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Yüksek Lisans Tezi

NURULLAH GÜR

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İSTANBUL, 2008

Marmara Üniversitesi
Sosyal Bilimler Enstitüsü Müdürlüğü

Tez Onay Belgesi

İKTİSAT Anabilim Dalı İKTİSAT (İNG.) Bilim Dalı Yüksek Lisans öğrencisi NURULLAH GÜR nın THE EFFECTS OF ENVIRONMENTAL POLICIES ON ECONOMIC DEVELOPMENT adlı tez çalışması ,Enstitümüz Yönetim Kurulunun 19.06.2008 tarih ve 2008-10/25 sayılı kararıyla oluşturulan jüri tarafından oybirliği/oyçokluğu ile Yüksek Lisans Tezi olarak kabul edilmiştir.

	Öğretim Üyesi Adı Soyadı	İmzası
Tez Savunma Tarihi	: 30.06.2008	
1) Tez Danışmanı :	**PROF. DR. AYSU İNSEL**	A İnsel
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ABSTRACT

THE EFFECTS OF ENVIRONMENTAL POLICIES ON ECONOMIC DEVELOPMENT

In this study, we analyze the effects of environmental policies like tax, charges, subsidies, command and control approaches, tradable permits and voluntary approaches on economic development. Humankind worsens environmental degradations day by day. Thus, Environmental policies are prerequisite for better environmental quality. But, environmental policies directly and indirectly affect economic growth, employment, competitiveness & technology, income distribution and health. These are the most important pillars of economic development. Thus we examine some key studies that focus on the effects of environmental policies on economic growth, employment, competitiveness & technology, income distribution and health in order to analyze the effects on economic development.

This study shows that, just like all policies, environmental policies have some costs and benefits on countries' economic performance. It is not possible to give one true recipe for countries which want to apply environmental policies. But, in this study, we conclude that if countries use efficient environmental policies that fit them, these policies will be a good opportunity for their economic development.

ÖZET

ÇEVRE POLİTİKALARININ EKONOMİK KALKINMA ÜZERİNE ETKİLERİ

Bu çalışmada vergi, harç, sübvansiyon, komuta ve kontrol yaklaşımları, ticarete tabi permiler ve gönüllü yaklaşımlar gibi çevre politikalarının ekonomik kalkınma üzerine etkileri araştırılmıştır. İnsanoğlu, çevresel olumsuzlukları gün ve gün ağarlaştırmaktadır. Bu yüzden de çevre politikaları daha iyi bir çevre kalitesi için olmazsa olmaz hale gelmiştir. Ancak çevre politikaları dolaylı veya dolaysız olarak ekonomik büyüme, istihdam, rekabet ve teknoloji, gelir dağılımı ve sağlığı etkilemektedir. Bu saydıklarımız da ekonomik kalkınmanın en önemli saç ayaklarıdır. Bundan dolayı bu çalışma çevre politikalarının ekonomik büyüme, istihdam, rekabet ve teknoloji, gelir dağılımı ve sağlığa etkilerini analiz eden en önemli çalışmaları incelemiştir.

Bu çalışma, bütün politikalarda olduğu gibi çevre politikalarının da ülkelerin ekonomik performanslarına maliyetlerinin ve faydalarının olduğunu gösteriyor. Çevre politikalarını uygulamak isteyen ülkeler tek bir reçete sunmak mümkün değil. Ancak bu çalışmada ülkelere uygun olan çevre politikalarının etkin bir şekilde uygulandığı takdirde bu politikaların ülkelerin ekonomik kalkınmaları için iyi bir fırsat olduğu sonucuna varmıştır.

ACKNOWLEDGEMENTS

I am deeply grateful to Professor Aysu Insel, for her assistant and encouragement from the very begining of this thesis.

I would also like to express sincere appreciation to my family for their unique supports throughout my education.

