.[11] There is also a necessary condition of well-functioning market. There must be a sufficient number of buyers and sellers and reasonable freedom of market entry and exit. Some permits holders may prefer to retain them rather than sell them, even when they are surplus to their current requirements. One reason is the uncertainty whether they could buy them back in the future and the other is holding back opportunities for expansion by the rivals.

3.3.4. Liability instruments

The liability systems aim to generate socially and environmentally responsible behaviour by introducing legal liability for the use of environmentally unfriendly technologies. The internalisation of social costs is done through legal action and these instruments, unlike taxes or charges, recover and assess environmental damages ex post. Nevertheless, they have also the effect of preventive incentives, as long as the expected damage payments exceed the benefits from non-compliance. Disadvantages are that liability systems require an advanced legal system and that there are high administrative and control costs.

[11] This is also called “grandfathering”. It is a system by which pollution permits are distributed to polluters in proportion to their emissions at an agreed day.

3.3.5. Performance bonds and deposit-refund system

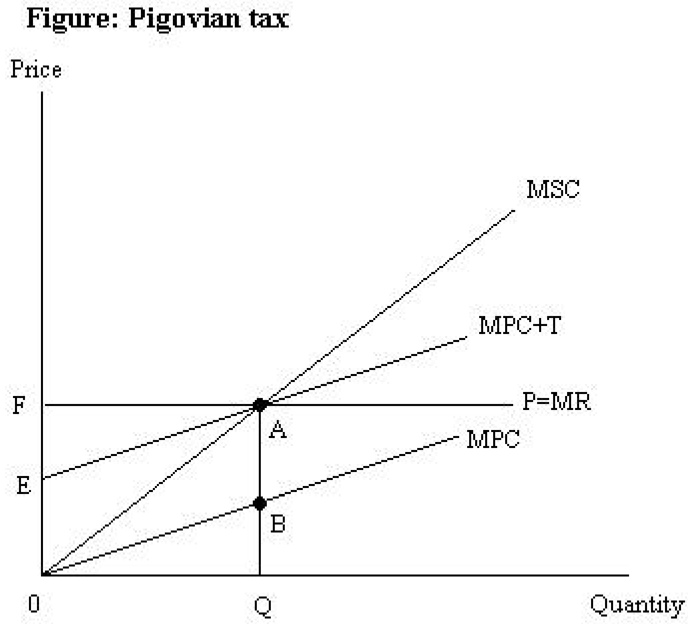
Performance bonds are payments to authorities, which take place before an activity that is potentially environmentally harmful. The objective of these instruments is to shift responsibility for controlling, monitoring and enforcement to individuals who are charged in advance for the potential environmental damage. They try to avoid the situation when the state has to pay the bill for environmental damages caused by single producers and consumers. The instrument forces individuals to act in compliance with environmental rules and use the environment in a sustainable way. After proving this, individuals or companies can get their bonds refunded. On the other hand, if they damage the environment, the government can use the bonds for improving environmental damages. But they are used less frequently than other economic instruments because of the high administrative costs and difficulties in monitoring environmental damage. They have been applied mainly in cases where is a clear possibility of environmental damage, such as surface mining.

This instrument is designed to encourage recycling. Deposit refund system requires a deposit to be paid upon the purchase of potentially polluting products. The deposit is refunded when the product is returned for disposal and recycling. Deposit-refund system is widely used in OECD countries, particular for beer and soft-drink bottles. The payment (deposit) is made at the moment of purchasing a product contained in a specified type of packaging and it is paid back when the packaging is returned to the dealer or specialised treatment facility. Their use on bottles is very effective in reducing the amount of such material disposed of into the general waste stream. But, in general, deposit refund system is not powerful enough for major environmental problems, because of its voluntary character and the low value of the deposits.

3.3.6. Fiscal instruments

Fiscal instruments such as taxes or subsidies for environmentally sound production can be used for full cost pricing of production and consumption. As defined by OECD (1997a) a tax falls into the environmental category “if the tax base is a physical unit (or a proxy for it) of something which has a proven specific negative impact on the environment, when used or released.” They try to bridge the gap between private and social cost of production and consumption of products and commodities. For example, prices of petrol or pesticides usually do not include the social costs of these products. Such pricing means that the effects of these products on the environment are not considered. The idea to use fiscal instruments for environmental protection is rather old. In the early twenties on the last century, Pigou (1932) had already proposed taxation of environmentally hazardous products.

Figure 3.2 The Pigovian tax



Source: http://en.wikipedia.org

The basic concept of the tax can be better explained on the following chart: because the market mechanism fails to factor in the total cost to society, output decisions are flawed, resources are allocated inefficiently, and social welfare is reduced. One method of reducing the effect of this market failure is to impose a Pigovian tax equal to the amount of the negative externality (or impose a subsidy in the case of a positive externality). Pigovian tax would shift the marginal private cost curve (MPC) up by the amount of the tax (to MPC + T). Faced with this cost increase, producers would reduce output to the socially optimum level (Q) and the amount of the externality would be reduced. The total government revenue from the tax (presumably to be used to mitigate the effect of the negative externality) is equal to the area 0,E,A,B. The profit to the firm is E,A,F. A key problem with this tax is that the government may not know how much of a tax to impose to discourage the negative externality. It may also give into lobbying by the polluters, thus letting the problem of excessive production and pollution continue.

There are three types of environmental taxes:

- taxes on final products associated with pollution such as motor vehicles,
- taxes on goods that are generally used as inputs into a polluting activity such as coal,
- taxes on polluting substances contained in inputs such as sulphur contained in coal (see for example Blackman and Harrington 2000).

Emission taxes are direct payments on the quantity and quality of pollutant discharged. They are applied to cope with many environmental concerns, such as air and water pollution and noise, in most OECD countries, although with varying intensity. Ideally, they should be equal to the marginal environmental damage caused by a certain product or activity. If this was the case it would adjust the price of a good exactly by the amount of reduction in social welfare caused by the externalities associated with the product.

Environmental taxes can have two types of favourable impacts. The first one is fiscal, i.e. they raise revenue, and the second one is, of course, environmental. These two impacts are inversely related. Which one dominates depend on the elasticity of demand for a good. If demand for a specific good is inelastic, then the tax will generate revenue but will not significantly reduce the consumption of the good or reduce the emissions caused by its consumption. On the other hand, if the demand is elastic, the tax will generate relatively little revenue but will reduce the consumption of the good and emissions. Generally, we can say that demand is more elastic if there are widely available substitutes of a good.

Thus, demand is more elastic when taxes are strictly targeted and therefore such taxes are more likely to have a significant environmental impact than broadly targeted taxes. For example, demand for high-sulphur coal is likely to be more elastic than demand for coal and demand for leaded gasoline is likely to be more elastic than demand for gasoline. In addition, for most goods, demand is more elastic in the long run than in the short run because consumers have more time to substitute. So the dominant impact of an environmental tax is likely to be fiscal in the short run and environmental in the long run.

The stability and amount of revenues collected from environmental taxes is probably very important criterion for policy-makers. But on the other hand, it is very misleading. This is because there is a trade-off between the stability and amount of revenues and the dynamic efficiency of taxes.[12] If the tax is efficient, there will be a continuos decrease of the revenues or at least of the amount of the tax per unit of GDP. The stability of the tax revenues is

[12] Dynamic efficiency of the instrument is related to the intertemporal incentives on polluters.

particularly important in the case of a "green tax reform".[13] It is because the intertemporal decrease in the budget revenues raised by green taxes is a problem for governments. If the goal is to collect a certain amount of revenues, the tax rate, in this case, has to be periodically increased. But industries and companies would probably oppose increasing the tax burden. And finally, when evaluating the effect of environmental taxes, their effects on other already existing taxes should be taken into account.[14] For example, CO2-based tax can lower the use of cars and therefore cause a reduction of the revenues from fuel excises.

The tax differentiation between leaded and unleaded gasoline has been introduced in most OECD countries together with a series of regulations requiring petrol stations to sell unleaded gasoline and a range of new emission standards for motor vehicles mandating catalytic converters. It is difficult to evaluate the effects of the tax differential used together with other tools, although it is widely recognised that the tax was successful in accelerating the move from leaded to unleaded petrol.

3.3.6.1. Advantages and disadvantages of environmental taxation

From the economic and ecological point of view, fiscal instruments are very efficient. Environmental taxation leads to the internalisation of negative externalities into the prices of goods and services, which are harmful to the environment. This leads to a correction of market failure and a shift in consumer's behaviour. Taxation encourages companies to develop and introduce more environmentally friendly production technologies since this will help them to save taxes. Even low taxes will induce cleaner production. On the other hand, this is not an order, fiscal instruments leave companies the freedom to decide whether they pay taxes or invest in cleaner production technologies.

The problem is that politically there is a tendency, caused by different industry lobbyists seeking to weaken the policy in their favour, to impose low taxes that do not cover the whole social cost. Not all the risks of environmental policy are born by industry as governments have much to lose if firms react to environmental measures by decreasing production or moving their factories to another country. It is difficult for this type of instrument to consider regional aspects of pollution or environmental damage.

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[13] This consists of reducing or eliminating environmentally harmful subsidies and of restructuring the tax system according to environmental criteria (i.e. reducing taxes on labor, capital and income and increasing or even introducing environmental taxes).

[14] This is called the second round effect in literature, as opposed to the first round effect, which indicates the amount of money raised by the tax.

The governments also have a tendency to use taxation just to create budget revenues. Raising revenue is one of the advantages of this instrument but it should not be the primary goal of environmental taxes. There is also low willingness to accept further tax burden by the public. Another major concern is that environmental taxes may be regressive, i.e. they may have a more cruel impact on poor households than on rich ones (Eskeland and Kong 1998). This impact is getting worse in the case the taxed good is a necessity item with only few substitutes. Using tax revenue to finance new expenditures that benefit poor households or to cut other regressive taxes can reduce the disadvantage. Though in literature we can find an argument that there is no evidence that economies with properly designed eco-taxes perform less well than those relying on command and control (Ekins and Speck 2000).

Environmental taxes are relatively easy to manage. It is because quantities of goods are usually easier to monitor than quantities of emissions. Another reason is that they are operated through government tax collection institutions, which are more established and effective than environmental regulatory institutions. The government authority setting a level of taxation does not have to know firms' marginal abatement costs. It only needs to know the price elasticity of a good in question.

The most important disadvantage of environmental taxes is that they do not create incentives to reduce emissions per se only to limit purchases of a good linked with emissions. Therefore, from this point of view, a tax on the polluting content of a good is preferable to a tax on input, and a tax on input is preferable to a tax on a final product. For example, of the three different types of environmental taxes that could be used to reduce emissions from power plants, a tax on the final product, electricity, can reduce emissions by reducing electricity demand (and hence electricity production) but cannot create incentives to cut emissions per unit of electricity generated. A tax on a polluting input, coal, can do this but cannot create incentives to use clean coal. A tax on the polluting content of input, such as a tax on the sulphur content of coal, can do this. But even this type of environmental tax cannot create incentives to install end-of-the-pipe pollution abatement equipment, because plants with such equipment pay the same unit tax as those without them.[15]

Another disadvantage of environmental taxes is that they may influence non-targeted activities. For example, a tax on coal intended to reduce sulphur emissions from burning will affect chemical manufacturers who use coal as a feedstock, not as a fuel. Such firms would

[15] Combining environmental taxes with technology standards can solve this problem. The resulting mixture policy can be more effective and more efficient than the tax or the standard alone. (Eskeland and Devarajan 1996)

not be able to lower their tax burden by substituting with low-sulphur coal. Excluding certain types of consumers from the tax can solve this problem. However, this may encourage the creation of black market for the taxed good. A related disadvantage is that taxes are difficult to differentiate geographically because non-uniform taxes may encourage creation of black markets.

There is increasing evidence of the effectiveness of taxes and charges in reducing air pollutants. Sweden introduced a charge on nitrogen-oxide (NO_x) emissions in 1992. It was designed to accelerate and stimulate investment in advanced burning and pollution-abatement technologies and as a supplement to existing regulatory measures. Nevertheless, a 35% reduction in NO_x emissions was achieved within 20 months after the implementation of the charge.[16] And reductions in emissions followed rapidly after the government announced its intention to introduce the charge in 1990. The charge stimulated industry to develop cheaper and more efficient technologies.

A tax on sulphur emissions was introduced in 1991 in Sweden to stimulate further reductions in sulphur oxides (SO_x). The result was a reduction of the sulphur content of fuel oils by almost 40% beyond the legal requirement. The tax also stimulated emission-abatement measures in combustion plants. In 1991, Sweden also introduced a tax differential between three types of diesel fuels used for motor vehicles. The cleanest diesel fuel (class 1) is taxed at 35% less than diesel fuels of class 3 (the dirtiest). The result has been a reduction in sulphur emissions from diesel vehicles by 75% on average. [17]

The Swedish experience illustrates that taxes are relatively easy to administer. Sweden has used existing tax authorities to administer its environmental taxes. Marginal administrative costs are estimated to be in the range of 1% to 5% of total revenues. It also illustrates that the trade-off between environmental impacts and fiscal revenues is significant. Revenue from Sweden's sulphur tax has fallen as the tax has discouraged demand for high-sulphur fuels. Furthermore, targeting environmental taxes is feasible. Sweden exempted industry from its carbon tax and also exempted firms using coal, oil, and peat as feedstock (instead of as fuel) from its sulphur tax.

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[16] The Swedish Experience: Taxes and Charges in Environmental Polic*y, Swedish Ministry of Environment, Stockholm, 1994.*

[17] The Swedish Experience: Taxes and Charges in Environmental Polic*y, Swedish Ministry of Environment, Stockholm, 1994.*

3.3.7. Financial instruments

Subsidies take a number of forms and they may include direct transfers or pricing and tax policies that are favourable to certain economic activities, the example are: grants, green funds, revolving funds, soft loans or subsidised interest rates. We can define subsidy as all government interventions that directly or indirectly keep prices for consumers below, or for producers above, market price level. Subsidies are used in many OECD countries, although to a limited extent. They could give incentives to mobilise additional financial resources for environmental protection and sustainable development and support environmentally friendly activities or projects with positive externalities, such as reforestation or advanced technologies to control soil erosion. They encourage a certain type of behaviour but the problem is that they do not internalise costs.

But, on the other hand, we can find many examples of governments still subsidising an unsustainable development. Governments spend hundreds of billions of dollars to subsidise production and consumption in resource-intensive sectors like agriculture, transport, energy, water, forestry and fisheries (van Beers and de Moor 2001). And many of these subsidies cause significant environmental effects. It is very important to identify such unsustainable market distortions and reduce them before starting to assess the use of economic instruments (e.g. applications of a carbon tax where governments paying subsidies for the production of electricity are likely to be relatively ineffective,) because it is possible that the reduction of subsidies would be sufficient and no addition action might be necessary.

3.4. Economic instruments versus regulations

Theoretical arguments suggest that there should be substantial gains, in the form of more flexibility, lower costs and increased innovation, if environmental policy uses economic instruments rather than traditional “command and control” regulations. The self-regulation at the polluters’ side is more efficient and cost-effective than rules and regulations because, in most of the cases, polluters know best how to control their hazardous output or environmental damages they cause.

Emission taxes, fixed at an appropriate level, as well as marketable permits, should minimise the cost of reducing pollution across polluters by moving the reduction in emissions to where marginal abatement costs are the lowest. Several studies have stimulated the effects of policies using economic instruments in reducing air pollution. They found that, on average, the cost of achieving a given environmental objective through CAC policies was six times higher than for cost-minimising instruments such as emission taxes and tradable permits (Tietenberg 1990).

Furthermore, economic instruments accommodate changes more easily. In the CAC approach, the regulator must formulate thousands of rules concerning different types of polluters. As regards market-based instruments, firms keep control over abatement decisions, whereas the regulator only sets permit quantities to achieve an environmental quality standard. As a result, changes in response to new technologies and economic conditions are automatic and decentralised. Also changing the environmental protection level is relatively simple. It involves just changing the quantity of tradable permits on the market.

The command and control regulations are regarded as economically inefficient because uniform limits are applied for all polluters regardless of individual cost and dynamically inefficient because polluters have no incentive to reduce pollution further than the standards set by a government (Hahn 2000). They may also discourage innovation of new, more environmentally friendly technologies. Market-based instruments, on the other hand, involve the creation of internalising charges to correct the failure of "free" markets to control the over-exploitation of environmental resources (Ekins 1999). The main appeals of market-based instruments are that they provide continuous incentives for abatement and do not order polluters actions. So firms have greater freedom to find cost-effective solutions. The firms are free to choose abatement technologies that minimise costs given their individual conditions. By contrast, under command and control regulations and emissions standards, the regulator more or less dictates which technologies would be chosen.[18] As regards the dynamic efficiency, since firms forcing market-based instruments of environmental protection can always increase their profits by reducing emissions, these instruments provide continuing incentives for emissions-reducing innovation. By contrast, incentives in a CAC approach are often discouraged by enforcement risks associated with using a non-approved technology.

But market-based instruments are not a universal solution of environmental problems. The fiscal instruments are often used not to solve an environmental problem but simply to generate government revenues. It is also important to keep in mind that any shift in pricing

[18] Although CAC regulations do not explicitly dictate firms' technology decisions, in fact they usually create strong incentives for firms to choose only officially approved technologies. Emissions standards are often developed with regard to the abatement abilities of specific technologies. Therefore, firms that want to minimise their risks of breaking the standards will want to adopt the technologies underlying the standards. The risk of

can have a lot of unforeseen indirect consequences, based on such variables as elasticity of supply and demand, insensitivity of some end-use products to price shifts, the problem of income distribution effects, the lack of product substitutability, etc.

It is also important to stress here, that economic instruments are not intended to replace CAC regulatory approaches. In fact, regulatory approaches remain necessary, particularly in addressing toxic, hazardous or health-related environmental dangers. Another reason is that economic instruments are related rather to the long-run sustainability, so they are not first-best options in addressing urgent pollution problems. We can find some other reasons for preferring CAC instruments or mixture of CAC and market-based instruments. First, when the marginal damages imposed by different polluters are not similar, e.g. when pollutants are geographically concentrated, it may be optimal to use CAC policies to directly control emissions from sources with relatively high marginal damages (Miltz, Braden and Johnson 1988). In particular when firms with high marginal damages also have high marginal abatement costs, because these "worst" polluters would abate the least in a tradable permit system. Although it is theoretically possible to design permits approach in such a way as to accommodate dissimilar marginal damages, e.g. by establishing multiple trading zones for emissions permits (see Klaassen 1996), in practice there are non-negligible administrative requirements. Finally, in the case of homogenous marginal abatement costs, opportunities for reallocation from firms with high marginal abatement costs to firms with low marginal abatement costs will be limited. Thus, the static efficiency properties of direct CAC instruments will be comparable to those of direct economic incentive instruments.

In general, we can conclude that regulatory instruments tend to perform relatively better in terms of their administrative feasibility, institutional compatibility and sometimes their environment effectiveness. In contrast, economic instruments have greater potential in terms of cost effectiveness and sometimes also in economic efficiency. This is the reason why the mixture of CAC and market-based instruments can be the best solution.

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paying a high penalty for using alternative approaches turns a de jure emissions standard into a de facto technology standard. (Blackman & Harrington, 2000)

3.5. Selecting and implementing process of economic instruments

Despite the fact that we can identify advantages and disadvantages of each instrument, it is not easy to choose the appropriate instrument for a given environmental problem. Before imposing a certain instrument or mix of instruments it is necessary to consider all economic, political, social and cultural constraints to make sure that the desired outcome is achieved. Therefore it is difficult to give guidelines as to which instrument should be used in which case and a case by case approach is necessary.

There are some necessary steps of the decision-making process for selecting the most appropriate instrument or mix of instruments. First of all, we need to assess a quality of the environment. It is necessary to have full information on the kind of problem, its roots and its effects on the environment. Then we need to define the key issues. Since it is usually impossible to solve all problems at the same time, it is necessary to focus on the most serious ones. The third step is the definition of objectives we want to achieve and the time frame. We need to decide if the emission should be stopped or just reduced by a certain amount. Finally we should select the most appropriate instrument or mix of instruments. In this stage we should take into account several questions: Will the instrument achieve the environmental goal effectively and at least cost? How costly will be the monitoring and enforcement? Will the instrument be flexible, i.e. when changes happen in technology or using of resources, will the policy accommodate them and remain effective? Will the instrument provide positive incentives, e.g. will it encourage firms to keep existing inefficient factories? Will the purpose and nature of the instrument be widely understandable to the general public? Will it be politically acceptable and feasible in terms of implementation? Etc. After choosing the right instrument to internalise the externalities, we should develop an implementation plan and control and evaluate the whole process of implementation.

3.6. Criteria for policy evaluation

The evaluation of the success of chosen environmental policy instruments is very important. For this purpose we can use a set of well-defined criteria. Seven of them are particularly important (Barde and Smith 1997).

The first one is the environmental effectiveness (i.e. Is the instrument likely to be effective in achieving and preserving the prescribed level of environmental quality?). The second criterion, economic efficiency, is measured by the extent to which the instrument has enabled a more cost-effective achievement of policy objectives than an alternative tool. Economic theory suggests that the main advantage of economic instruments is their potential for minimising the aggregate abatement-costs across polluters ("static efficiency"). But economic instruments provide also the "dynamic efficiency", i.e. they are generally expected to be more effective than others at stimulating innovation in pollution-control technologies. Administration and compliance costs (including those of the administrative bodies responsible for applying the instrument as well as those subject to it) are important, too. The individual characteristics and relative complexity of policy instruments will influence this cost burden substantially. Additional criterion is the budget revenue provided by some of these instruments, e.g. taxes and charges. This revenue could allow other taxes to be reduced, or government spending to be increased, on, for example, specific environmental measures. Policy-makers must also consider wider economic effects that include the impacts on aggregate prices, income distribution, employment and trade. The use of the instrument should be administratively feasible in terms of information requirements, administrative demand and political acceptability. The instrument must be also compatible with the environmental policy approach and the existing administrative framework.

The major reason for lack of evaluation of economic instruments is that they are often used in combination with other policy measures. Thus evaluating their contribution is a difficult, and sometimes impossible, task. Another reason is that the necessary data are often lacking. And there are also institutional obstacles, which arise from the division of responsibility between different government departments.

3.7. Environmental protection and economic growth

The primary objective of economic activities on a country level is usually to increase the country's wealth by increasing the GDP. Nevertheless, economic growth is normally considered as polluting the environment and depleting natural resources.

Many politicians and decision-makers are afraid that imposing economic instruments would lead to a lower productivity and consequently a lower increase of the GDP. But OECD came to the conclusion that a well-balanced environmental policy would decline GDP by only 0.1 to 0.2 per cent[19]. The cost of no action would be higher. If externalities are not internalised the result would be depletion of natural resources and pollution of the environment to a great extent. In the long run this would lead to increasing costs for health treatment and for cleaning the environment.

The economic growth is also important for increasing wealth of individuals, decreasing a rate of unemployment and balancing income distribution within a society. If this were right, there would be no solution for the conflict between economy and ecology. But in order to select the effects of economic instruments on economic growth it is necessary to distinguish different stages of economic growth.

Economies at the first stage of economic growth, such as countries with a very low GDP, very high unemployment rate, high illiteracy rate, where people are dying of hunger and facing serious housing problems, need economic development to meet the basic needs of the population. In these countries it is almost impossible to use of the above-mentioned economic instruments for environmentally sound development. The poor people would hardly pay higher prices for water or other basic goods to improve the environmental protection. Thus, most of the economic instruments using in the developed countries do not seem to be appropriate for environmental management in this case, because they were designed according to the needs of industrialised countries. This should not mean that very low-income countries should not care about the environment at all, but we have to find more appropriate solutions (e.g. cleaner technologies, green loans, and international co-operation or trust funds).

Countries at the second stage of economic are able to fulfil the demand for basic needs of their population. For them economic growth is only necessary to meet the demand for consumption which exceeds basic needs. Such countries can take environmental protection

[19] OECD 1997

into account and they can impose some of the above-mentioned economic instruments. Nevertheless, using economic instruments must be target oriented and fitted to specific social, economic and cultural constraints.

The third level, where most industrialised countries belong at, can be characterised as a stage of over-consumption and high demand for luxury goods. In association with the over-consumption there is also a very high awareness on the part of the population of environmental concerns. The population requires a higher consideration of environmental impacts from the government. We can say that majority of economic instruments was designed for these countries. On the other hand, there are strong lobby groups that argue against the introduction of economic instruments. They use such arguments that using instruments would affect economic further growth, international competitiveness or employment rate. Since these lobby groups have a great influence on decision-makers, the process of internalisation of all social costs of economic activities in such countries is quite slow and difficult.

3.8. Environmental protection and international competitiveness

The lack of empirical evidence about the economic performance of market-based instruments supports consumers and industries in their fears about the effect of domestic economic instruments on international competitiveness. Many governments or strong industries in industrialised countries are afraid of loosing their position in the international market. They fear that after introducing an economic instrument they would not be able to compete with products from other countries any more. It is true that some incentives can reduce the international trade competitiveness of certain industries.

Empirical research shows that the impact of economic instruments on competitiveness is not easy to predict and we should use a case by case approach. In the short run, we can expect negative impacts of environmental protection policies. But companies are able to adapt after some time, find technical solutions to meet the environmental constraints given through economic instruments and produce their products with less environmental impacts.

The national economy can even benefit from environmental protection by establishing other activities, e.g. a creation of a tourist resort at a lake which, in the past, was heavily polluted by industries surrounding it. We can also say that the costs of environmental protection are only the smaller part in the production cycle and that the costs such as labour, natural resources and taxation are far more important.

On the other hand, costs of environmental protection can also be seen as a comparative disadvantage for a country. But as we see in the case of other important comparative disadvantages, such as lack of natural resources or climatic constraints, the countries have succeeded in adapting to the conditions and this implies it should be possible even in the case of environmental protection.

If using economic instruments generates a change in the production cycle or introduction of cleaner technology, these could be sold on the world market to other countries that are willing to catch up. As an example, we can mention Japan, where the industry had adapted very quickly to the introduction of limiting values for the emission in the 80s of the last century and it developed sophisticated filter techniques very quickly. These were sold all over the world and, thus, the Japanese industry benefited a lot from the new regulations.

Nevertheless, when we look at some of the most competitive and wealthy nations, such as EU countries, Norway or Japan, we can see that they have the highest environmental standards. This implies that economic effects of a well-defined environmental policy seem to be very low, at least in the long run. Solid and sufficient environmental policy does not create a lag or puts an obstacle to the industrial development or trade, but in case it is efficiently designed and implemented, can contribute to the increase of competitiveness and wealth without putting a burden on the nature and endangering the future of the generations to come. After years of neglect many countries have to learn how to take into account the environment in the economic cost-benefit analysis when maximising welfare and speeding the economic growth.

4 Environmental policy of the EU: basic approaches

4.1. Introduction

The European Union is having an increasing impact on policy making in the Member States especially in the field of environmental policy. It is partly because national standards laid down in law are being questioned and harmonised and partly because Member States dispute together on the aims, content and settings of environmental policy. Thus the decisions about what could and should be achieved by which instruments have been influenced by policy developments at the European level. Also for states outside the EU, the EU has for long been regarded as a global actor of major importance with an increasing impact on every part of the globe in such diverse issue areas as trade, development, security, defence, and last but not the least environmental policy. The EU is also responsible for the initiation of several important international environmental protection projects. In general, key factors behind the existence of an environmental policy at the EU level are the growing recognition of the transboundary character of environmental problems and the consequences of national environmental standards for international trade and competition.

The European Union has a proactive environmental policy aimed at protecting the soil, water and air, the climate, fauna and flora, which has developed continuously during the thirty years of its existence. All major types of environmental problems are now covered by EU policies, from hazardous waste transportation to environmental impact assessment and from nature conservation to climate change. The range of policy instruments has been broadened from environmental quality standards and product norms to emission standards and various kinds of procedural measures. In other words, in addition to adopting framework legislation, which provides a high level of protection for the environment while guaranteeing the operation of the internal market, the EU has established a number of non-regulatory instruments, such as voluntary agreements, environmental monitoring or economic instruments, and a financial instrument for the environment: LIFE.

4.2. The Development of European Union Environmental Policy

The Treaty establishing the European Community, as amended by the Single European Act, explicitly provides for the development and implementation of a Community policy on the environment. Since the emergence of environmental policy in the 1970s, the formal pattern of institutional authority has been changed three times: by the Single European Act, by the Maastricht Treaty and by the Treaty of Amsterdam.[20] During the development of the EU environmental policy, following areas have been accessed to it:

a) water quality: drinkable water, water surface etc.,
b) air quality: pollutants in atmosphere, emissions etc.,
c) chemicals and other dangerous elements: the testing, marketing,
d) noise: maximum levels,
e) wildlife and countryside protection,
f) “polluter-pays” principle.

But it took a long time before the environmental policy at the EU level had been developed. Environmental protection found no place in the Treaty of Rome. It first was in the 1970s that the idea of European environmental policy emerged for the first time. Prior to 1970s, there were only limited policy measures concerned with environmental protection. These included safety standards for radiation, controls on the testing of new chemicals, restrictions on vehicle noise and early measures to protect the countryside in less favoured areas (Weale 2000). The 1970s were also the period when most active agenda setting occurred in EU environmental policy. One of the first crucial issues for the environmental policy were the conclusions of the UN Stockholm conference in the 1972. These conclusions were then used as a basis for the Environmental Action Program, worked out by the Commission, taking into account one of the main objectives of the EU – harmonic and sustainable development in the European Communities (Art. 2, EC Treaty). It’s clear, that the following principle could have been achieved only with monitoring the ecological aspects of different economic activities and development. But before the Single European Act came into effect in 1987 there was no explicit mandate for an environmental policy at European level.

The main reason for the development of an environmental policy at EC level in the seventies was the fear that common market trade could be obstructed by different national environmental policies, mainly product standards. In addition to competition policy based reasons, there were also other influences which played a role in development of EC environmental policy, such as recognition of the growing importance of environmental problems and their transnational nature as well as the view that the EC could provide a suitable framework for addressing problems of global environmental pollution. However, in the early years there were always conflicts between these environmentally based arguments and the objectives associated with economic targets.

Until the early 1980s European environmental policy in conceptual and regulatory terms was characterised predominantly by reactive reporting on acute environmental damage and the introduction of restrictions using classical regulatory instruments (see O.J. 1977 No. C 139/1). The third Environmental Action Programme, passed in 1983 (O.J. 1983 No. C 46/1) and the establishment of the Directorate-General on the Environment marked the beginning of a new phase in European environmental policy. As well as legal instruments, other initiatives have included information campaigns and the establishment of the European Environment Agency (EEA) as a central data collection point. The EEA was established in Copenhagen and its aim was to become an independent, objective and reliable institution providing the information on the state of environment and environmental protection throughout Europe (Jakš 1998: 105).

The Single European Act established the three priorities of the EU environmental policy:

a) to preserve, protect and improve the quality of the environment,

b) to contribute towards protecting human health and

c) to ensure a prudent and rational utilisation of natural resources (Art. 130R)

and defined the four criteria to be considered before an environmental policy is adopted. These are:

a) the availability of scientific and technical data,
b) environmental conditions among the regions of the Community,
c) the potential costs and benefits of the environmental action and
d) the economic and social development of the Community as a whole and its effect on the balanced development of the European regions (Art. 130R).

[20] See Table A.1 in Annex for summary of the principal features of rule-making at each stage.

4.2.1. Legislation frameworks of the environmental policies in the EU

Despite the conflicts of interest between environmental and economic targets, six Community Environment Action Programmes have been successfully implemented and over 700 legal texts (Directives, Regulations, Decisions, etc.) were adopted from the beginning of the 1970s, covering many aspects of environment policy[21]. Till the end of the 1980s many of the legislation was a product of compromises between differing national perspectives on environmental protection.

The legal basis of EC environmental policy clearly reflects the link to the development of Single Market. Since the Treaty of Rome did not mention environmental provisions, the European institutions had to rely on rather unsatisfactory treaty bases when drafting the legislation in this area. For a long time, the measures had to be based on Article 100, covering the common market, Article 36 allowing trade restrictions on the grounds of public health or the protection of humans, animals or plants, and, after 1972, on the Article 235 allowing to draft proposals as a way of achieving the broad objectives laid out in the Treaty (Weale 2000). Article 100 of the EEC Treaty allowed the Community to harmonise legal and administrative regulations of the member states, which directly affected the establishment or function of the common market. In cases where Article 100 of the EEC Treaty was not applicable, Article 235 was used. It entitled the Community to act where action by the EC appeared necessary to implement Treaty objectives and where the required competence was not provided under terms of the Treaty.

Integrating EC environmental policy with the implementation of the single market through basing environmental policy initiatives on Articles 100 and 235 of the Treaty had a major impact in two ways on how environmental policy decision making functioned at the EC level. First, the potential for action by the Commission was limited from the outset, as both Articles agreed unanimity for decisions by the Council of Ministers. Whereas with qualified majority decisions the Commission has a greater chance to carry through its ideas with support from individual nation delegations in the Council of Ministers, with decisions based on unanimity, it has from the outset to concentrate more on reconciling interests. As a result of the great variations in traditions in regulating the environment and in national positions on ecology and the economy, with the unanimity requirement it was often the case that special conciliation procedures were necessary to reconcile divergent interests. In addition to compensation payments and package deals, other strategies included the use of less ambitious quality standards or the drafting of legislation in broad terms which gave the member states more discretion in domestic application of the legal requirements. Thus, the impact of implementing the European environmental policy in different Member States varied considerably and in some cases was inadequate.

Second, the legal foundations for EC environmental policy were not, as already noted, primarily based on environmental protection as an independent objective. The primary intention was to create a framework of conditions for economic integration with the result that the implementation of the Single Market strategy acted also as a motivation for the European institutions to act on environmental protection issues. This primacy of economic over environmental needs was intensified by the asymmetrical representation of economic interests compared to environmental ones in the European decision making process. Whereas bodies representing economic interests are widely represented on the advisory committees of the Commission and/or are often informally consulted, environmental bodies have had less access to these networks.

Although there was no change in the legal basis until the coming into force of the Single European Act (SEA), there were, with the growing awareness of environmental issues in the 1980s, some changes which were reflected in the gradual transition from the formerly predominant principle of protection against hazards to the principle of risk management. Furthermore, the Commission has increasingly shifted the emphasis of its measures from ambient air quality to an emission oriented approach in the tradition of German environmental regulation.

Together with the preparations for the implementation of the Single Market, which started in the late 1986, there were accessed ties with ecological aspects of this idea. In the 1987 in the frameworks of the Single European Act there were first attempts to bring environmental legislation into life. The Act had stated that completion of the Single market is an important means of achieving *inter alia* a sustainable and non-inflationary growth with respect to the environment.

The provisions of the SEA relating to the environment were contained within Title VII of the Treaty „Environment", Articles 130r-130t. Article 130r laid down the aims and principles of the EU environmental policy. It dealt with the division of competencies between the Member States and the European Union and called for the co-operation with third countries and international organisations on environmental problems. Article 130t allowed Member States to introduce stricter protective measures as long as they were not in conflict

[21] www.europa.eu.int

with other provisions of the Treaty (Weale 2000: 44). The SEA also introduced for the first time the subsidiarity principle, which stated that the EU should take action only if the desired result could ”be attained better at the Community level than at the level of the individual Member States”(Art. 130R). The main institutional effect of the Single European Act on environmental policy was related to the new procedures for inter-institutional relations. The introduction of the co-operation procedure provided a new channel of EU decision-making which allowed the European parliament a second reading of draft EU legislation.[22] Under the SEA, the co-operation procedure applied only when a vote was to be taken by a qualified majority in the Council.

Both Maastricht Treaty (1992) and Amsterdam Treaty (1997) have proposed the sustainable development principle – the fifth environmental action. The Maastricht Treaty sets the European Union the objective of promoting sustainable growth while respecting the environment, which was mentioned also in the Preambule of the Treaty. From now the environment had become a fully-fledged European policy.

The most important political change done by the Treaty on European Union was, however, that the one affecting the passing of legislation. The new co-decision procedure was to be used for the agreement of the Action Programs and the co-operation procedure became the norm for the majority of environmental policy decisions. Both procedures involve the use of majority voting in the Council for most environmental legislation.[23] The European Parliament was to play an even more important role in environmental decision-making than it had done in the past. The new co-decision procedure allowed for the possibility of three different readings by the Council and Parliament.

The role of the European Parliament was even strengthened by the Treaty of Amsterdam, which replaced the co-operative procedure by the co-decision procedure. The Treaty also incorporated the principle of sustainable development that should be integrated with other policies from now.

The creation of the Single Market thus has to accept these changes. The principle which states, that the environmental protection issues are to be included into the creation and fulfilment of the other Communities' policies, have been of a great importance not only for the current EU members, but also (through the White Paper criteria) for the countries of the

[22] see Annex - Table A.1 “Environmental rule-making competence (1967-1997)”

[23] Of course, there were few exceptions to the majority voting rule involving legislation on fiscal matters, environmental issues with limited transdisciplionary implications, some aspects of water pollution policy and policies likely to affect national energy policies. (see for example: Weale 2000)

Central and Eastern Europe, which were applying for the membership and became new EU members last year.