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ABBREVIATIONS

BaU Business-as-usual scenario

BTA Border tax adjustments

CAFÉ Corporate Average Fuel Economy

CDM Clean Development Mechanism

CER Certified Emission Reduction

CH_4 Methane

COI Costs of illness

CFC Chlorofluorocarbons

CO Carbon monoxide

CO_2 Carbon dioxide

CO_2e Carbon dioxide equivalent

CCS CO_2 capture and storage

EU European Union

EC European Commission

EKC Environmental Kuznets Curve

EMAS EcoManagement and Auditing Scheme

EPA Environmental Protection Agency

ETS Emission Trading Scheme

FDI Foreign Direct Investment

FOA Food and Agriculture Organization

GDP Gross Domestic Product

GHG Greenhouse Gases

GtC Gigaton or billion ton carbon

IEA International Energy Agency

IPCC Intergovernmental Panel on Climate Change

JI Joint Implementation

NAs Negotiated agreements

NAFTA North American Free Trade Agreement

NOx Nitrous oxide

NMVOC Non-methane volatile organic compounds

N2O Nitrous oxide

PFCs per fluorocarbons

p.p.m parts per million

RECLAIM Regional Clean Air Incentives Market

RGGI Regional Greenhouse Gas Initiative

R&D Research and development

SOx Sulfur dioxide

SF_6 Sulfur hexafluoride

OECD Organisation for Economic Co-operation and Development

UN United Nations

UNDP United Nations Development Programme

VAT ad valorem taxes

VA Voluntary approaches

WTO World Trade Organization

WTP Willingness-to-pay

1. INTRODUCTION

Humankind, animals and plants share the same earth and live together. Environment and natural resources are source of life for both of them. Recently, there is some debate about environmental degradations. Environment and natural resources have been used as an engine of growth since industrialization. But we have been used them unproficiently. Thus, humankind is accused of devastating the environment with different ways. As a result, world turns into a poor place to live in with each passing date. A new report or study about environmental degradations is being published every day. Media are filled with reports about environmental degradations. While some people perceive these as scaremonger or starry-eyed romantics and don't pay any attention to these news, reports or studies, some people take them into account seriously.

One thing is so clear that we don't take lessons from our past experiences. Maya civilization (250–950 AD) collapsed largely as a result of serious and prolonged drought. Some 4000 years ago a number of well-known Bronze Age cultures also crumbled because of degradations. More recent examples of societies that collapsed or faced chaos on account of depletion or degradation of natural resources include the Khmer Empire in South East Asia, Eastern Island, and several others (Pachauri, 2007).

Nowadays, the picture is the same. The first global conference on environment was arranged in 1972. During the twenty years between the United Nations (UN) Conference on the Environment in Stockholm (1972) and UN Conference on Environment and Development in Rio de Janeiro (1992), we had ignored environmental problems and not became aware of their magnitude. Thus, both environmental degradations and their costs had risen up exponentially. In 1997, more than 1500 delegates, lobbyists and heads of state from over 150

countries met in Kyoto in order to achieve a treaty to cut greenhouse gas emissions around the world. We also couldn't manage Kyoto Protocol process efficiently.

Developed countries don't want to disrupt their economic growth and changing their consumption and production patterns. Developing countries also recognize their claim that rich nations became developed with using environment and natural resources up to the end, so developing countries also have a right to become a developed country with using same patterns. Thus, nobody wants to put themselves under an environmental degradation. Shortly, everyone desires to be a free rider.

Scientific studies like Intergovernmental Panel on Climate Change's reports show that our basic life standards like access to clean water & sufficient food, stable health conditions and security of settlements are in great danger. Thus if there is a right time to protect our planet, today will be the right time, not tomorrow.

Environmental policies will give a chance to us in order to achieve our national and international targets for better environmental quality. Environmental policies have also some benefits and cost like every policies. Environmental policies affect economic development directly and indirectly. Thus, it is important to understand these effects in order to evaluate environmental policies.

In the second chapter, we try to put emphasize on different environmental movements and economic doctrines in order to realize their beliefs on environment. It is important that these movements and doctrines shape the discussions about environmental degradations and environmental policies.