4.2.2. Sources for financing the environmental policies

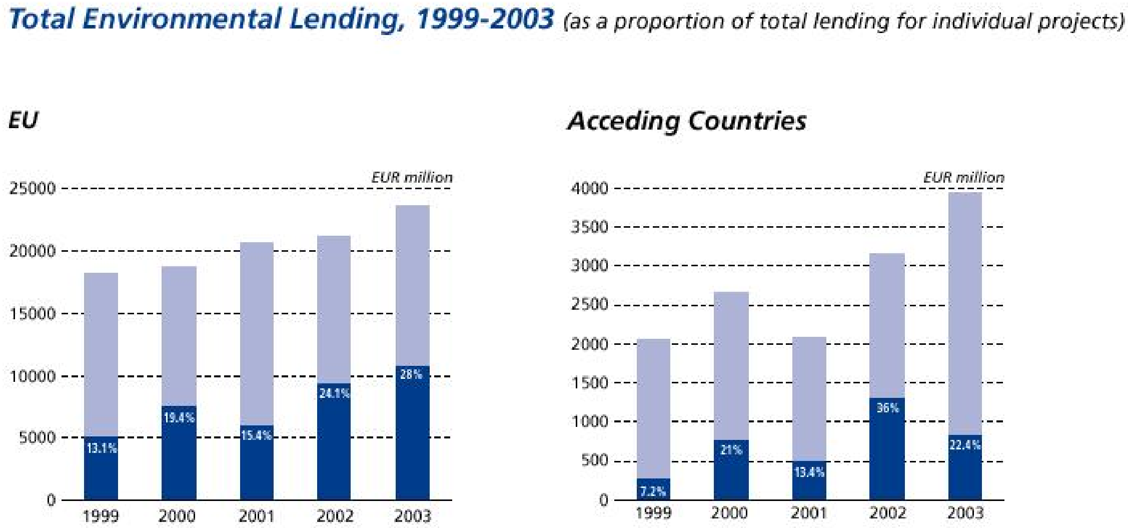
To finance the environmental protection policies the Cohesion fund was created by the Maastricht Treaty – a structural fund, which is to be used for two things only: transport and environment protection policy. The Fund is being financed from the second-big (after the common agricultural policy) part of the EU budget expenditure part. However, the amount actually spent on the environmental protection policy is low: in 1995 it made 100 million of ECU[24] (in comparison with billions of ECU spent on the agricultural policy or the co-operation with the third countries). In the last years the absolute amount of money spent on the environmental policy has slowly increased: in 2000 it was 157.7 million EUR, 196 million EUR in 2002 and 250.2 million EUR in 2004.[25] But this amount is still negligible compared to, for example, the budget expenditure on the Common Agricultural Policy, which equalled 46781.29 million EUR in 2004.[26] The EU can't make its Member States to increase the contribution to the Cohesion fund and thus to support the environmental protection policy.

Together with the Cohesion fund there are the activities of the European Investment Bank (EIB), which contribute to the environmental protection policies. Financing environmental projects - that is, where the main objective of the investment is environmental - is a major activity of the Bank (Týč 1999: 42). It was in 1972 when the EIB included a review of the environmental impact in project appraisals for the first time and in 1984 the Board of Governors decided to set environment as a central EIB objective.[27] From that time, the EIB includes environmental considerations among its assessment criteria for all projects financed, making compliance with Union and national laws a precondition for granting its loans.

Lending for projects that contribute towards safeguarding the environment and improving the quality of life, both within and outside the European Union, totalled approximately 9 billion EUR in 2001. About the same amount was spent on environmental lending in 2002.[28] In the figure, we can see the total environmental lending of the European Investment Bank in 1999-2003.

[24] European Commision: *How Does The European Union Work*?, Brussels, Luxembourg, 1996, p.18.
[25] European Commission: The General Budget of the European Union, http://europa.eu.int.
[26] European Commission: The General Budget of the European Union, http://europa.eu.int.
[27] www.eib.org
[28] source: European Investment Bank - www.eib.org

Figure 4.1 EIB: Total environmental lending 1999-2003



Source: European Investment Bank: *Environmental Report,* 2003, p.6 (www.eib.org)

The largest part, close on 40 per cent, of environmental loans went to water management projects, including hundreds of schemes improving drinking water and waste treatment throughout the Union. Investment in environmentally sound techniques to process industrial and toxic waste was financed in Belgium, Denmark, Germany, the Netherlands and Portugal. Reduction of atmospheric pollution, especially from power stations, has been promoted in particular in Finland, Germany, Greece and Italy, and the introduction of environmentally- friendly techniques has been supported in industrial plants in virtually every country of the Union.

Enhancing the urban environment and improving the quality of life in urban areas, where two out of three Europeans live and work, is a core activity of the EIB, representing close on a third of environmental protection loans and covering some fifty large cities. The main objective is to promote sustainable urban structures through, for instance, a wide range of investment in public transport, notably rail, and other schemes to reduce traffic congestion and associated pollution, but also through loans for urban renewal as well as water and waste management schemes.

Recent examples of EIB - financed urban investment projects are light railway lines in Lisbon, Lyons and Valencia, the Athens metro and cleaning up of the Venice lagoon including restoration works in the city itself, as well as a wide-ranging development program in and around Rome comprising road works, sewerage and restoration of historic buildings.[29]

[29] EIB: www.eib.org

The EIB has also been lending money for projects protecting the environment and improving the quality of life in the accession countries. The loans helped these countries to meet EU environmental standards. Examples of projects supported by the EIB loans in are: reconstruction work following the flooding in Poland and Hungary or water and sewerage projects in Poland, the Czech Republic, Hungary and Slovenia. The EIB also devotes money to finance the environmental projects in the Euro-Mediterranean Partnership Countries, such as Morocco, Algeria, Turkey or Tunisia.

The last source of financing the EU environmental policies we are going to mention here is the Financial Instrument for the Environment (LIFE), established in 1992. It is Commission that is responsible for the financial control and monitoring of the implementation of LIFE projects. LIFE consists of three thematic components: "LIFE-Nature", "LIFE-Environment" and "LIFE-Third countries" and cofinances environmental initiatives in the European Union and certain third countries.

The LIFE instrument has been implemented in several phases. During the first period, from 1992 to 1995, 400 million EUR was allocated to LIFE projects. In the second phase, from 1996 to 1999, it was approximately 450 million EUR. The third phase, "LIFE III", began in 2000 and it was supposed to last till 2004 with a budget of 640 million EUR. But last year it has been extended to the year 2006 and the budget had been increased by 317 million EUR.[30] During the decade 1992-2002, about 2050 projects were supported by this financial instrument.[31]

4.2.3. An economic impact of the environmental policies

Why it is so important to co-ordinate the environmental policy at the EU level? We can say, that the environmental protection policy has already found its place among other policies of the EU, but there are still many lacks and problems. For example, there exist great differences in between the norms of several EU members that can promote the investment and/or the industry development in a given country or, on the contrary, it can make many firms to leave the market. Comparing Sweden and France, for instance, we see that Sweden uses much more strict environmental protection policy rules than France. Therefore any given

[30] Source: http://europa.eu.int
[31] Source: http://europa.eu.int

firm investing in Sweden is going to have greater losses just because of the environmental policy measures. This can badly harm the functioning of the Single Market.

Transportation, energy and tourism are areas that can be a source of economic gain and profit and can influence environment in many ways. That is the reason why the areas of co-operation were defined. It is important to access their impact on environment and bring it under some legislation rules to create the terms of responsibility for those, who don't play according to the rules.

The protection of the environment should go hand in hand with the progress and construction in the EU. Let's take, for example, the problem of waste. Waste is also a commercial commodity. However, to prevent abuses in the fields of transport and storage, the transfer of waste from one Member State to another is a subject to special rules. These special rules are warranted by the magnitude and environmental impact of the waste problem: two billions tones of waste are produced in the European Union every year, of which 20 to 30 million tones are dangerous. Dangerous and toxic waste needs to be treated by the best available methods and technology to ensure a high level of protection for the environment and public health (European Commission 1996a). Since waste can't always be recycled or stored safely enough at the place of production, it may have to cross an internal border for storage, treatment, reconditioning or recycling. Paradoxically, therefore, the free movement of waste acts as a safeguard against the unauthorised dumping.

Under the EU environmental action plan an integrated approach is being developed in order to find the best sustainable path to the economic and social development. All this is vital not only for the environment, but for such important objectives as the well-functioning Single Market itself: it depends on the success of the policies in the field of transport, energy, industry, agriculture and tourism, which in turn depends on the capacity of the environment to sustain them.

Many environmental issues of today, like acid rains, climate changes, greenhouse effect and the above-mentioned waste have cross-borders impacts and can only be solved throughout the co-operation among economic operators and sectors and throughout a policy mix, which are best achieved within the Single Market context.

Acid rain in one country, for example, can result from sulphur emissions by industrial plants located in another one. Thus the quality of Dutch drinking water depends on the substances it contains and which enter the river from the German territory.

The EU has already acted in a number of sectors, for instance by limiting the toxic content of automobile exhaust, lowering permitted pollution levels from the factories and restricting the shipment of the dangerous waste.

In some decisions the European Court of Justice has ruled that environmental considerations can be more important than free-trade principles. At that international level, the EU supports efforts to create an international framework for resolving trade conflicts arising from the application of national or regional measures designed to protect the environment (Jakš 1998: 107). All these criteria enabled many EU members to sustain high environmental standards and protect the nature together with the high tempo of the economic growth (Scandinavian states).

4.3. Principles of the EU environmental policy

EU environmental policy documents, treaties, and legislation are characterised by the use of various principles. Weale (2000: 62) classify them into four broad categories:

a) principles concerned with sound environmental management;
b) principles concerned with the level at which environmental standards should be set;
c) principles concerned with the basis of task assignment in a system of multi-level governance;
d) principles concerned with the integration of environmental considerations with other sectors of public policy.

In the table below, we can see the list of these principles, together with the indication in which action programme the principle was first discussed and whether or not it is recognised in the SEA or the TEU.

Table 4.1 *Principles of the EU environmental policy*			
Principle	**Action Programme**	**Single European Act (1986)**	**Treaty on European Union (1992)**
Environmental management			
Prevention	First	Yes	Yes
Action at source	First	Yes	Yes
Integrated pollution control	Fourth	No	No
Level of standard			
Prudent use	First	Yes	Yes
High standard	No	Yes	Yes
Precaution	No	No	Yes
Task assignment			
Appropriate level	First	No	No
Subsidiarity	No	Yes	Yes
External integration			
Polluter pays	First	Yes	Yes
Integration	Fourth	Yes	Yes
Sustainable development	Fifth	No	No
Source: Weale et al. (2000), p.63			

As regards the first category: principles of sound environmental management, it includes three important principles. The principle of prevention states that action should be taken to prevent environmental problems from occurring rather than to control the effects of pollution once it has taken place (Weale 2000: 63). The logic behind is that prevention is cheaper than remedy. In other words, it is less costly to design the production technologies so that their pollution outputs are minimised than to use end-of-pipe solutions. The principle of taking action to correct pollution at source is stricter than the polluter-pays principle. It is because the first one does not allow merely compensate victims but it implies that the polluter must deal with the problem.

The First Action Programme defines the principle of prudent use of natural resources saying that the exploitation of natural resources that cause damage to the ecological balance must be avoided. Moreover, the principle of high level of protection established by the Single European Act (Art. 100a (4)) suggests that the Community was concerned with more than just the simple harmonisation of standards in such a way that free trade would be facilitated.

According to the principle of an appropriate level, in each category of pollution it is necessary to establish the level of action (local, regional, national, Community and international) best suited to deal with the pollution in question (Weale 2000: 68). The principle of subsidiarity, introduced by the SEA, requires that the European Union could take measures only when the objectives related to the protection of the environment could by attained better by EU action than by the Member States (Art. 130R (4)). The Maastricht Treaty added fuller statement of the principle of subsidiarity to the preamble of the Treaty.[32]

Since the pollution has its source in a variety of otherwise legitimate activities, such as transport, agriculture or industry, the environmental protection cannot be the responsibility only of a separate branch of environmental policy, but it has to be integrated into a wide range of public policies. This principle was recognised for the first time in the SEA, in which environmental protection requirements were made "a component of the Community's other policies" (Art. 130R (2)). This requirement was even strengthened in the Maastricht Treaty by the formulation that environmental "protection requirements must be integrated into the definition and implementation of other Community policies" (Art. 130R (2)).

Now, we would like to focus in more details on two principles:

Precautionary principle was adopted by the UN Conference on the Environment and Development (1992) in order to protect the environment, meaning that "*a precautionary approach should be widely applied, whenever there are threats of serious or irreversible damage to the environment, lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation".*[33]

Polluter-pays principle is a means of "*ensuring that the polluter (or resource consumer) should be charged with the cost of whatever pollution prevention and control measures are determined by the public authorities, whether preventative measures, restoration or a combination of both*".[34]

[32] In areas that do not fall within its exclusive competence, the Community shall take action, in accordance with the principle of subsidiarity, only if and in so far as the objectives of the proposed action cannot be sufficiently achieved by the Member States and can therefore, by reason of the scale or effects of the proposed action, be better achieved by the Community. (Treaty on European Union, Article 3b)

[33] European Environmental Agency (www.eea.eu.int)

4.3.1. Polluter-pays principle (PPP)

While disasters such as the sinking of the Prestige oil tanker seize the headlines, environmentalists are concerned also about thousands of small scale incidents such as the escape of slurry from farms into rivers. There is a need of a law that will force businesses to take more steps to curb the risk of causing damage, as well as meeting the costs of restoring the environment if it occurs. Businesses have to follow the rules and no exemptions calling for "good agricultural practice" or permits should not be allowed. That's why the EU Commission and EP Environmental Committee are trying to meet these needs and call for a wide financial and legal accountability of polluters.[35]

This is done through the EC environmental liability regime, one of the most important principles in the framework of the environmental protection policies, aiming at implementing the Polluter Pays Principle (often referred as PPP) and describing the key elements needed for making such a regime effective and practicable[36]. It is a way of implementing the main principles enshrined in Article 174 of the EC Treaty, above all the Polluter Pays Principle. Polluters must pay for the damage they have caused. The application of this method will encourage the various parties concerned to take more precautions and will reduce pollution.

For the principle of liability to be effective these three conditions must be fulfilled:

- polluters must be identifiable;
- the damage must be quantifiable;
- there must be a link between the polluter and the damage.

In addition, the principle of liability cannot be applied for dealing with pollution of a widespread, diffuse character such as climate change.

In most of the Member States, there are laws on liability for damage caused by activities that are hazardous to the environment, but these laws only apply with respect to damage to human health or property. What is needed is an environmental liability regime that covers damage to natural resources, at least for resources that are already protected by Community legislation. The effectiveness of the regime depends on the existence of effective financial security based on transparency and legal certainty with regard to liability. The Community regime should be devised so as to minimise transaction costs.

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[34] European Environmental Agency (www.eea.eu.int)
[35] Environmental Liability Directive

[36] White Paper of 9 February 2000 on environmental liability (www.europa.eu.int)

4.3.2. Precautionary principle (PP)

A shift towards prevention and implementation of the precautionary principle in everyday decision-making has became one of the most important new goals of environmental and technology policies in the last decade. The European Community has already made use of the precautionary principle on several occasions, especially in environmental policies, such as regarding climate change or the protection of the ozone layer.

Many pessimistic prognoses originated in the past (see for example Thomas Malthus or Albert Schweitzer) have foretold the depletion of natural resources, the extermination of nature and environment as a result of the aggressive human activity. However pessimistic they were, the one thing they managed to reflect in a proper way – without maintaining the capacity to foresee and direct the actions accordingly, man will end up destroying the earth.

The problem of being wise before it is too late is not of an easy kind, especially when the environmental or health impacts may be far into the future and the real (or expected) costs of implementing them are large and should be taken immediately. In order to prevent disasters from happening, one has to react before there is strong proof of harm, particularly if the harm may be delayed and irreversible. Such an approach, including both scientific evidence and policy-making gave birth to the so-called precautionary principle.[37]

The definition of "precautionary principle"[38]includes two key points:

1) Precautionary principle adopted by the UN Conference on the Environment and Development (1992) that in order to protect the environment, meaning that a precautionary approach should be widely applied, whenever there are threats of serious or irreversible damage to the environment, lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation.
2) Precautionary principle permits a lower level of proof of harm to be used in policy-making whenever the consequences of waiting for higher levels of proof may be very costly and/or irreversible.

[37] Precautionary prevention has often been used in medicine and public health, where the benefit of doubt about a diagnosis is usually given to the patient ("better safe than sorry").

[38] The following resources have been used as a primal source of the definition: 1) ETC/CDS, General Environmental Multilingual Thesaurus (GEMET 2000); and
2) EEA. 1999: "Environment in the European Union at the turn of the century", p.278. Environmental assessment report No. 2

4.3.2.1. From the history of implementation of the precautionary principle

The precautionary principle and its application to environmental hazards and their uncertainties only began to emerge as such within environmental science in the 1970s, when German scientists and policy-makers were trying to deal with "death of forests" and its possible causes (including air pollution, for instance). The "precautionary" principle in the German Clean Air Act of 1974, as elaborated in the 1985 report on the Clean Air Act included elements such as:

- research and monitoring for the early detection of hazards;
- general reduction of environmental burdens;
- promotion of 'clean production' and innovation;
- proportionality principle, where the costs of actions to prevent hazards should not be disproportionate to the likely benefits;
- co-operative approach between stakeholders to solving common problems via integrated policy measures that aim to improve the environment, competitiveness and employment;
- action to reduce risks before full 'proof' of harm is available if impacts could be serious or irreversible (Boehmer-Christiansen 1994).

Since the 1970s, the precautionary principle has found its way into the political agenda, and was incorporated in many international agreements, particularly in the marine environment, where ecological data on pollution yielded little understanding but much concern. More generally, Principle 15 of the UN Rio Declaration on Environment and Development 1992 extended the idea to the whole environment.[39]

In Europe, the most significant support for the precautionary principle has come from the European Commission's Communication on the Precautionary Principle (European Commission, 2000) and the Council of Ministers Nice Decision (2000). They have made significant contributions to the practical implementation of the precautionary principle, especially concerning stakeholder involvement and the avoidance of trade disputes. EU Commission considers that the precautionary principle should in particular be taken into consideration in the fields of environmental protection and human, animal and plant health.

[39] See Box B.1 in Annex "The "precautionary principle" in selected international treaties and agreements"

Although it never defines it, the EC Treaty does mention the precautionary principle in Article 130(2) of 1997 Amsterdam Treaty (97/C 340/01) as well as in European Court Judgements of 1998-05-05[40].

Policy orientations concerning the implementation of the precautionary principle in practice were set out by the EU Commission in the Green Paper on the General Principles of Food Safety and the Communication of 30 April 1997 on Consumer Health and Food Safety, by Parliament in its Resolution of 10 March 1998 concerning the Green Paper, by the Council in its Resolution of 13 April 1999 and by the Joint Parliamentary Committee of the EEA (European Economic Area) in its Resolution of 16 March 1999.

4.3.2.2. Difficulties in implementing the precautionary principle

Decision-makers are constantly faced with the dilemma of balancing the freedoms and rights of individuals, industry and organisations with the need to reduce or eliminate the risk of adverse effects to the environment or to human health. Finding the correct balance so that appropriate, non-discriminatory and transparent decisions can be made, requires a structured decision making process with detailed scientific and other objective information involved. This structure is provided by the three elements of risk analysis:

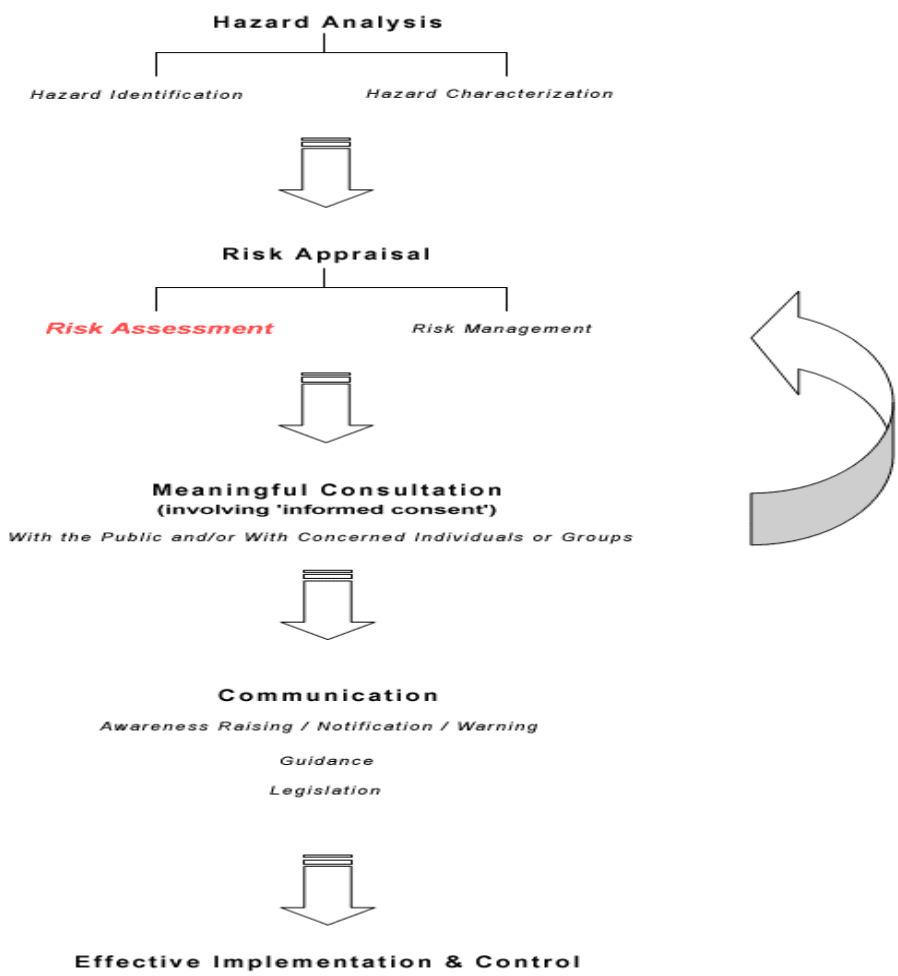
- risk assessment,
- choice of risk management strategy and
- communication of the risk.

The following diagram illustrates the scheme of analysis needed for the implementation of the precautionary principle. It is important to take into consideration three conditions when reviewing it (EEA 2001):

1) the process must be transparent,
2) clear statements on reliability must be made with the support of statistical data, and
3) statements of uncertainty must imply calculations.

[40]Ground 63 of Case C-157/96 & Ground 99 of Case C-180/96

Figure 4.2 Scheme of actions for the implementation of the precautionary principle



Source: European Environmental Agency, (www.eea.eu.int)

The precautionary principle is relevant only in case of potential risk, even in case when this very risk cannot be fully demonstrated or quantified or determined, largely because of the insufficiency of the scientific data necessary for the final decision. However, it should be noted that the precautionary principle could under no circumstances be used to justify the adoption of arbitrary decisions.

The most frequent difficulties in implementation of the precautionary principle are of scientific and political nature. During the deciding whether or not to implement the precautionary principle a risk assessment is taken into account. And this requires reliable scientific data and logical reasoning, which can bring the decision-makers to a conclusion expressing the possibility of a hazard's impact on the environment, or health of a given population (with taking into account the extent of possible damage, persistency, reversibility as well as delayed effects). However it is not possible in all cases to complete an assessment of risk, because the scientists are confronted with the problem of strong uncertainty – they might know the basic parameters, however, the probability distributions are often unknown. The limits of scientific knowledge may affect all four components of risk assessment: hazard identification, hazard characterisation, appraisal of exposure and risk characterisation.

As regards political issues, they are often the most controversial ones. As Funtowicz and Ravetz (1994) state in their paper "The worth of a songbird: Ecological economics as a post-normal science" a naive interpretation of a precautionary principle would "…entail a halt to all innovation, even that intended to benefit the environment. For to require that every proposed innovation be *proced* harmless would amount to a uniform ban; the task is to articulate varieties of 'burden of proof'[41] that are each appropriate to the issue and the forum of discussion". The issue is clear – there is a strong need to make the politicians accurately assess each implementation of the precautionary principle, basing on all scientific data available as well as public discussions including representatives of every sphere of public life, interested in the issue.

There is also a re-election problem. In spite of the fact that some politicians may be environmentally-oriented and concerned about the sustainable development and nature-protection issues, they still have to compete for re-election. The majority of decision-makers tend to express less radical views and incline to the centrist ideology simply for addressing wider political spectrum. The short-lasting nature of the political power and ability to make decisions, the cyclical way of changing the political forces at power creates a major threat for the precautionary principle implementation in the every-day life and reduces the concern about the environmental issues to mere political rhetoric.

Moreover, the political decision-making faces the pressure of public opinion. Even though some hazard requires an immediate implementation of the precautionary principle, politicians may hesitate and postpone it in order to prevent any social clashes from happening. After all, they are interested only on a seizure of power for as long as possible and it is their interest to make every single voter happy.

In such a radical situation, as described above, politicians will choose to sweep aside the precautionary principle thinking in order to meet the needs of the public (and give the "green light" to pollution – in the most extreme case).

[41] The term of "burden of proof" relates to the issue when, for instance, on a basis of the international agreements there is a list of certain harmful substances. When a party enters the export-import relations and for example, exports some substances that might be harmful (according to the mutual accepted list), it is the party's cost to arrange the certificates and proofs that its product is not of any harm to human health. The same principle applies to the environmental issues – i.e. pollution or emissions.

4.4. Environmental Action Programmes of the European Community

The Environmental Action Programmes (EAPs) of the European Community were developed by the European Commission and approved by the Council of Ministers each setting out environmental policy objectives, priorities and Community action plans in the certain period. Since the Maastricht Treaty the Action Programmes have been agreed in consultation with the European Parliament as well as the Council. They did not, however, provide a binding legal basis for passing environmental measures, but served merely as guidelines according to which EC environmental policy should be focused.

Over the last 30 years, major progress has been made in establishing a comprehensive system of environmental controls in the EU and a number of broad principles underpinning environmental policy have emerged. But rather than highlighting ecological issues or problems pure and simple, the Actions Programmes were designed to initiate projects that would be of benefit to the people of the EU and its environment. Initially, these were broken down into three categories (O.J. 1973 No. C 122/1):

- action to reduce or prevent pollution;
- action to improve the environment and living conditions;
- action in international organisations relating to the environment.

Action began in 1972 with four successive Programmes, based on a vertical and sectoral approach to ecological problems. In the first Environmental Action Programme of the European Community (1973-1976), improving the quality of life and protection of the natural environment were defined as major priorities (O.J. 1973 No. C 122/1). This first Programme was followed by five more Environmental Action Programmes for the periods: 1973-76, 1977-82, 1983-87, 1987-92, 1993-2000 and 2001-2010.

Now we will focus more on the last two Environmental Action Programmes.

4.4.1. The 5th Environmental Action Programme (1993-2000)

The fifth EAP was the Community strategy for the period 1993-2000. For each area it covered, the program established long-term objectives, set targets to be met by the year 2000 and prescribed a set of actions with a view to achieving the specified objectives.

Unlike the first four Programmes which concerned about market distortions caused by national environmental regulations the fifth EAP, titled "Towards Sustainability", was explicitly global in its approach and focused on reducing pollution levels, implementing legislation that would benefit EU citizens and integrating the environmental dimension into all areas of Commission policies. [42]

The first four Action Programmes cover the shift from thinking about environmental deterioration only in terms of its impact on people to acceptance of a commitment to protect the environment for its own sake. Moreover, the acceptance of the need to pursue sustainable development, embodied in the Fifth Programme, reflects the realisation that environmental damage has long-lasting and far-reaching effects.

For twenty years, Community environment policy has essentially consisted in the elaboration of a legislative framework aimed at combating pollution and protecting the environment. But despite the adoption of this legislation, the report on the state of the environment published in 1992[43] described deterioration in the environment over the same period, in the fields of atmospheric and aquatic pollution, soil degradation, nature conservation, urban environment and waste management. The main worries were: a sharp increase in emissions of "greenhouse" gases due to the rising industrialisation and transport; a threat to water quality; increased spreading of nitrates and sewage sludge in agriculture, increased use of hyper-intensive farming, excessive use of chemical fertilisers, pesticides and herbicides in agriculture; a reduction of biological diversity; a deterioration of living environment due to rising pollution, noise, and damage to the architectural heritage and public places; and an increase of domestic and industrial waste due to the rising production and consumption of goods together with poor use of recycling and reuse options.

It was clear that without new political initiatives, the damage to the environment would continue to increase. Thus the main objective of the Fifth Programme of action in

[42] Commission of the European Communities (1992): *Fifth Environmental Action Programme: Towards Sustainability.*
[43] Resolution of the Council and the Representatives of the Governments of the Member States, meeting within the Council of 1 February 1993 on a Community program of policy and action in relation to the environment and sustainable development.

relation to the environment was to transform patterns of growth in the Community in such a way as to promote sustainable development. The Programme continued to tackle environmental problems (such as climate change, aquatic pollution and waste management), but also aimed to establish new relations between the actors in the environmental sector.

Moreover, the fifth Programme set out a new approach to Community environment policy based on the following principles:

- the adoption of a global, proactive approach aimed at the different actors and activities which affect natural resources or pollute the environment;
- encouraging changes in social behaviour by engaging all the actors concerned (public authorities, citizens, consumers, enterprises, etc.);
- the will to change current trends and practices which harm the environment for current and future generations;
- using new environmental instruments;
- establishing the concept of shared responsibility.

The Community was limiting its action to the following priority areas:

- long-term management of natural resources: soil, water, countryside and coasts;
- integrated approach to combating pollution, and acting to prevent waste;
- reducing the consumption of energy from non-renewable sources;
- improving the management of mobility by developing efficient and clean modes of transport;
- drawing up a coherent package of measures to improve the quality of the urban environment;
- improving health and safety, in particular in relation to the management of industrial hazards, nuclear safety and radiation protection.

The Programme pointed out five target sectors for Community interventions: industry, energy, transport, agriculture and tourism. Concerning industry field, the objectives were, for instance: to encourage voluntary agreements, to develop rational resource-management, to improve the information available to consumers and to adopt Community standards for manufacturing processes and products. In the energy field the Community aimed at improving energy efficiency, reducing a consumption of fossil fuels and promoting use of renewable energy sources. In transport area, it was necessary to improve the management of infrastructure and vehicles, develop public transport and improve the quality of fuels. As regards the agriculture, a reform of the Common Agricultural Policy and forestry development, taking into account environmental requirements was necessary. The tourism objectives were: to improve the management of mass tourism and the quality of tourism services, to promote alternative forms of tourism and information and awareness campaigns.

In addition to the regulatory instruments, which have generally been used with regard to the environment, the program provided for the development of a broader mix of instruments. They can be divided into the following groups:

- regulatory instruments
- financial instruments
- horizontal measures

As regards regulatory instruments they have fixed minimum levels of protection, implemented international agreements and established rules and standards with a view to the internal market. Financial instruments were used to create incentives for producers and consumers to protect the environment and use natural resources in a responsible manner (economic, fiscal and civil responsibility measures) and also as "price corrections" ensuring that products and services which respect the environment are not penalised in terms of cost. Finally, horizontal measures should improve information and environmental statistics that are necessary for comparable nomenclature, standards, criteria and methodologies, promote scientific research and technological development, improve sectoral and spatial planning, public information and professional training.[44]

4.4.2. The 6th Environmental Action Programme (2001-2010)

The fifth EAP was already completed in 2000 and now is followed by the Sixth Programme, which will last till 2010. This last EAP goes further than previous ones. It is the most strategic approach yet adopted by the Commission to meeting the environmental objectives of the EU and calls upon the active involvement and accountability of all sections of society in the search for innovative, workable and sustainable solutions to the environmental problems we face. It effectively provides the environmental component of the Community's overall strategy for sustainable development.

The strategic approach is underpinned by five major objectives that each emphasizes the need for more effective implementation and more innovative solutions:[45]

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[44] For more details about environmental protection instruments see Section 3.

[45] European Commission: *6th Environment Action Programme 2001-2010 (Environment 2010: Our Future, Our Choice)*

- improve the implementation of existing environmental legislation at national and regional level;
- integrate environmental concerns into other policy areas;
- work closely with business and consumers in a more market-driven approach to identify solutions: businesses must be encouraged to innovate, not just simply be penalized; information for consumers allow them to choose environmental friendly products;
- ensure better and more accessible information on the environment for citizens, since their daily decisions directly or indirectly impact the environment;
- and develop a more environmentally conscious attitude towards land-use planning.

The EAP indicates four priority areas for action:

- climate change;
- nature and biodiversity;
- environment and health and quality of life;
- sustainable use of natural resources and management of wastes.[46]

As regards tackling the climate change, the key priority is the implementation of the Kyoto Protocol to cut greenhouse gas emissions by 8% over 1990 levels by 2008-12. This goal is considered as a first step to the long-term target of a 70% cut in the future. Due to the evidence that human health as affected by environmental problems related to air and water pollution, dangerous chemicals and noise, the EU calls for a holistic and comprehensive approach to environmental and health with precaution and prevention as a central element.

Since the resources like soil, water, air and timber are under a great pressure, the EU suggests to use the instruments, such as taxes and incentives, to ensure the consumption of renewable and non-renewable resources does not exceed the carrying capacity of the environment. The Community also calls for improving resource efficiency and encouraging recycling and recovery of wastes.

The Sixth Programme also has taken into account the enlargement of the Union. The Community supported the implementation of environmental legislation in new Member States by funding programmes.

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[46] European Commission: *6th Environment Action Programme 2001-2010*

4.5. EU as an international actor

For a long time, Community environmental policy focused mainly on solving problems within the Community. Member States, however, soon came to recognise the global nature of pollution and the need for concerted action at regional and international level. Article 130r (1) of the EC Treaty includes the objective of promoting measures at the international level to deal with regional or world-wide environmental problems. Mostly four major environmental problems call for international action: climate change, ozone layer depletion, biodiversity loss and deforestation. The co-operation can be multilateral, in the framework of different international institutions (UNEP, OECD or the Council of Europe), or bilateral, in the framework of aid to developing countries and combating trans-border pollution.

But the formulation of a co-ordinated environmental foreign policy on the international stage finds its limitations in several institutional and political mantraps, mainly encoded in the institutional system itself. Despite the highly integrated policy field of environmental protection in the EU, the complex nature of the problem as well as the status of "mixed competence" in the EU system very often brings about a controversy between both EU actors, and at the international level. It undermines a powerful EU negotiation position.

One feature of the debate has been the search for alternatives to the traditionally dominant "command and control" approach in the EU as well as in national environmental policy. The question is whether the command and control approach is still appropriate in a modern risk society. The command and control approach is connected with a state-centred vision of co-ordination or at least state influenced forms of decision making by individual as well as collective actors. The questioning of this traditional approach means that it is also necessary to consider modern non-hierarchical forms of governance.

To be a forceful leader in international environmental negotiations the EU needs enough pressure from outside. The complex decision-making process between the EU and its Member States implies a considerable amount of time and compromises with the result, that often EU positions represented internationally are merely provisional compromises waiting for clarification among Member States.

While the EU has often been a constant pusher in terms of negotiating position and rhetoric, its leadership performance, especially in terms of implementation has been much less impressive. This undermines the credibility of the EU as a forceful international actor. The "renaissance" of the nation state as an important actor in international environmental politics and the crisis of international environmental institutions makes it more and more difficult for the EU to sell its strategy of multilateralism effectively.

5 Environmental Kuznets Curve (EKC) and the factors leading to reducing of the pollutants' emissions: the empirical study of the Czech Republic

5.1. Introduction

In this part of the diploma thesis we will set up the prerequisites for the model explaining the inter-dependence between the pollutants and the economic development of various groups of countries in order to estimate correlation between various factors leading to pollution.

We will start with calculating the relationship known as the Environmental Kuznets Curve (EKC) for chosen groups of countries and taking into account just one environmental-pressure factor on the left-hand side: carbon dioxide, sulphur dioxide, nitrogen oxides and suspended particles of dust in the air caused by the airborne emissions series. The right-hand side of the equation is represented by the GDP per capita in the chosen groups of countries. The results of this exercise will lead us to choosing the right emission factor to be tested in the case of the Czech Republic as the new EU Member State sharing the same environmental standards and values.

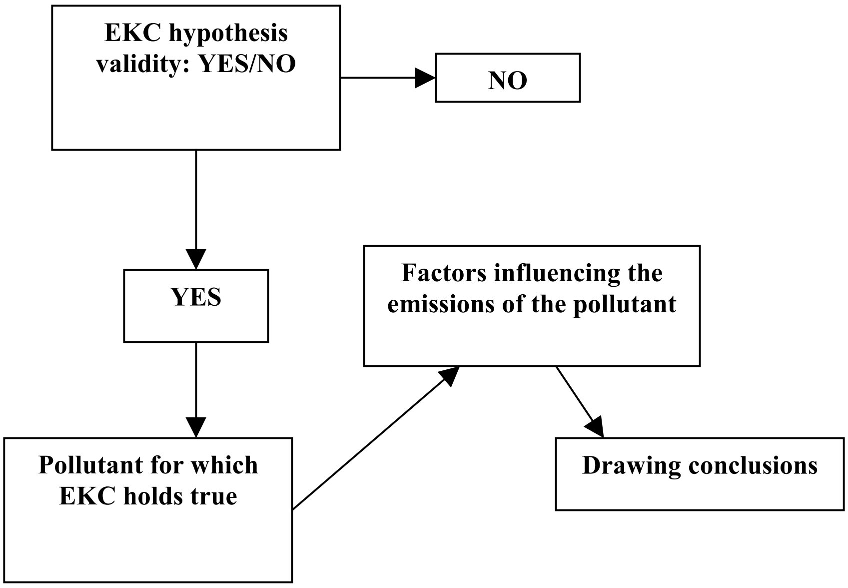
The first step will be to run the regressions for the emissions per capita of the selected pollutants on GDP per capita in 13 OECD countries in order to estimate whether or not the Environmental Kuznets Curve hypothesis holds.

Then we will estimate the relationship between the environmental pollution expressed by CO_2 and SO_2 emissions per capita and the GDP per capita first for the 15 EU countries using the cross-country data for the year 1997 and then for the Czech Republic for the period from 1990 to 2001.

The last part of the model will be to detect what economic, geographic and demographic factors represented by the unemployment level, GDP per capita, environmental protection investments, population density, the amount of agriculture and forest area and the number of internet users have an impact on the level of pollution in the Czech Republic.

The philosophy of the model itself and the methodological occurrence can be graphically presented on the following diagram:

Figure 5.1: The summary of the model



But before we start with running the OLS and multiple regressions using the SPSS for Windows software package and discuss the results, let us first look at the theoretical framework of the Environmental Kuznets Curve and the discussion on this issue in the economic literature.