In the third chapter, we examine environmental degradations like climate change, water pollution, soil degradation, air pollution, etc. because we should know what we battle

with. Then, we focus on environmental policies and their advantages and disadvantages in the fourth chapter. Finally, we analyze the impacts of environmental policies on economic development through economic growth, employment, income distribution, competitiveness & technology and health in the fifth chapter.

2. AN UNDERSTANDING OF THE ENVIRONMENT FROM THEORETICAL PERSPECTIVE

In this chapter of our study, we focus on different beliefs concerning environmental issues in order to analyze how environmentalists, economists and people evaluate the environment. What is the relationship between humankind and nature? How can we define environmentalism and ecologism? What is the main difference between them? How do economic doctrines consider the relationship between economy and environment? What are their main assumptions? As far as we are able to understand these questions, we attempt to analyze the relationship between the environment and the economy from a different point of view.

2.1 Environmentalism and Ecologism

The following section will contrast many issues with different viewpoints concerning environmental issues. And Dobson (1990) distinguishes between environmentalism and ecologism (O'Brein and Williams, 2004: 289). First of all it is necessary to define environmentalism and ecology. In terms of the definition of environmentalism, environmentalism can be represented as a political movement committed to the preservation, restoration or improvement of the natural environment. Specific aims of environmentalism are to control the behavior of the human population in order to protect the quality and continuity of life through conservation of natural resources, to restrict the negative effects of modern

technology, to prevent environmental degradation and to adopt the environmentally benign forms of political and economic organization.

Environmentalist approaches can be represented in two ways: Light Green and Dark Green. A light green approach is essentially reformist and accepts the major institutions of capitalist society and seeks to engender respect for the environment and preservation of the environment through strategies that do not disrupt modern economic growth. On the other hand, the dark green environmental approach is more radical than that of the light greens. It begins from the assumption that fundamental practices will have consequences for future generations (O'Brein and Williams 2004: 289). So it is more radical in its thinking and against capitalist-style economic growth. It tends to believe that all the current political ideologies are corrupt and lead to environmental degradation.

On the other hand, ecologism is a political ideology based on the position that the non-human world is worthy of moral consideration, and this should be taken into account in social, economic, and political systems. Ecologism accepts: limits to economic and population growth; limits to consumption. Ecologism considers the natural world as a model for the social world with its equality and interdependence of all species. Ecologism was founded on 19th century and first became widespread with the belief which was, and remains, against industrialization (Heywood, 2004: 269).

There are two tensions within ecologism: Deep ecologism and shallow ecologism. The deep ecologist perspective completely rejects any belief that the human species is some way more important than, any other species or nature itself. It has anti-growth belief in order to ensure sustainability of nature itself. Shallow ecologism focuses on humankind and

sustainable growth. Shallow ecologists criticize deep ecology for subscribing to irrational or mystical doctrines and for advocating unrealistic solutions (Heywood, 2004: 271).

The central difference between environmentalism and ecologism is that while ecologism focuses on the relationship between humans and nature in a non-hierarchical manner, environmentalism places humans at the centre of its analysis.

There are also some other different perspectives, even if some writers adopt two main branch of environmentalism. They use different terms to express the central distinctions. O'Riordan (1976) distinguishes between technocentric and ecocentric positions. The technocentric perspective is based on the assumption that the central objective of economic growth is to satisfy the needs of humans. This perspective is based on the superiority of Western cultural values and the transformational capacity of capitalism (O'Brein and Williams 2004: 289). Overall, the technocentric viewpoint is optimistic, showing confidence in humankind. But ecocentrism recognizes that the ecosphere, rather than any individual organism, is the source and the support of all life. Its main argument is that no single organism is more important than another. The ecocentric ethic comes from the term first coined 'biocentric' in 1913 by an American biochemist, Lawrence Henderson, to represent the idea that the universe is the originator of life (Campbell, 1983 as citied in Kotenkamp and Moore, 2001: 2)[1]. According to the ecocentric belief, one of the main reasons for ecological problems is humankind. This belief sometimes seems to view humankind as a tumor (Idem, 2007: 16).