5.2. The prerequisites of the Environmental Kuznets Curve

The environmental Kuznets curve is an inverted-U relationship between environmental quality and economic development.[47] The theory of EKC suggests that the intensity of the per capita environmental impacts of production falls after per capita income passes certain threshold level. It is usually stated that the environment is an income-elastic commodity (Bimonte 2002). In the first stage of industrialisation, pollution and environmental degradation in the environmental Kuznets curve world grows rapidly because people are more interested in jobs and income than clean air and water, communities are too poor to occupy themselves with the environmental issues and environmental regulation is correspondingly weak. In other words, in the first part of the EKC, environment may be supposed to be an obstacle for economic growth, and therefore growth has a negative effect on environmental quality. Moreover, there is empirical evidence showing a positive feedback between poverty and environmental degradation (Perrings 1995).

[47] Kuznets's name was apparently attached to the curve because of its resemblance to Simon Kuznets's concept (1955) between income inequality and development.

However, the situation changes as income rises. Leading industrial sectors become cleaner due to new technologies and environmental investment, people value the environment more highly, and regulatory institutions become more effective. Beyond some level of income per capita, which varies among different indicators of environmental degradation, economic growth leads to environmental improvement. But the reason why environmental quality increases when income becomes higher than a threshold level is still not completely clear (Bimonte 2002). The fundamental implication of this theory is that economic growth may be seen as favouring environmental protection.[48] This is contrary to the general idea that economic growth leads to environmental degradation. This idea reflects the "scale effect". In other words, if there were no changes in the structure of the economy or technology used, pure growth in the scale of the economy would result in a proportional growth in pollution and other environmental damages. On the other hand, the idea behind the EKC model is that "at higher levels of development, structural change towards information-intensive industries and services, coupled with increased environmental awareness, enforcement of environmental regulations, better technology and higher environmental expenditures, results in levelling off and gradual decline of environmental degradation" (Panayotou 1993b). At higher levels of development, environmental protection and expenditure starts to rise because social preferences shift away from private to public goods. We can conclude that from a certain point, due to either necessity (environment becomes a "resource" that has to be taken into consideration in order to grow further) or higher level of participation (information accessibility, better level of education, and more equitable income distribution) economic growth stimulates environmental improvements (Bimonte 2002).

Many econometricians have generally accepted the basic premises of the model and focused on measuring its parameters. Their regressions, typically fitted to cross-sectional observations across countries or regions, suggest that air and water pollution increase with development until per capita income reaches a range of $5000 to $8000. When income rises beyond that level, pollution starts to decline, as shown in the "conventional EKC" line in Figure 1 below.

There are, however, many critics of the concept of "conventional EKC". Some of them argue that cross-sectional evidence does not reflect the dynamics of the process. They maintain that even if the EKC relationship existed in the past, it is not likely to exist in the future

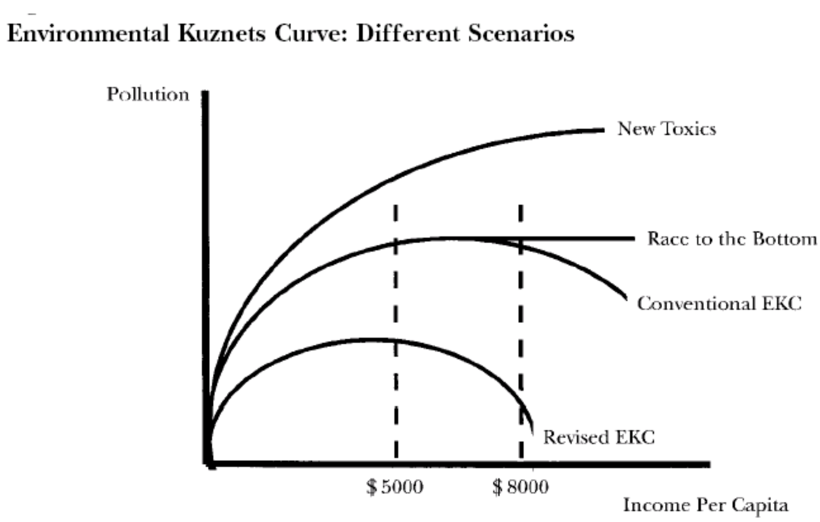
[48] The idea that economic growth is necessary in order to environmental quality to be maintained or even improved is an essential part of the sustainable development argument propagated by the World Commission on Environment and Development in *"Our Common Future".*

because of the pressures placed on the environmental regulation by global competition. Over time there will be no threshold level, where the environmental quality begins to rise, and the curve will rise to a horizontal line at maximum existing pollution levels. This is case is illustrated in the Figure 5.2 as the “race to the bottom” in environmental standards promoted by globalisation. In this scenario, relatively high environmental standards in developed countries impose high costs on polluters. And there is a concern of moving the most polluting firms to developing countries, where there is great unemployment, people have low incomes and environmental regulations are weak or they do not even exist. In addition, the capital outflows might force the governments in developed countries to begin relaxing their environmental standards. So the environmental Kuznets curve flattens and rises towards the highest existing level of pollution.

Other pessimistic approach is that, even if some pollutants are reduced over time with increasing income, there are still newly creating unregulated and potentially toxic pollutants. Thus, the overall environmental pollution may rise, even if certain sources of pollution are reduced, as shown by the “new toxics” line in the Figure 5.2 below.

However, Dasgupta et al.(2002) claim that there is not much empirical research underlying the “race to the bottom” and “new toxics” scenarios. In their view, recent empirical work suggests that the curve is actually dropping and shifting to the left as shown by the “revised EKC”. This implies that the pollution starts to fall at lower levels of income and economic growth generates less pollution in the early stages of industrialisation compared to the “conventional EKC”.

Figure 5.2 Environmental Kuznets Curve



Source: Susmita Dasgupta, Benoit Laplante: “Confronting the Environmental Kuznets curve”, Journal of Economic perspectives, Volume 16, page 148.

Many empirical studies have tested the environmental Kuznets curve model. The typical approach has been to regress cross-country data for ambient air and water quality on various specifications of income per capita.

Empirical researchers are far from agreement that the EKC provides a good fit to the available data, even for conventional pollutants. For example, Stern (1998) claims that the evidence for the inverted-U relationship applies only to a subset of environmental measures, e.g. air pollutants such as sulphur dioxide or suspended particulates. On the other hand, Grossman and Krueger (1993) argue that suspended particulates decline monotonically with income and Stern et al.(1998) find that sulphur emissions increase through the existing income range. As regards the water pollution, the results are quite similar, i.e. there is no clear evidence that EKC holds true for certain pollutants.

The problem is also that data is scarce for many pollutants in many countries, not just in developing ones. For this reason, for example, we can just estimate the EKC's shape for toxic pollutants.

There are, however, several problems with environmental Kuznets curve. The first is that the inverted-U relationship is not observed for all types of pollutant. While it has been observed for pollutants with local and recent effect, it tends not to be observed for transboundary[49] pollutants, where is only little local incentive to internalise the negative externality, or those whose effect will be felt in the future.

The second problem is that the positive implications of economic growth to environmental quality have caused some authors to claim that only economic growth is necessary. Beckerman (1992) maintains that the surest way to improve the environment is to become rich. In this point of view, problems of environmental degradation are only temporary, because economic growth together with technological innovation will solve them in time. But behind this idea, there is a strong assumption that technological innovations will always come just in time. Arrow et al. (1995) argue that there is no reason to believe that the relationship linking income and environmental quality is automatic, and there is no evidence showing that economic growth is a perfect substitute for environmental policy.

Since environmental performance varies among countries, it is possible that also additional variables, others than income per capita, may influence the environmental performance of a country (Bimonte 2002). For example, economic and social policy may

[49] A transboudary impact can be defined as any significant adverse effect on the environment that occurs across the borders of different states. (See Markandya et al.: *Dictionary of Environmental Economics,*2001)

have a great influence on determining the emergence of the downward slopping part of the EKC (Grossman and Krueger 1995).

5.3. Testing the EKC hypothesis empirically

5.3.1. The data and the hypothesis

Let us start with estimating the relationship between the pollutant and the level of GDP called as "environmental Kuznets curve" using the 70 annual observations for the 13 OECD developed countries throughout the 1970s and 1990s including the GDP per capita in every country and various pollutants (represented by CO_2, NO_x, SO_2 and suspended particles).[50] It is useful to compare the results of time series studies because they capture the dynamic process involved.

The data are taken from the OECD database and include 254 observations on 13 countries represented by the developed Western economies, i.e. EU most developed members, US and Canada[51]. The GDP is expressed in GDP values computed in thousands of USD per capita and the emissions are expressed in metric tones per capita[52]. Our sample used includes only countries that are at the advanced stage of economic development process. It is logical to assume that the interest in environmental protection comes with wealth and that after satisfying their basic needs, such as food or industrial production, the society turns its face to environmental values (obviously putting them at the top of some version of Maslow's pyramid[53]).

The idea behind this will be to test the relationship between the pollutant per capita and GDP per capita. We have deliberately picked up the most developed countries on the world to test whether the Kuznet's curve relationship described at the beginning of this chapter has rational grounds and can be tested for the data available.

The hypothesis we are trying to test is the one suggested by the EKC model:

- the higher the level of GDP per capita, the lower the pollutant emissions per capita.[54]

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[50] We are using GDP per capita as explanatory variable instead of income per capita. See for example Stern (2003)

[51] The data are taken from the OECD "Statistics" section on Statistics database accessible to general public on www.oecd.org.

[52] See for instance www.oecd.org.

[53] Maslow's pyramid is the concept used in Management and Marketing. It is basically the ordering of human's values and priorities, arranged from the basic ones at the bottom (food, cloth) to the advanced values such as self-recognition or respect of the others.

[54] See for example: Bimonte (2002) or Stern (2003)

- alternatively: in case the hypothesis is rejected, it would lead us to the conclusion that the higher the level of GDP per capita the higher are the emissions.

5.3.2. The model

Let us start with the carbon dioxide (CO_2) per capita and GDP per capita. We will estimate the equation by ordinary least squares method. The regression model can be formally expressed in the following way:

$$\boldsymbol{log\ (E/P) = \alpha + \beta * log(GDP/P)^2 + u;} \qquad \textbf{(1)}$$

where E is emissions (in this case CO_2 emissions), P is population and log indicates the logarithmic function. The first term on the RHS (α) is the intercept parameter.

The earliest EKCs were simple quadratic functions of the levels of income. The shape of environmental Kuznets curve clearly gives us a message that we are likely to deal with an inverted U-shaped (parabola function, which is expresses as: $y = x^2$) relationship. Thus, to test the parabola-shaped curve, we will put the logarithm of the independent variable (here the log of GDP per capita) into the powers of 2.

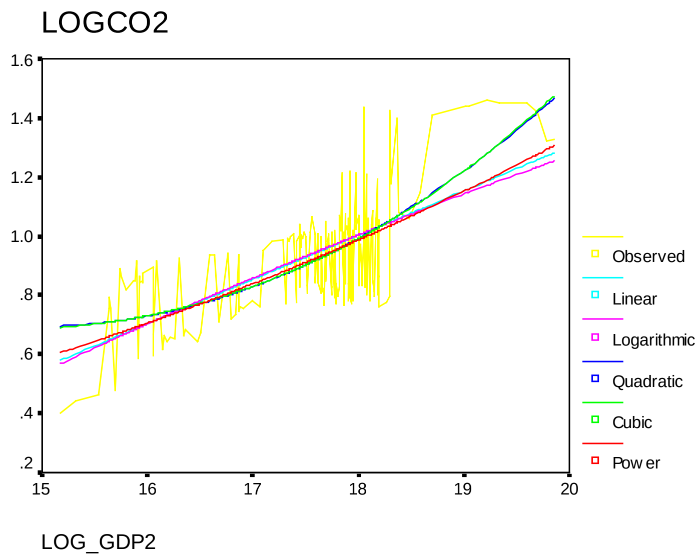
The use of logarithms is explained by the fact that we are trying to estimate the non-linear relationship, the use of logarithms for this purpose is defended for instance in Maddala (2001). Moreover, economic activity implies the use of resources and, by the laws of thermodynamics, the use of resources implies the production of waste. Thus, we should not allow levels of dependent and independent variables to become zero or negative. This restriction can be applied by using a logarithmic dependent variable.

Estimating the relationship between CO_2 and GDP per capita gives the following outcome (figures in parentheses are standard errors):

$$\mathbf{Y = \underset{(0.209)}{-1.691} + \underset{(0.012)}{0.685}*X, \quad R^2 = 0.469} \qquad \textbf{(2)}$$

where Y is the dependent variable (in this case it is CO_2 per capita) and X is the independent or explanatory variable (GDP per capita). As for the intercept –1.691, it means that there would be no carbon dioxide emissions if the GDP were zero. In fact they should be negative. But in reality this would not happen. This model is very simple and there are more explanatory variables for the CO_2 emissions. The coefficient of determination (the adjusted R-square) in this case equals 0.469.[55]

Figure 5.3 Relationship between CO_2/P and GDP/P
(OECD countries)



Source: own estimations

For the case of carbon dioxide emissions the hypothesis we have stated above seems not to hold. As we can see in the Figure 5.3, the estimated curve is rather slowly increasing. There is no inverted-U relationship between CO_2 emissions per capita and GDP per capita in this data sample. The reason might be as follows: the CO_2 emissions are rather global polluting than local. In the case of cross-border pollutant, there is little local incentive to internalise the externality (Dasgupta et al. 2002: 149). With rising income people care more about the environmental protection but they pay more attention to the pollutants causing local environmental damages.

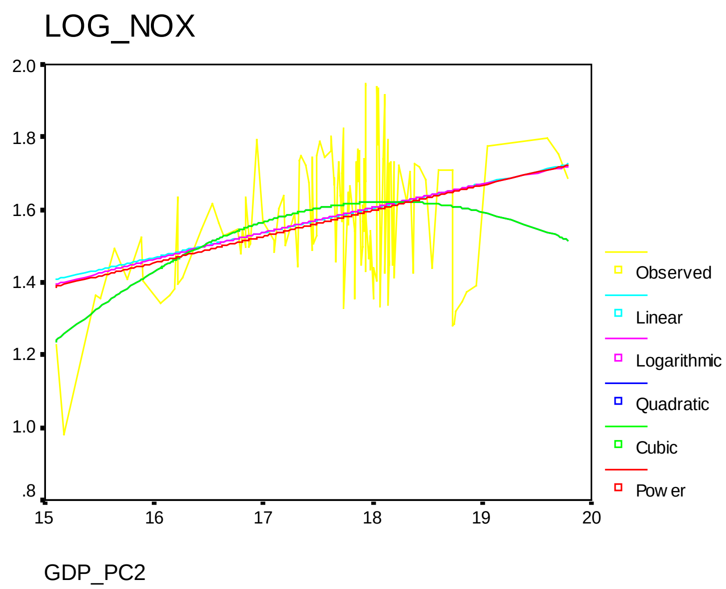
Now let us proceed with the same procedure to derive the environmental Kuznets curve using the correlation of nitrogen oxides and GDP per capita for the same sample of 13 OECD countries. We get the following (figures in parentheses are standard errors):

$$\mathbf{Y = 0.388 + 0.348*X, \qquad R^2 = 0.121 \qquad (3)}$$
$$\mathbf{(0.285) \quad (0.016)}$$

[55] The coefficient of determination always falls in the interval between zero and 1 for any given regression. If R2 is close to zero, it means that the independent variable X explains very little of the variation in Y. And vice versa the closer to zero R2 is, the more of the variation in Y it explains. In other words, if R2 is high (it means close to 1), then X is a good explanatory variable for Y. (See for example Maddala, G.S.: *Introduction to econometrics,* 2001)

Again, Y is the dependent variable (NO_x - nitrogen oxides emissions per capita) and X is the explanatory variable (GDP/P). In Figure 5.4 we can see the estimated Kuznets curve for NO_x pollution. There is a decreasing NO_x pollution for the GDP per capita after certain point, which again reminds the Kuznets curve. But the adjusted R-square is low and the beta coefficient is positive. This rises certain doubts whether the relationship between dependent and independent variables reminds the inter-dependence expressed by the Environmental Kuznets Curve. What concerns possible explanations for the positive beta estimate there can be a few, the most likely one is that for the nitrogen oxides the turning point of the "EKC" is yet to come and thus the rise in GDP per capita causes the increase in the pollutant.

Figure 5.4 Relationship between NO_x /P and GDP/P
(OECD countries)



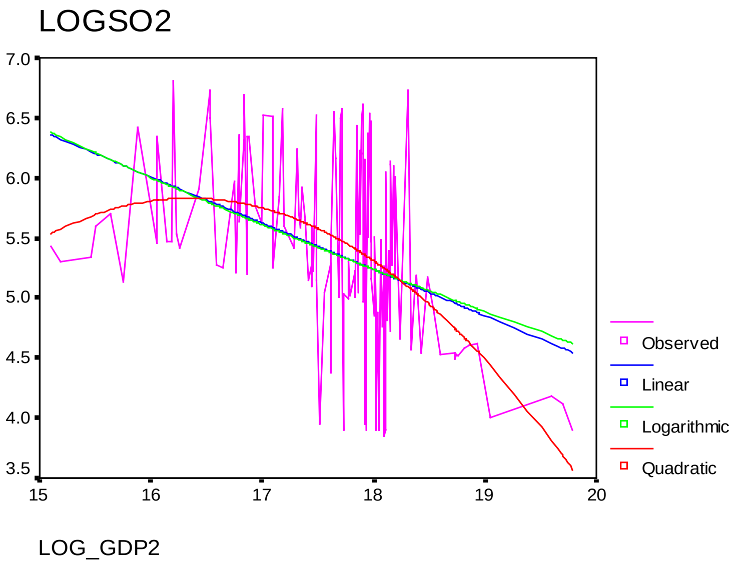
Source: own estimations

Correlating sulphur dioxide emissions per capita and GPD per capita in the OECD countries we get following result given by OLS estimation (figures in parentheses are standard errors):

$$\mathbf{Y = 12.188 - 0.434*X, \qquad R^2 = 0.188 \qquad (4)}$$
$$\mathbf{(1.222) \quad (0.069)}$$

The β coefficient for the GDP per capita equals –0.434. This means there is reciprocal proportion between GDP/P and SO_2 emissions. In other words, the higher is the GDP per capita level the lower is the pollution of SO_2. This seems to support our hypothesis. However, the adjusted R-square is again very small as in the case of NO_x emissions.

Figure 5.5 Relationship between SO_2/P and GDP/P
(OECD countries)



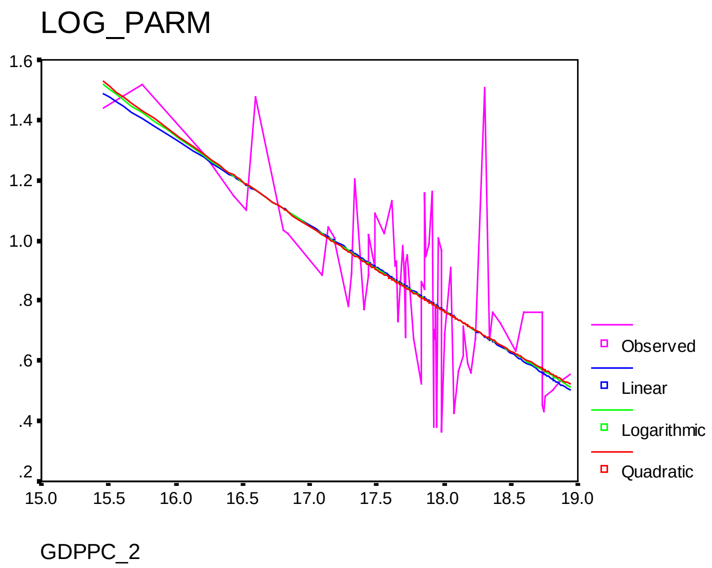
Source: own estimations

It is peculiar that in the case of SO_2 and GDP correlation (both computed as per capita) the β-estimator for GDP per capita is negative, which gives a perfect sense in the logic of testing the EKC relationship (indeed: the more is GDP per cap, the less is pollution per cap). This case might be supported by hints in the research literature (see Dasgupta et al. 2002: 149). The reason is that people commonly care more about the local pollution than about the global environmental damages. In the case of the SO_2 emissions, which is a local pollutant, there is bigger incentive to internalise the externality than in the case of, for example, CO_2 emissions, whose impact on the environment is rather global.

Finally, for the sake of complicity, let us make the final estimation with testing the interdependence of airborne emission series represented by suspended particles (per mat) and the GDP per capita level in every country. The data we are using are again the OECD 13 for the period of 1985-2000 years. We get (figures in parentheses are standard errors):

$$\mathbf{Y = 5.862 - 0.707{*}X, \qquad R^2 = 0.493 \qquad (5)}$$
$$\mathbf{(0.606) \quad (0.034)}$$

Figure 5.6 Relationship between suspended particles per capita and GPD/P (OECD countries)



Source: own estimations

It seems that in the case of per mat airborne emissions the relationship reminds the EKC. The beta coefficient for the explanatory variable is negative, which means that the higher the level of GDP per capita, the lower the emissions per capita, and the adjusted R-square is high enough.

To sum it up, for this sample of 13 OECD countries, it seems that among all the pollutants the most significant relationship occurs in the case of SO_2 and and par mat. The relationship resembles the shape and the prerequisites of the EKC, the "turning point" seems also clearly defined and the beta is negative, leading us to the "perfect case of EKC relationship".

5.4. EKC cross-country analysis: the case of EU

5.4.1. The data and the hypothesis

Now let us draw our attention to testing the Kuznets curve hypothesis for the case of 15 EU members. As it has been show in the previous chapter, the environmental regulations have a long-established tradition in the EU legislative and it is likely that the EKC relationship will hold true in this case. Therefore, the hypothesis in this case will be that there is a negative relationship between the decreasing value of pollutants per capita and the increasing value of GDP per capita.

For now, let us adapt a slightly different approach, as the one Bimonte (2002) used in his paper for correlating the relationship between the protected area and GDP per capita. For our analysis, we will use cross-country data for EU-15 for one single year: due to the availability of data, in the case of the SO_2 emissions are taken for the year 1997 and what concerns the CO_2 emissions the observations are from the year 2001. The data are taken from Global Environment Outlook Data Portal[56] and represent the values of GDP per capita expressed in thousands of USD and emissions expressed in metric of tons of pollutant per capita.

5.4.2. The model

Using the data and the approach described above, let us start with the relationship between CO_2 pollutant per capita and GDP per capita. The regression model can be formally expressed in the same way as in the previous sub-section 5.3.2. (i.e. equation 1):

$$log\ (E/P) = \alpha + \beta * log(GDP/P)^2 + u; \qquad (1)$$

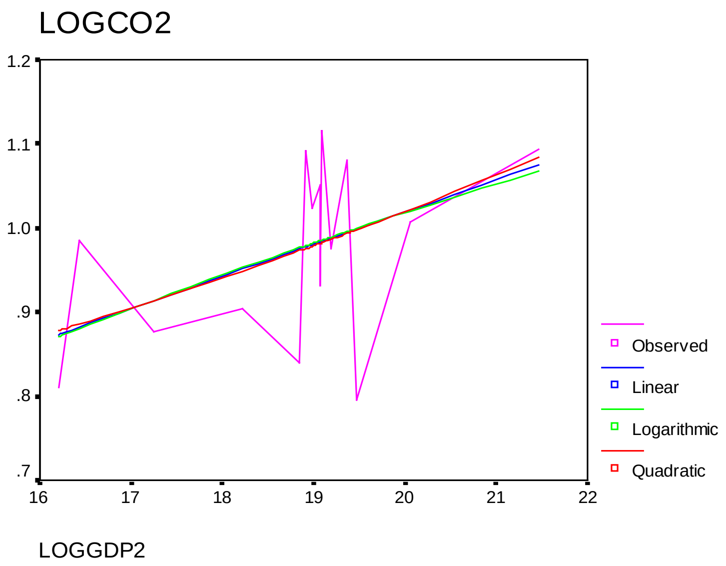
Where, E is again emissions (in this case CO_2 emissions), P is population and log indicates the logarithmic function. As in the regression for the OECD countries, we will use the logarithm and we will put the logarithm of the independent variable (here the log of GDP per capita) into the powers of 2. The reasons are explained in the previous part (see sub-section 5.3.2.).

[56] http://geodata.grid.unep.ch

Here are the results of estimating the equation by OLS (figures in parentheses are standard errors):

$$Y = 0.252 + 0.475*X, \qquad R^2 = 0.166 \qquad (6)$$
$$(0.371\ )\ \ (0.020)$$

Figure 5.7 Relationship between CO_2/P and GDP/P
(EU-15, using cross-country data)



Source: own estimations

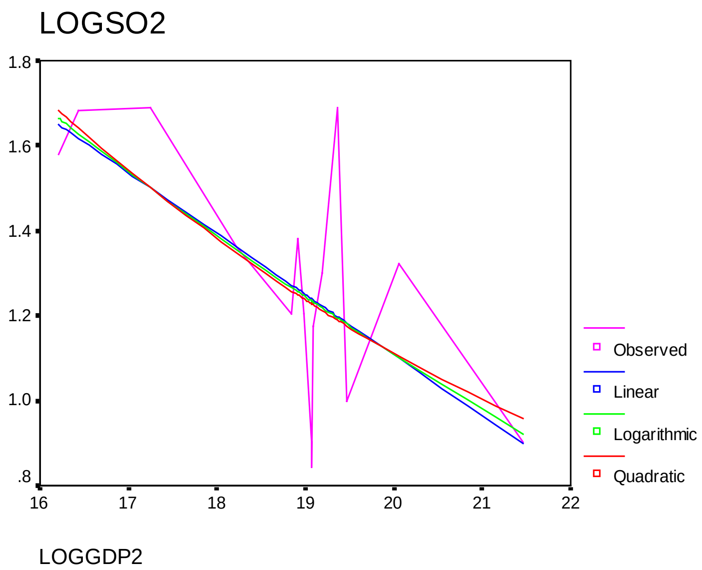
As in the case of 13 OECD countries, the correlation seems odd. In fact, the beta estimator for the GDP per capita is again positive. It generally contradicts the EKC hypothesis and the hypothesis we are testing. Holding true, the relationship would mean that the more of GDP per capita the citizens of EU-15 do have, the more they pollute. This is a serious problem about relying on this prediction supported by the fact that adjusted R-square is very low for this regression. Thus, it seems that just the correlation run between the local emissions and the GDP per capita level show the trend drawn by the EKC.

For verification, let us take the correlation between sulphur dioxide per capita and GDP per capita. We test the same relationship described by the equation (1), substituting CO_2 for SO_2. We get (figures in parentheses are standard errors):

$$Y = 3.966 - 0.657*X, \qquad R^2 = 0.388 \qquad (7)$$
$$(0.856)\ \ (0.046)$$

There is again the reciprocal proportion between GDP/P and SO_2 emissions (beta coefficient is negative) as in the case of the OECD countries (equation 4). For the EU cross-country data sample the absolute value of the beta coefficient is even higher than in the previous case. This means that the increasing GDP per capita has bigger impact on the environmental quality. We also have higher adjusted R-square. It seems that for the EU-15 cross-country data sample our hypothesis holds.

Figure 5.8 Relationship between SO_2/P and GDP/P
(EU-15, using cross-country data)



Source: own estimations

It appears that with negative beta and the trend clearly showing the EKC, the correlation perfectly suits.

5.5. Testing the EKC for the Czech Republic

5.5.1. The data and the hypothesis

Now let us estimate the EKC relationship for the case of the Czech Republic. For our regression we will use the observations on the Czech Republic taken for the period from 1990 to 2001 (i.e. 12 annual observations). The data are taken from the Czech Statistical Office[57] and Global Environment Outlook Data Portal[58]. Again the GDP per capita expressed in constant 1995 US$ per person is the independent variable and the pollutant per capita is the dependent variable. In this section we calculate the EKC only for two pollutants: sulphur dioxide (SO_2) and carbon dioxide (CO_2). It is because the sulphur dioxide seemed to fit the EKC model well in the previous regressions whether the CO_2 emissions did not. Both of them are expressed as emissions per capita in metric tons of CO_2 or SO_2 per person.

The Czech Republic is also at the advanced stage of economic development process as well as the sample of OECD countries used for our estimations in the sub-section 5.3. Moreover, the environmental protection policy has been largely influenced by the EU environmental policy regulations. Thus, we again assume a negative relationship between the decreasing value of pollutants per capita and the increasing value of GDP per capita.

5.5.2. The model

Let us test the two basic relationships expressed in equation of model set up in sub-section 5.3.2. We will take a close look at the correlation between the CO_2 per capita, SO_2 per capita on the right-hand side and GDP per capita on the left-hand side.

First, we will estimate the EKC for sulphur dioxide emissions in the Czech Republic. We get the following outcome:

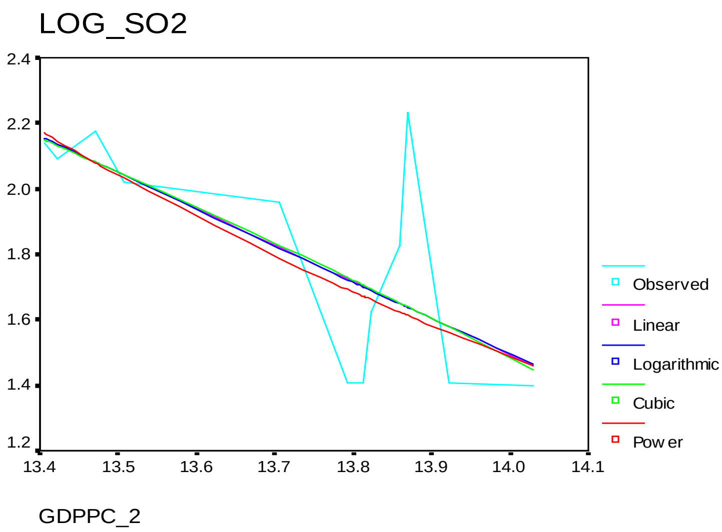
Model Summary			
R	R-square	Adjusted R-square	Std. Error of the Estimate
.699	.489	.438	.25374
Explanatory variables: (Constant), GDPPC_2 Dependent variable: SO2_PC			

57 www.czso.cz
58 http://geodata.grid.unep.ch

Coefficients				
	Std. Error	Standardized coefficient BETA	t-value	Sig.
(Constant)	4.941		3.457	.006
GDPPC_2	.360	-.699	-3.092	.011
Dependent Variable: LOG_SO2				

The beta coefficient for the explanatory variable is positive and the value of adjusted R-square is high enough. As we have seen from the previous cases (13 OECD countries or 15 EU Member States), the Kuznets curve relationship holds true for the SO_2 – GDP relationship. This has been proved also in the case of the Czech Republic. However, in the Figure 5.9 we can see a sudden jump in the level of SO_2 emissions per capita. This strange pattern can be caused by many factors and/or change in parameters. One of possible explanations is that at the beginning of the 1990s a great part of the output was created in the heavy industry, which hardly pollutes the environment. Moreover, at that time, the advanced environmental policy in the Czech Republic was only starting to develop which went hand in hand with the restructuralization and transformation of the heavy industry.

Figure 5.9 Relationship between SO_2/P and GDP/P
(Czech Republic)



Source: own estimations

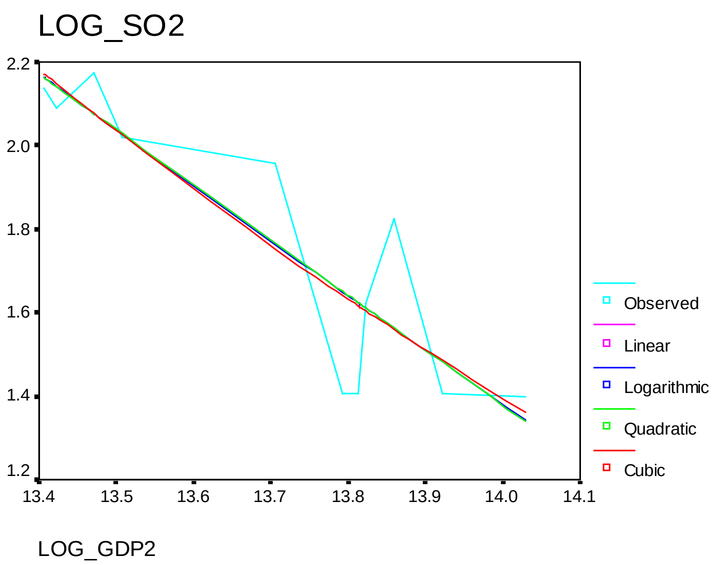
For the next step, let us omit the data from 1990 for the Czech Republic (derived from the data for the Czechoslovak federation) and run the regression again:

Model Summary			
R	R-square	Adjusted R-square	Std. Error of the Estimate
.881	.777	.752	.16208
Explanatory variables: (Constant), LOG_GDP2 Dependent variable: LOG_SO2 (ADJUSTED)			

Coefficients				
	Std. Error	Standardised coefficient BETA	t-value	Sig.
(Constant)	3.235		6.146	.000
LOG_GDP2	.236	-.881	-5.600	.000
Dependent Variable: LOG_SO2 (ADJUSTED)				

As we can see in the Tables, we got better results. The beta coefficient is still negative and its absolute value is greater than in the previous case. The significance level has improved and the adjusted R-square is greater. In the Figure 5.10, there is the estimated EKC for this case. Still there is a sudden jump in the SO_2 emissions but it is half as big as in the previous case.

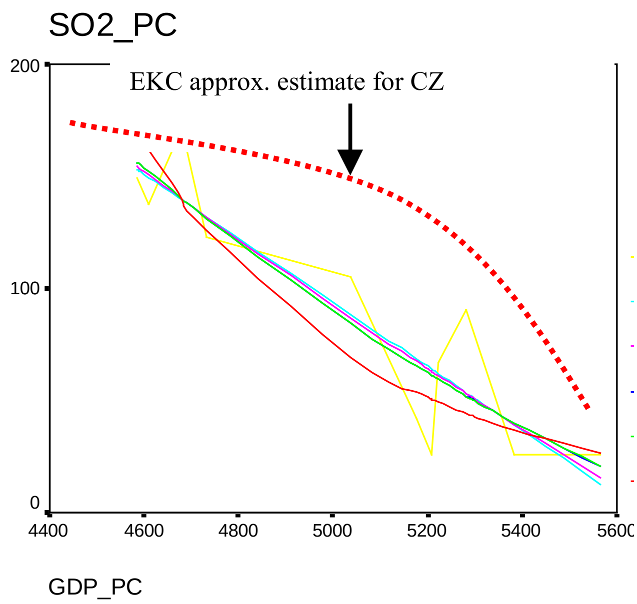
Figure 5.10 Relationship between adjusted SO_2/P and adjusted GDP/P (Czech Republic)



Source: own estimations

Let us try to estimate the “turning point” for the Czech Republic: as we see in Figure 5.10, the trend of sulphur dioxide pollution is decreasing with GDP per capita.

Figure 5.11 EKC approximation for the Czech Republic



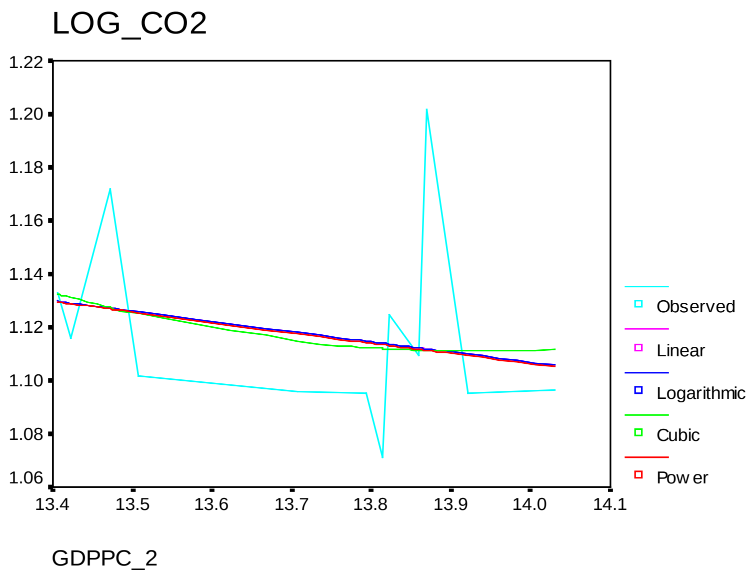
Source: own estimations

Just to see in the case for CO_2 pollution and GDP per capita (the case of the Czech Republic) we will now run the regression for those two:

Model Summary			
R	R-square	Adjusted R-square	Std. Error of the Estimate
.223	.050	-.045	.03734
Explanatory variables: (Constant), GDPPC_2 Dependent variable: CO2_PC			

Coefficients				
	Std. Error	Standardised coefficient BETA	t-value	Sig.
(Constant)	.727		2.261	.047
GDPPC_2	.053	-.223	-.724	.486
Dependent Variable: LOG_CO2				

Figure 5.12 Relationship between CO_2/P and GDP/P (Czech Republic)



Source: own estimations

We got the negative beta coefficient that should suggest the negative relationship between the carbon dioxide emissions and the level of GDP per capita. But the value of adjusted R-square is negative and thus there is no correlation between these two variables.

5.6. EKC model for the Czech Republic

5.6.1. The data for testing the EKC for the Czech Republic

In the previous sections, while estimating whether the Kuznets curve can be tested, we came across the fact that the most significant relationship was observed in the case of SO_2 pollutant (sulphur dioxide). In this sub-section we will attempt to extend our model and apply it on the case of the Czech Republic. The data we will use are the time-series for the Czech Republic covering the period of 1990-2001 (12 annual observations)[59] and they were taken from the Czech Statistical Office[60] and Global Environment Outlook Data Portal[61].

5.6.2. Discussion of the model and the hypothesis: methodological concerns

The analytical approach used in the model presented below was touched in the beginning of this chapter. Basically, we are building a two-stage model: first, we are using the results of testing the EKC from the previous sections of the chapter; second, we are trying to pick up the most significant variables that are to be of a considerable influence on the pollutant factor. From the previous sections, we have came to the conclusion that the "perfect" case for which the EKC always proves to exist is the test of SO_2 emissions on the left-hand side and the GDP per capita on the right-hand side.