[1]. In order to get more information, you will check: Campbell, E.K (1983), " Beyond Antropocentrism", Journal of the History of the Behavioural Sciences 19, p. 54-67

According to Robyn Eckersley, another key division is between the anthropocentic and ecocentric approaches. The Anthropcentic one, which is closely related to humanism, is the idea that humans must be the central concern, and that humanity must judge all things. This view regards nature as resource storage for humankind. In other words, man has a god-given right to do as he wishes. The term 'anthropocentric' was first coined in the 1860s, on time the controversy over Darwin's theory of evolution, to represent the idea that humans are the centre of the universe (Kortenkanp, Moore 2001: 2). Darwin's qualification of nature was so important and it served in an effective and undeniable way in the age of industrialization (Idem, 2007: 17). Anthropocentrism considers humans to be the most important life form, and other forms of life to be important only to the extent that they affect humans or can be useful to humans. As seen above, according to the ecocentrist view, the world as a dynamic, interrelated web of relations between all organisms and reject the anthropocentric that favors humans because of their special capabilities.

2.2. Neoclassic and Marxist Perspective

When we turn our interest to economical perspective, it is necessary to focus on two different economic ideologies and their points of view about environment. These are the Neoclassical and Marxist perspectives. As with their different doctrines about production, accumulation and distribution, their consideration of the relationship between the economy and environment is also different.

Neoclassical theory revolves around individualism. It assumes that a good society must be one which both permits freedom and opens up the opportunity for freedom in order to satisfy ways of life. Neoclassical theory takes as a base of individualism, self-regulating

competitive economic system and perfect market relations. Thus, the image of neoclassical economics is solely based on strict anthropocentrism.

Holmes Rolston (1994) underlines this false imagine of economics: *In the market per se, people operate in self-interest. There it is rational to be efficient, get the most for your money, make the most profit. Within economics, that is the meaning of rationality. (Rolston, 1994:156 as citied in Pearce, 1998, p.14)*

Economic rationality is certainly about maximizing well being, but there is nothing in economics that says an individual's well-being has to depend solely on what I consume (Pearce, 1998:14). In other words economic rationality creates the consumption society whose consumption pattern is based on individual's wills not based on their needs. It is with sadness that this consumption society is one of the major culprits of environmental degradation.

But, neoclassical theory accuses other factors that cause environmental degradation. According to neoclassical theory, environmental degradation arises because of market failure, negative externalities and the lack of proper valuation of natural resources. In other words, within this neoclassical framework, the overuse of natural resources is seen as the consequence of a lack of well-defined property rights. Under the lack of well defined property rights, externalities occur. An externality exists whenever the welfare of some agent depends not only on his or her activities but also on activities under the control of some other agent (Tietneberg, 2006: 68). The problem of lack of well defined property rights was named 'the tragedy of commons'[2] by Hardin (1968). Hardin (1968:1244) said in his article that: "*Therein*

[2] He gave the example of the grazing of animals on a common ground in his study. Individuals are encouraged to increase personal wealth. When owners take their animal to grazing land, every animal added to the total degrades the commons a small amount. Although the degradation for each additional animal is small relative to the gain in wealth for the owner, if all owners follow this pattern the commons will ultimately be destroyed

is the tragedy. Each man is locked into a system that compels him to increase his herd without limit. Ruin is the destination toward which all men rush, each pursuing his own interest in a society that believes in the freedom of the commons,"

So the main reason for environmental degradation, according to neoclassical theory, is market failure. Thus, perfect property rights market must be established in order to avoid market failures. Considering neoclassical theory, perfect property rights markets are characterized by four conditions (Todaro, 1997: p.352):

1. *Universality: All resources are privately owned.*
2. *Exclusively: It must be possible to prevent other forms from benefiting from a privately owned resource.*
3. *Transferability: The owner of a resource may sell the resource when desired.*
4. *Enforceability: Property rights must be secure from involuntary seizure.*

When these conditions are not met, inefficiencies in resource allocation[3], or what can be termed market failures, are likely to arise. As a result, environmental degradation becomes inevitable. There are two solutions for restoring efficiency (Adaman, Ozkaynak, 2002). Two solutions are proposed to restore efficiency. The first one is to create a regulatory agency which achieve optimality on the one hand and reduce environmental degradation on the other hand. This agency reaches these targets by using environmental policies. The second solution suggests that clearly defined property rights are the best way to internalize the externalities and achieve optimality as the Coase Theorem[4] imply.