We will use the following model:

$$\log SO_2 = \beta_1 \log UNEMP + \beta_2 \log GDP + \beta_3 \log INVEST + \beta_4 \log POPDENST + \beta_5 \log AGRAREA + \beta_6 \log INTERNET + \beta_7 \log FOREST;$$

[59] See Annex – Table A.2 for the precise numbers
[60] www.czso.cz
[61] http://geodata.grid.unep.ch

Where SO_2 is the dependent variable, the sulphur dioxide emissions per capita in the Czech Republic expressed in metric tones of pollutant per capita. The explanatory variables used in the model are the following:

- UNEMPL - indicates the level of total unemployment in the Czech Republic between the years of 1990 and 2001 expressed as a percent of total labour force[62]. It is expressed in percentage points;
- GDP stands for the level of gross domestic product per capita of the Czech Republic between 1990 and 2001 expressed in constant 1995 US$ per person (the 1995 value is taken as a constant);
- INVEST indicates expenditure on environmental protection investment and is expressed in millions of CZK in current prices. The variable is actually a representation of the total value of fixed assets acquired for environmental protection;
- POPDNST is the variable for population density in the Czech Republic between 1990 and 2001 measured in number of people per square kilometre;
- AGRAREA is the amount of agricultural area in the Czech Republic between 1990 and 2001 measured in thousands hectares used in agriculture or for the sub-agricultural use;
- INTERNET indicates number of internet users in the Czech Republic in the period from 1990 to 2001 expressed in number of people having the internet connection at home or having permanent possibility to use internet facilities;
- FOREST is the total land area covered by the tree species in the Czech Republic and it is expressed in hectares between the 1990 and 2001;

[62] The data for the Czech Republic we have been using for the model are taken backwards from 1990 and are computed for the Czech Republic as a part of Czechoslovak federation, therefore are consistent with the data for the Czech Republic as an independent country starting from 1993, www.czso.cz

The variables can be divided into several clusters. We can depict the nature of the independent variables in the following table:

Table 5.1 Independent variables: the model for the factors leading to decrease of the environmental pollution in the Czech Republic

Variable	Classification	Impact (-/+ sign)
Unemployment	Economic	-
GDP per capita		-
Environmental investments	Environmental	-
Population density	Demographic	+
Internet users		-
Agricultural areas	Geographical	+
Forested areas		-

Source: own estimations

The signs of the independent variables are presented in the table 5.1 above. We assume that each of the variables has negative or positive impact on the dependent variable – the pollutant factor represented by the SO_2 per capita. Here is the list of the independent variables entering the model with the sign of each of them discussed in detail:

- Unemployment: the higher unemployment brings about the lower output (industrial output, communal waste, etc.) which in its turn leads to the decrease in environmental pollution. We assume that the sign is negative;
- GDP per capita: the wealthier is the population (measured in GDP per inhabitant) the lower will be pollution. Thus again, the nature of impact is expected to be negative;
- Environmental investments: the more the government and the NGOs invest into the nature protection, the less it is polluted. Again in this case the sign is likely to be negative;
- Population density: higher population density brings social tensions and increases the pollution level. Thus, the higher is the population density, the higher will be the pollution;
- Internet users: we assume that the higher is the internet usage rate, the better is the access to the information for the average citizen. Thus the relationship will be negative;

- Agricultural areas: the higher is the percentage of the agricultural areas, the more pesticides and other chemicals are applied, the more harmful substances are realised into the atmosphere. The relationship we assume is positive;
- Forested areas: the higher is forestation, the less is pollution. The sign is likely to be negative.

The hypothesis standing behind the model is similar to what has been tested previously, however there are some extensions: primarily, we assume that there is a relationship (log-linear) between the dependent and the independent variables; secondly we will test the relationship picking up the most influencing variables to determine the dependent variable.

The validity of the model can be criticised: in fact, there are 7 independent variables represented by just 12 observations each. However, this is due to the problem with environmental data going back to Communist times which are impossible to find in case of the Czech Republic (due to obvious reasons). The model with 7 independent variables and 12 observations thus has 5 degrees of freedom. This problem will be eliminated by getting rid of variables with less significance and thus increasing the degrees of freedom. Therefore the validity of the model will increase.

There are more methodological concerns:

First, the model misses the intercept. Some reasons seem to justify this choice: at first, the log functional form fits the data better; the other reason is that the Czech Republic is not on the first stage of its development process, moreover some attempts to protect the environment have been done during the former regime.

Second, using the natural logarithm in the regression equation has its grounds:

a) the relationship between the dependent and the independent variables is likely to be non-linear. The double-log (or multiple-log, as in our case) specification is more appropriate in the analysis of a relationship that we assume has a non-linear nature;
b) the equation expressing the model will be estimated in log form to take care of the heteroskedasticity problem (when the errors u_i in the regression equation do not have a constant variance σ^2) (see Maddala 2001).

Running a multiple regression using SPSS for Windows software package we get the following outcome:

Model Summary				
R	R-square	Adjusted R-square	Std. Error of the Estimate	Durbin-Watson
.997	.995	.985	.04084	3.092
Explanatory variables: (Constant), LOG_FORE, LG_INVES, LG_AGRIC, LOG_GDP, LOG_UNEM, LG_INT, LG_POPDE Dependent variable: LOG_SO2				

Coefficients				
	Std. Error	Standardised coefficient BETA	t-value	Sig.
LOG_UNEMP	.217	-.363	-2.614	.059
LOG_GDP	1.734	-.388	-2.634	.058
LG_INVES	.293	-.904	-4.163	.014
LG_POPDE	71.100	1.090	5.020	.007
LG_AGRIC	23.266	.101	1.156	.312
LG_INT	.029	.178	.952	.395
LOG_FORE	81.760	.874	4.847	.008
Dependent Variable: LOG_SO2				

As we can see in the model summary Table, the adjusted R-square is very high (it almost equals to one). In the second Table we have estimated beta coefficients for the explanatory variables. We can see that the regression equation takes the form:

logSO2 = -0.363*UNEMPL -0.388 *GDP -0.904*INVEST + 1.090*POPDENST + 0.101*AGRAREA +0.178*INTERNET +0.874*FOREST;

As regards the impact of dependent variables on the SO_2 emissions, the beta coefficient is negative for the unemployment rate, GDP per capita and environmental investment. In other words, with increasing these three variables environmental quality will improve. In all three cases its value is lower than 1, so their impact on SO_2 emissions is less than proportional. We have assumed the negative sign also for the internet users and forest area variables. It seems that the number of internet users and the forest area do not have any significant positive impact on the environmental quality. One possible explanation can be that people who care about the environment do not use the internet to such extent. Another explanation can be that internet is relatively new technology which has found its wide application just in the beginning of the 1990s. And thus the results can be dubious. As regards the positive beta coefficient for the forest area explanatory variable the estimation is quite surprising. One of the possible explanations can be that the forestation and forests management has for a long time been in the hands of the state and the environmentally-friendly approach in managing the forests has started to emerge throughout the 1990s. However, there is still more to improve in that direction.

As we have assumed the beta coefficients for the population density and the agricultural area are positive. The impact of the agricultural area in the Czech Republic is quite small compared to the population density variable, where the beta coefficient is higher than one, which means that there is more than a proportional impact on the sulphur dioxide emissions.

In the next step, let us pick up the most significant independent variables, those influencing the SO_2 per capita in the Czech Republic at the most. The choice of technique is simple enough: we will drop the variables with the highest P-value (i.e. those when the result can be called “insignificant”)[63] and proceed with the multiple regressions until we reach the highest level of significance for some remaining variables (the P-value of which will be less than 0.01). Here is the output of the regressions run.

At the first stage, let us get rid of the INTERNET (number of internet users) variable.

Coefficients				
	Std. Error	Standardised coefficient BETA	t-value	Sig.
LOG_UNEMP	.200	-.411	-3.207	.024
LOG_GDP	1.064	-.498	-5.514	.003
LG_INVES	.175	-.739	-5.696	.002
LG_POPDE	57.409	.970	5.534	.003
LG_AGRIC	14.119	.035	.665	.536
LOG_FORE	77.495	.924	5.405	.003
Dependent Variable: LOG_SO2				

[63] The term “highly significant” is used to denote “significant at the 0.01 level” See for example a famous statistician Sir R.A. Fisher.

Now, let us omit the variable standing for the agricultural areas per inhabitant: AGRAREA. We get the following output:

Coefficients				
	Std. Error	Standardised coefficient BETA	t-value	Sig.
LOG_UNEMP	.186	-.391	-3.295	.017
LOG_GDP	.999	-.508	-5.987	.001
LG_INVES	.164	-.755	-6.211	.001
LG_POPDE	54.567	.963	5.779	.001
LOG_FORE	72.322	.901	5.650	.001
Dependent Variable: LOG_SO2				

Now, we will run the regression without the unemployment variable. We get the following output:

Coefficients				
	Std. Error	Standardised coefficient BETA	t-value	Sig.
LOG_GDP	1.093	-.309	-3.337	.012
LG_INVES	.173	-1.048	-8.155	.000
LG_POPDE	63.824	1.324	6.792	.000
LOG_FORE	111.692	.850	3.450	.011
Dependent Variable: LOG_SO2				

It seems that the GDP per capita variable should be left out. Let us see what happens if we run the regressions without it.

Coefficients				
	Std. Error	Standardised coefficient BETA	t-value	Sig.
LG_INVES	.241	-.881	-4.943	.001
LG_POPDE	90.784	1.111	4.005	.004
LOG_FORE	136.216	.368	1.224	.256
Dependent Variable: LOG_SO2				

The P-value of FOREST has increased. It might be because it was inter-correlated with the GDP level. It seems reasonable – the richer country invests more in forestation and vice versa poorer countries tend to exploit their forest resources. Now we will omit the FOREST variable:

Coefficients				
	Std. Error	Standardised coefficient BETA	t-value	Sig.
LG_INVES	.112	-.687	-8.255	.000
LG_POPDE	27.248	.786	9.444	.000
Dependent Variable: LOG_SO2				

Thus, these two variables: investment in the environmental protection and the density of population have the largest influence on the level of SO_2 per capita in the Czech Republic. The model takes form:

logSO2 = - 0.687*INVEST + 0.786*POPDENST;

The investment in environmental protection increases the environmental quality while the population density has a negative impact on the environment. The reasons explaining the positive beta coefficient in the case of environmental investment are obvious. Regardless the efficiency of such investment they improve more or less the environmental quality. On the other hand, the higher population density implies more inhabitants in certain area who create more waste and emissions. Another explanation can be that industrial centres have always been the places where large amount of people has been concentrated on one place. Plants and factories giving jobs to the many have attracted people from the rural areas thus creating agglomerations and population centres.

Because of the coefficient of determination of our model being close to one, we can conclude that these two are good explanatory variables for sulphur dioxide emissions.

Model Summary				
R	R-square	Adjusted R-square	Std. Error of the Estimate	Durbin-Watson
.969	.939	.925	.09248	1.069
Explanatory variables: (Constant), LG_INVES, LG_POPDE Dependent variable: LOG_SO2				

Thus, the model we have built up for the Czech Republic clearly shows that environmental and demographic factors, represented by environmental investments and population density are of a great importance for fighting with significant pollution factors.

5.7. Testing the EKC hypothesis: some conclusions

Environmental Kuznets curve hypothesis seems to have its grounds in the cases tested above. In our model we tested for what factors the EKC hypothesis holds true and consequently built up a model to test which factors influence the pollutant emissions for the EU Member State represented by the Czech Republic.

It seems that some form of a relationship or inter-dependence that reminds the EKC truly exists for our test and the curve is valid for certain observations of pollutant. As it has been shown in the previous sub-sections, our hypothesis holds true in the case of sulphur dioxide emissions and suspended particles. For sulphur dioxide the inter-dependence seems to exist for the OECD countries, EU-15 and the Czech Republic. As regards the first regression model using OECD panel data, our assumption stated in the sub-section 5.3.1. seems to hold also for suspended particles. For carbon dioxide our hypothesis is rejected in all cases (i.e. using panel data for OECD countries and the Czech Republic and the cross-country data for fifteen EU members in 1997). In other words, our estimations show that the higher the level of GDP per capita the higher are CO_2 emissions. The most possible reason for this is that the CO_2 is harming the environment at the global level, so there is not so high pressure to internalise the externalities like it is in the case of sulphur dioxide emissions. This fact is also consistent with Perman and Stern's (2003) conclusion that the EKC relationship does not exist and the indicators of environmental degradation are more likely monotonically rising in income.

As regards the model for testing the influence of several factors on pollution in the Czech Republic we picked up the sulphur dioxide as the indicator of environmental quality. It is because sulphur dioxide emissions perfectly fit to the environmental Kuznets curve estimations we have made for the OECD countries as well as for the EU-15 and the Czech Republic. In our regression we found out that there are two explanatory variables with the most significant impact: population density and the amount of investment in environmental protection.

6 Conclusions

The road to the realisation that the fate of the environment we all live in is actually in our hands was a long and hard one. Since the 1970s some righteous initiatives undertaken by brave visionaries such as Gro Harlem Brundlandt or Ingvar Carlsson have started to be taken into consideration as the alternative way of global industrial development as known before. Peoples world-wide began to realise that the greatest impact on the environment is being initiated by their own activities and that if something is to be changed and the world we live in has to be preserved for the generations to come, it is them to undertake such an activity.

Among many other tools to preserve the environment and protect the nature the economic ones, represented by environmental taxes and tariffs, have proved to be the most effective ones. However, their implementation is hard to accomplish without the broad support of the world's governments and international organisations.

No surprise that large world hegemonies and economic and political unions have also followed this pattern. The European Union with its solid environmental legislation belongs to one of the most respected global leaders in the world. With its deepening and enlargement the EU, recently embracing ten new Member States, including the Czech Republic, is coming through the implementation and stabilisation of its environmental standards: there is a great diversity in the EU when it comes to the environmental principles, however the pattern and the focus on the sustainable development and environmental protection remains the common guideline principle.

In our diploma thesis we have followed the development of the environmental principles and sustainable development from their very beginning to nowadays. The particular focus has been made on the environmental economics and the economic tools used for the sustainable development. We have seen that most of these tools and instruments find their implementation in the developed western economies. More than that there is an attempt to use these instruments in the case of economies in transformation, often those weighted by the grim heritage of neglecting and systematic destruction of the environment officially used by the Communist governments of the Central and Eastern European Countries (CEEC).

The greatest value-added of the diploma thesis is represented by the econometric model analysing the environmental issues using the econometric models. We focus on the case of CEEC, especially those successful ones enjoying the EU membership, represented in this thesis by the Czech Republic.

The critics might come up with the idea that in the case of the EU "newcomer" analysed in our diploma thesis on the example of the Czech Republic approach similar to the developed western economies cannot be used. After all the Czech Republic has just undergone the transformation lasting for fifteen years with all the environmental standards to be implemented in a very short period of time, the developed economies of the West had twice as much time for that. Our analysis and the econometric model estimating the hypothesis of the Environmental Kuznets Curve (EKC) seems to state quite the opposite. Analysing the EKC for the Czech Republic we prove our hypothesis of the negative correlation between the emissions per capita and the GDP per capita, the results being the same for the sample of the OECD countries representing the western developed economies and the fifteen EU Member States prior to the 1st of May 2004 enlargement.

The Czech Republic being the EU member truly belongs to Europe. No just historically, culturally or in any other way, but also because due to its recent success and persistence in implementing the environmental standards and legislation. A lot has been done in recent decade, however there is still more to be done. It clearly comes from our analysis that there are areas in which more effort has to be made, urban and rural planning is an example. The density of population, being one of the factors leading to increasing emissions in the Czech Republic in the past decade, has to be taken care of by planners. Moreover, the model we have set up in our diploma thesis, shows that more effort has to be made by the government on the national and local level to increase the investments in the environmental protection and education. It appears that the recent efforts made in this direction yield a positive effect on the environment.

Therefore, it can be stated that when it comes to environmental standards and environmental protection the pattern the Czech Republic as the EU recent member is comparable with the rest of the EU. This leads us to the conclusion that there is an institutional space in the Czech Republic to be filled with the environmental regulations including the advanced economic instruments of environmental regulation.

With all that taken into account we come up to the conclusion that there is a lot that can be done to protect the environment and guide the economic and political actors in that way. There is a need of decisive steps to be taken at all levels and if taken properly all of them will be of a great favour for the environmental protection and management. Every state is capable of following the standards to be set and the more effort is being done, the more successful the implementation can be, as shows the example of the Czech Republic.

Environmental protection is in the interest of us all, so should we act to fulfil the ideas of sustainable development and global nature protection.

Annexes

Table A.1 Environmental rule-making competence (1967-1997)

	Pre-SEA[a] (1967-87)	**SEA[a]-Maastricht (1987-93)**	**Maastricht-Amsterdam (1993-97)**	**Amsterdam**
Legal basis	None: policy usually made under Articles 100, 235 Occasional use of Article 213 and Article 30 (Euratom)	Articles 130s and 100a Occasional use also of Article 42-43 for CAP[b] related measures, and Article 118a	No major change; some use of Article 130d Use of Articles 84(2), 228(3), 75, 113, 32, (Euratom)	No major change, although Article 100a(3) has been modified to extend the obligation to pursue a high standard of protection to the EP and ESC
Council voting	Unanimity	Article 100a: QMV[c]; Article 130s: general principle of unanimity reaffirmed with possibility of QMV allowed for subject to unanimous Council approval	QMV extended to Article 130s in general, but subject to broad and crucial exemptions (fiscal provisions, town and country planning, land use, management of water resources, energy related matters)	No extension of QMV; unanimity exemptions still apply
European Parliament powers	Consultation procedure, conciliation procedure (for acts with financial implications)	Council need only consult Parliament, and this was the case even where the Council decided to reach a decision on a proposal based on Article 130s by QMV. However, the co-operation procedure applied to any majority decisions taken under Article 100a.	Co-operation procedure to be employed whenever QMV under Article 130s is used in principle; new co-decision principle to be used in relation to general action program	Co-operation procedure generally abolished (except for EMU) and co-decision replaces this where it is currently used in Article 130s

[a] Single European Act
[b] Common Agricultural Policy
[c] Qualified majority voting

Source: Weale et. al (2000)

Table A.2 Data set: the Czech Republic (1990-2001)

Year	**Internet users** (number of people)	**Forest area** (hectares)	**Agricultural area** (thousands of hectares)	**Population density** (people per square kilometre)	**Environmental investments** (millions of CZK)	**Unemployment** (percentage of unemployed to the number of population in working age)	**GDP per capita** (constant 1995 US$ per person)	**SO_2 per capita** (metric tons of CO_2 per capita)	**CO_2 per capita** (metric tons of CO_2 per capita)
1990	0	2542218	4280	133,36	6048	1,5	5298	171,3403	15,91214
1991	0	2542328	4320	133,4	9376	4,0	4681	149,2094	14,852
1992	20000	2542133	4300	133,5	16354	3,2	4587	137,4976	13,589
1993	60000	2542658	4282	133,6	19890	4,3	4610	122,9407	13,059
1994	130000	2544248	4276	133,7	28720	4,3	4733	104,8375	12,644
1995	150000	2545572	4281	133,7	32252	4,0	5037	90,77534	12,469
1996	200000	2547157	4280	133,6	37036	3,9	5283	66,98013	12,861
1997	300000	2546882	4280	133,5	40953	4,8	5222	41,92547	13,319
1998	400000	2547792	4284	133,3	35160	6,5	5175	25,42011	12,455
1999	700000	2549619	4282	133,1	28956	8,7	5207	25,44977	11,776
2000	2300000	2551873	4279	132,9	20350	8,8	5384	25,5	12,455
2001	2600000	2556224	4278	132,7	21600	8,1	5566	25,0	12,479

Source: Czech Statistical Office (1990-2002), Swiss Global Environment Outlook Portal (2004).

Box B.1 The “precautionary principle” in selected international treaties and agreements

Montreal Protocol on Substances that Deplete the Ozone Layer, 1987 ‘Parties to this protocol... determined to protect the ozone layer by taking precautionary measures to control equitably total global emissions of substances that deplete it...’
Third North Sea Conference, 1990 ‘The participants... will continue to apply the precautionary principle, that is to take action to avoid potentially damaging impacts of substances that are persistent, toxic, and liable to bioaccumulate even where there is no scientific evidence to prove a causal link between emissions and effects.’
The Rio Declaration on Environment and Development, 1992 ‘In order to protect the environment the Precautionary Approach shall be widely applied by states according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.’
Framework Convention on Climate Change, 1992 ‘The Parties should take precautionary measures to anticipate, prevent or minimise the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost.’
Treaty on European Union (Maastricht Treaty), 1992 ‘Community policy on the environment... shall be based on the precautionary principle and on the principles that preventive actions should be taken, that the environmental damage should as a priority be rectified at source and that the polluter should pay.’
Cartagena Protocol on Biosafety, 2000 ‘In accordance with the precautionary approach the objective of this Protocol is to contribute to ensuring an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health, and specifically focusing on transboundary movements.’
Stockholm Convention on Persistent Organic Pollutants (POPs) 2001 Precaution, including transparency and public participation, is operationalised throughout the treaty, with explicit references in the preamble, objective, provisions for adding POPs and determination of best available technologies. The objective states: ‘Mindful of the Precautionary Approach as set forth in Principle 15 of the Rio Declaration on Environment and Development, the objective of this Convention is to protect human health and the environment from persistent organic pollutants.’

Source: European Environmental Agency, (www.eea.eu.int)

References

Monographs:

- Artis, M.J., Lee, N., (eds.), (1995): *The economics of the European Union: Policy and analysis*, Oxford University Press.

- Beers, C.v., Moor, A., (2001): *Public Subsidies and Policy Failure*s, Edward Elgar

- Bergesen, H.O., Parmann, G., (1997): *Green globe year-book 1997 of international cooperation on environment and development***,** Oxford.

- Bergh, J.C.J.M.v.d., Straaten, J.v.d., (1997): *Economy and Ecosystems in Change: Analytical and Historical Approaches,* Edward Elgar.

- Brack, D., Grubb, M., Windram, C., (2000): *International trade and climate change policies,* London.

- Ciriacy-Wantrup, S.V., (1952): *Resource Conservation: Economics and Policie*s. University of California Press, Berkeley.

- Cleveland, C.J., Stern, D.I., Costanza, R., (2001): *The Economics of nature and the Nature of Economics,* Edward Elgar.

- Costanza, R., et al., (2001): *An Introduction to Ecological Economics,* International Society for Ecological Economics.

- Dornbusch, R., Poterba, J.M., (1991): *Global warming: economic policy responses,* Cambridge.

- Faber, M., Proops, J., (1996): *Ecological Economics: Concepts and Methods,* Edward Elgar.

- Georgescu-Roegen, N., (1971): *The Entropy Law and the Economic Process*, Harvard University Press, Cambridge, Massachusetts.

- Goodstein, E.S., (1995): *Economics and the Environment,* Prentice-Hall.

- Gore, A., (1994): *Země na misce vah: ekologie a lidský duch,* Argo.

- Hanley, N., Shogren, J.F., White, B., (1997): *Environmental Economics in Theory and Practice*, MacMillan Press Ltd, Houndmill-London.

- Hardi, P., (1994): *Environmental Protection in East-Central Europe: A market-oriented approach,* Bertelsmann Foundation Publishers, Gütersloh.

- Heinelt, H., et al., (2001): *European Union environmental policy and the new forms of governance,* Ashgate Publishing Limited, England.

- Jakš, J., (1998): *Quo Vadis Evropská Unie*, ETC Pulishing s.r.o..

- Jarvis, P.J., (2000): *Ecological Principles and Environmental Issues,* Prentice-Hall.

- Kapp, K.W., (1950): *The Social Costs of Private Enterprise,* New York.

- Klaassen, G., (1996): *Acid rain and environmental degradation: The economics of emission tradin*g. Brookfield, VT: Edward Elgar.

- Kneese, A. V., Ayres, R.U., d'Arge, R.C., (1972): *Economics and the Environment: A Materials Balance Approac*h, Washington, D C: Resources for the Future.

- Kolstad, C.D., (2000): *Environmental Economics*, Oxford University Press, New York.

- Liefferink, D., Andersen, M.S. (eds.), (1997): *The innovations of EU Environmental Policy,* Scandinavian University Press, Copenhagen.

- Maddala, G.S., (2001): *Introduction to econometrics,* Third edition, John Wiley & Sons Ltd.

- Markandya, A., et al., (2001): *Dictionary of Environmental Economics,* Earthscan Publications Ltd, London.

- Markandya, A., et al., (2000): *Political Economy of the Environment,* Edward Elgar.

- Meadows, D.H., et al., (1970): *The Limits to Growth*, Earth Island, London.

- Meadows, D.L., Meadows, D.H., Randers, J., (1992): *Beyond the Limits: Global Collapse or a Sustainable Future*, Earthscan, London.

- Mill, J.S., (1857): *Principles of Political Economy*, Parker,London.

- Moldan, B., Hák, T., (2000): *Czech Republic 2000: ten years on: environment and quality of life after ten years of transition,* Charles University, Praha.

- Paley, W.S., (1952): *Resources for Freedom: Report of the President's Materials Policy Commission*, Washington, DC.

- Panayotou, T., (1993a): *Green Markets: The Economics of Sustainable Development*, Institute for Contemporary Studies Press.

- Pearce, D.W., Turner, R.K., (1990): *Economics of natural resources and the environment*, The Johns Hopkins University Press, Baltimore.

- Perman,R., McGilvary, J., Common, M., (1999): *Natural Resource and Environmental Economics*, 2nd edition, Longman.

- Pigou, A.C., (1932): *The Economics of Welfare,* 4th edition, Macmillan and Co., London.

- Pinder, D., (1998): *The new Europe: economy, society and environment,* Chichester.

- Rawls, J., (1972): *A Theory of Justice*, Harvard University Press, Cambridge, Mass.

- Siebert, H., (1992): *Economics of the Environment: theory and policy,* Berlin.

- Šauer, P., (2002): *Environmental economics, policy and international relations: focus on Visegrad group countries,* Praha.

- Turner, R.K., Pearce, D., Bateman, I., (1994): *Environmental economics: An elementary introduction,* Harvester Wheatsheaf, London.

- Týč, V., (1999): *Základy práva Evropských společenství pro ekonomy*, Linde Praha a.s.

- Weale, A., (2000): *Environmental Givernance in Europe,* Oxford University Press Inc., New York.

- Wills, I., (1997): *Economics and the Environment; A signalling and incentives approach*, Allen & Unwin, St. Leonards.

Working papers:

- Agnolucci, P., (2004): *Ex post evaluations of CO2–based taxes: a survey*, Tyndall Centre Working Paper 52.

- Antweiler, W., Copeland, B.R., Taylor, M.S., (1998): *Is free trade good for the environment?,* NBER working paper series (6707).

- Bergh, J.C.J.M.v.d., Hofkes, M.W., (1997): *A Survey of Economic Modelling of Sustainable Development,* Tinbergen Institute Discussion Paper.

- Bergh, J.C.J.M.v.d., (2000): *Ecological Economics: Themes, Approaches, and Cifferences with Environmental Economics,* Tinbergen Institute Discussion Paper.

- Cetkovský, P., Tošovská, E., Černá, A., (1994): *Economic transformation and the environment,* Praha.

- Dasgupta, P., (1996): *The economics of the environment,* The development economics research programme (73), London School of Economics.

- Eskeland, G.S., Devarajan, S., (1996): *Taxing Bads by Taxing Goods: Pollution Control with Presumptive Charges,* Directions in Development, The World Bank, Washington D.C.

- Eskeland, G.S., Kong, C., (1998): *Protecting the Environment and the Poor: a Public Goods Framework Applied to Indonesia*, Policy Research Working Paper No. 1961, The World Bank, Washington D.C.

- Fredriksson, P.G. (ed.), (1999): *Trade, Global Policy, and the Environment,* World Bank Discussion Paper No. 402

- Hertzman, C., (1995): *Environment and health in Central and Eastern Europe: a report for the Environmental Action Programme for Central and Eastern Europe,* World Bank discussion papers.

- Loschel, A., Mraz, M., (2001): *EU enlargement and environmental policy***,** Mannheim, DE : Centre for European Economic Research.

- Panayotou, T., (1993b): *Empirical Tests and Policy Analysis of Environmental Degradation at Different Stages of Economic Development*, Working Paper WP238, Technology and Employment Programme, International Labour Office, Geneva.

- Pezzey, J., (1992): *Sustainable Development Concepts: An Economic Analysis,* World Bank Environment Paper No.2.

- Stern, D.I., (2003): *The Environmental Kuznets Curve,* International Society for Ecological Economics.

- Stern, D.I., et al., (1998): *Is there an environmental Kuznets curve for sulfur?*, Working papers in Ecological Economics, 9804, Australian National University, Canberra.

Articles:

- Arrow et al. (1995): *Economic growth, carrying capacity, and the environment,* in: *Science* 268, pp.520-521.

- Barde, J-P, Smith, S., (1997): *Do economic instruments help the environment?,* in: *The OECD Observer*, no. 204, February/March: 22-26.

- Barde, J-P, (2000): *Environmental policy and policy instruments*, in: Folmer, H., Gabel, H. (eds.): *Principles of environmental and resource economics,*Edward Elgar, Cheltenham, pp. 157-201.

- Beckerman, W., (1992): *Economic growth and the environment.* Whose growth? Whose environment?, in: *World Development* 20, pp.481-496.

- Bergh, J.C.J.M. v.d., Mooij, R.A.d., (1996): *An assessment of the growth debate*, in: Bergh, J.C.J.M. v.d., (ed.): *Handbook of Environmental and Resource Economic,.* Edward Elgar, Cheltenham.

- Bergh, J.C.J.M. v.d., Ferrer-i-Carbonell, A., Munda, G., (2000): *Alternative models of individual behaviour and implications for environmental policy*, in: *Ecological Economics* 32(1): 43-61.

- Bimonte, S., (2002): *Information access, income distribution, and the Environmental Kuznets Curve*, in: *Ecological Economics* 41/2002, pp. 145-156.

- Blackman, A., Harrington, W., (2000): *The use of economic incentives in developing countries: Lessons from international experience with industrial air pollution*, in: *Journal of Environment & Development*, Vol. 9, No.1, pp.5-44.

- Blamey, R.K., Common, M.S., (1999): *Valuation and ethics in environmental economics,* in: Bergh, J.C.J.M.v.d. (ed.): *Handbook of Environmental and Resource Economics,* Edward Elgar, Cheltenham.

- Boehmer-Christiansen, (1994): The precautionary principle in Germany: Enabling government, in: O'Riordan, T., Cameron, J. (eds.) "Interpreting the precautionary pinciple", Cameron and May, London.

- Dasgupta, S., et al., (2002): *Confronting the Environmental Kuznets curve,* in: *Journal of Economic perspectives*, Volume 16, Number 1/Winter 2002, pp. 147-168.

- Ekins, P., (1999): *European environmental taxes and charges: recent experience, issues and trends*, in: *Ecological Economics* 31, pp. 39-62.

- Ekins, P., Speck, S., (2000): *Proposals of environmental fiscal reforms and the obstacles to their implementation*, in: *Journal of Environmental Policy and Planning* 2, pp. 93-14.

- Funtowicz, S., Ravetz J., (1994): The worth of a songbird: Ecological economics as a post-normal science, in: Ecological Economics, 10/1994.

- Goodland, R., (1995): *The Concept of Environmental Sustainability*, in: *Annual Review of Ecological Systems*, 26, pp. 1-24.

- Grossman, G., Krueger, A., (1993): *Environmental Impacts of the North American Free Trade Government*, in: Garber, P., (ed.): *The U.S.-Mexico Free Trade Agreement*, Cambridge, pp. 13-56.

- Grossman, G., Krueger, A., (1995): *Economic growth and the environment*, in: *Quarterly Journal of Economics* 110, pp. 353-378.

- Hahn, R., (2000): *The impact of economics on environmental policy*, in *Journal of Environmental Economics and Management* 39, pp. 375-399.

- Hotelling, H., (1931): *The Economics of exhaustible resources*, in: The journal of Political Economy, 39 (2), p. 137.

- Jupille, J., Caporaso, J.A., (1998): *States, Agency and Rules: The European Union in Global Environmental Politics*, in: Rhodes, C. (Ed.): *The European Union in the World Community*, Boulder, London , pp. 213 - 229.

- Kuznets, S., (1955): *Economic growth and income inequality*, in: *American Economic Review* 45, pp. 1-28.

- Miltz, D., Braden, J.B., Johnson, G.V., (1988): *Standards versus Prices Revisited: The Case of Agricultural Non-point Source Pollution*, in: *Journal of Agricultural Economics*; 39(3), September 1988, pp. 360-68.

- Mulder, P., Bergh, J.C.J.M.v.d., (2001): *Evolutionary economic theories of sustainable development***,** in: *Growth and Change*, 32 (winter) 2001, pp. 110-134.

- Munda, G., (1997): *Environmental economics, ecological economics, and the concept of sustainable development,* in: *Environmental Values* 6 (2) 1997, pp. 213-233.
- Perman, R., Stern, D.I., (2003): *Evidence from panel unit root and cointegration tests that the environmental Kuznets curve does not exist*, in: *Australian Journal of Agricultural and Resource Economics*, Vol. 47.
- Perrings, C., (1995): Sustainable livelihoods and environmentally sound technology: theoretical and conceptual approaches, in: Ahmed, I., Doeleman, J.A. (Eds.): *Beyond Rio. The Environment Crisis and Sustainable Livelihoods in the Third World*, MacMillan Press Ltd.
- Ready, R.C., (1995): *Environmental Valuation under Uncertainty*. in: D.W. Bromley (ed.): *Handbook of Environmental Economics*. Basil Blackwell Ltd, Oxford-Cambridge, pp. 568-593.
- Selden T.M., Song, D., (1994): *Environmental quality and development: is there a Kuznets curve for air pollution?,* in: *Journal of Environmental Economics and Environmental management*, p.147-162.
- Spash, C.L., (1999): *The Development of Environmental Thinking in Economics*, in: *Environmental Values* 8/1999, pp. 413-435.
- Stern, D.I., (1997): *Limits to substitution and irreversibility in production and consumption: a neoclassical interpretation of ecological economics*, in: *Ecological Economics* 22, pp. 197-215.
- Stern, D.I., (1998): *Progress on the Environmental Kuznets Curve*?, in: *Environment and Development Economics*. 3:2, pp.175-198.
- Tietenberg,T.H., (1990): *Economic Instruments for Environmental Regulation*,in: *Oxford Review of Economic Policy*, Vol. 6, No. 1, p. 24.
- Turner, R.K., Perrings, C., Folke, C., (1997): *Ecological economics: paradigm or perspective*, in: Bergh, J.C.J.M. v.d., Straaten, J.v.d. (ed.): *Economy and Ecosystems in Change: Analytical and Historical Approaches*. Edward Elgar, Cheltenham.

Treaties, Reports:

- European Commission, (1983): *The Polluter Pays Principle*, Luxembourg.
- European Commission, (1986): *Fourth Environmental Action Programme 1987-92,* Luxembourg.
- European Commission, (1990): *Environmental Policy in the European Community,* Luxembourg.
- European Commission, (1992): *Fifth Environmental Action Programme: Towards Sustainability*, Luxembourg.
- European Commission, (1996a): *The Single Market,* 2nd edition, Brussels, Luxembourg.
- European Commission, (1996b): *How Does The European Union Work?,* Brussels, Luxembourg.
- European Commission: *The General Budget of the European Union: For the Financial Years: 2000-2004,* Luxembourg.
- European Commission, (2000): *Communication from the Commission on the precautionary principle,* Brussels.
- European Commission (2000): *White Paper of 9 February 2000 on environmental liability,* Luxembourg.

- European Commission, (2001): *Sixth Environmental Action Programme: Environment 2010: Our future, our choice,* Luxembourg.

- European Environmental Agency, (1996): *Environmental Taxes: Implementation and Effectiveness,* Copenhagen.

- European Environmental Agency, (1999): *Environment in the European Union at the turn of the century*, Environmental assessment report No. 2.

- European Environment Agency, (2001): *Late lessons from early warnings: the precautionary principle 1896-2000***,** Environmental issue report No 22, Copenhagen.

- European Environment Agency, (2002): *Environmental Signals 2002: Benchmarking the Millennium*, Copenhagen.

- European Investment Bank, (2003): *Environmental Report.*

- IUCN, (1980): *World Conservation Strategy.*

- Muguruza, M.I., (1999): *Environmental - sustainability reviews of EU trade measures and agreements: final report prepared for the European Commission*, DG XI, Environment and Development Resource Centre, Brussels.

- OECD (1991): *Environmental Policy: How to Apply Economic Instruments*, Paris.

- OECD (1997a): *Sustainable Consumption and Production*, Paris.

- OECD (1997b): *Evaluating Economic Instruments forEnvironmental Policy.* Paris.

- OECD (2001): *Sustainable Development: Critical Issues*, Paris.

- Single European Act (1986)

- Swedish Ministry of Environment, (1994): *The Swedish Experience: Taxes and Charges in Environmental Policy*, Stockholm.

- Treaty establishing the European Community (1957)

- Treaty on European Union (1992)

- Treaty of Amsterdam (1997)

- Treaty of Nice (2001)

- UNEP (1993): *Economic Instruments for Environmental Protection,* Paris.

- United Nations (1993): *Agenda 21: Programme for Action for Sustainable Development and Rio Declaration,* New York.

- World Commission on Environment and Development, (1987): *Our Common future*, Oxford University Press.

Statistics, numerical data:

- Eurostat - http://www.eurostat.com
- OECD - http://www.oecd.org/
- World Bank – http://www.worldbank.org/
- Czech Statistical Office - http://www.czso.cz
- Global Environment Outlook Data Portal - http://geodata.grid.unep.ch
- The European Pollutant Emission Register - http://www.eper.cec.eu.int/

Internet sources:

- http://www.euroskop.cz/
- http://www.evropska-unie.cz/
- http://www.czp.cuni.cz/
- http://europa.eu.int/
- http://europa.eu.int/comm/
- http://www.europarl.eu.int/
- http://ue.eu.int/
- http://www.eea.eu.int/
- http://www.tinbergen.nl/
- http://www.jrc.cec.eu.int/
- http://www.panda.org/
- http://www.wwf.org
- http://www.nber.org/
- http://www.aere.org
- http://en.wikipedia.org