---

[3] Optimum allocation of resources and the Pareto Optimum will not be reached.
[4] We deeply analyze the Coase Theorem in the next sections. Briefly, the Coase Theorem states that As long as information and transaction costs are low and both parties (the party who creates externality and the party who is

But there is a problem here which will be termed the free good problem. In most 'introduction to economics' books, water and air were categorized as free goods[5]. It is argued that air and water are freely abundant in the nature and they are, thus, free goods. But the rise of ozone layer depletion and water shortages show that these kinds of things, which affect our life directly, are not free goods. So there is a big problem about this area in terms of theorizing from the perspective of the neoclassical economy. Later neoclassical economy understood that there is no market and so a price for environmental goods. This means that we must find a way that will tell us the value of environmental goods in order to analyze environmental policies.

There are direct and indirect valuation methods. While direct valuation methods estimate monetary values, indirect valuation methods infer a value rather than estimate it directly (Anderson, 2006: 235). Direct and indirect methods also branch off into observable and hypothetical valuation. Hypothetical valuation methods mean that even though markets do not exist, the economist attempts to derive economic values as if markets did, in fact, exist (Pearce, 1998: 15).

This means that four main kinds of valuation method exist: direct observation methods (market price and simulated markets), direct hypothetical method (contingent valuation), indirect observation method (travel cost method, hedonic property values, hedonic wage

affected by this externality) are free to bargain, market will produce an efficient solution for this externality. So, there is no need to government.

[5] The free good is a term used in economics to describe a good that is not scarce.

values and avoidance expenditure) and indirect hypothetical valuation methods (attribute-based models and contingent ranking)[6].

Even if the problem of the valuation of environmental goods is solved, there are more problematic issues about environmental degradation in the neoclassical perspective. According to the neoclassical perspective, all individuals are the same and they try to maximize their wealth. Once a representative individual maximize its wealth, it will be also be beneficial for the wealth of society. Even if this predigest is useful for theory and studies, when we analyze this in respect of the environment this kind of egocentric human model is not consistent with environmental based economy.

There are some another problem which ecologists and economists have highlighted. Neoclassical economics provide a convincing analysis of environmental change that stems from the omission of the fundamental laws of thermodynamics and ecology from its basic assumption (O'Brein and Williams, 2004: 298). Neoclassical economics seems natural resources as a reproducible factor. As O'Brein and Williams (2004), however, mentions, there is no guarantee that sometime in future a finite natural resource will be replaced by technology. Besides natural resource, Stern (2003) also mentions that mainstream neoclassical economics approach assumes that the quantity of energy available to the economy in any period is endogenous, though restricted by constraints such as the pressure in oil reservoirs and economic constraints such as the amount of installed extraction, refining, and generating capacity. But fundamental laws of thermodynamics have crucial explanations nature of energy. The constraints that we mentioned above are not the only factors that determine the quantity of available energy. Consequently, Stern (1999) underlines that environment and

[6] In order to find more information about economic methods for measuring environmental values, you will check Anderson (2006) and Tietenberg (2006).

natural resources are non-reproducible and many renewable resources are potentially exhaustible. Finiteness and exhaustibility of resources make the notion of indefinite economic growth problematic.

Arguably, the other most important failure of neoclassical economics is its discounting factor in growth model. The Ramsey- Cass- Koopmans model was derived by Ramsey (1928), C. Koopmans (1961, 1965, 1967) and David Cass (1965). The critique about this growth model is related to the issue of discounting for the future and ecologists argue that the future discounting assumptions of conventional economics are not ethical because people who have lived in the past are involved in decision-making about people who will live in the future.

As the utility of consumption now is greater than consumption tomorrow, we have time-preference. The reason for imposing "time preference" is more a mathematical one than a logical one - necessary for solving an intertemporal optimizing program. According to Ramsey, using time preference was ethically indefensible, but he used a mathematical contrivance which effectively did the same thing. The objective of the representative individual is to maximize utility below with respect to budget constraint.

Now it is important to understand the relationship between the environment and economy from Marxist Approach. All previous economic systems had a production mode and structure and these caused some problems in the accumulation of resources and distribution and growth of wealth. According to Marxists, all previous economic systems also had their own environmental problems, but it is capitalism that is at the root of contemporary environmental crises (Burkett, 2003: 107). Capitalism engenders planetary catastrophe

because under capitalism labor and nature- the two basic source of wealth- are first, socially separated and then exploited with its production system. We must bear in mind that both Marx and Engel hadn't directly addressed the relationship between the environment and the economy in their contributions and books. Marx had, however, made some references to environmental degradation in his contributions.

Nineteenth century agricultural chemists discovered that the loss of soil nutrients - such as nitrogen, phosphorus, and potassium through the exportation of food and fiber to the city - was disrupting the soil nutrient cycle and undermining capitalist agriculture (Foster, 2002). Nineteenth century agricultural chemists Justus von Liebig had argued that "Great Britain robs all countries of the conditions of their fertility" and singled out Britain's systematic robbing of Ireland's soil as a prime example. For Liebig a system of production that took more from nature than it put back could be referred to as a "robbery system," a term that he used to describe industrialized capitalist agriculture (Foster, 2007).

As a result in the 19th century, Marx focused on metabolic rift[7] in which the natural cycling of nutrients was broken by capitalism. As food was shipped from villages to cities to meet the needs of burgeoning populations, soils became depleted of nutrients at the same time that residues of food wastes (Magdoff, 2002).

Marx sums up his critique of capitalist agriculture in Volume 1 of *Capital*:

"Capitalist production collects the population together in great centres and causes the urban population to achieve an ever-growing preponderance. This has two results. On the one hand it concentrates the historical motive force of society; on the other hand, it disturbs the

[7]Metabolic rift in the most general sense refers to a disruption in the exchange between social systems and natural systems, which is hypothesized to lead to ecological crisis. (http://www.eoearth.org/article/Metabolic_rift)

metabolic interaction between man and the earth, i.e. it prevents the return to the soil of its constituent elements consumed by man in the form of food and clothing; hence it hinders the operation of the eternal natural condition for the lasting fertility of the soil...But by destroying the circumstances surrounding that metabolism... it compels its systematic restoration as a regulative law of social production and in a form adequate to the full development of the human race...

"All progress in capitalist agriculture is a progress in the art, not only of robbing the worker but of robbing the soil; all progress in increasing the fertility of the soil for a given time is a progress toward ruining the more long-lasting sources of that fertility...Capitalist production, therefore, only develops the technique and the degree of combination of the social process of production by simultaneously undermining the original sources of all wealth – the soil and the worker."(Marx, 1976:637-38 as citied in Foster, 1999: p.379).

In Volume 1 of Capital, Marx also notes that capitalist mode of production exploits both labor and soil:

“Capitalist production, therefore, develops technology, and the combining together of various processes into a social whole, only by sapping the original sources of all wealth — the soil and the labourer.” (Marx, 1867 as citied in Kula 2006: p.56)

So, while Marx recognized the existence of ecologically destructive methods within the agricultural system, he never took into account the possibility that ecological degradation might threaten economic crisis under production system of capitalism, due to the impairment of the natural conditions of production (Foster, 2002). In summary, capitalism seems to be the root cause of environmental problems within Marxist perspective.

Marxist approach has fallen out of favor recently, so Marxists have become aware that there must be modifications and revisions to this framework. Magdoff (2002) mentioned that there are two contradictions in capitalism one internal and emanating principally from class struggle, the other external and emanating principally from undermining of conditions of production. As we mentioned above, the first one fall out of favor. So the second contradiction becomes more dominant. The new environmental movement is more vital and the class based movement tends to take a subordinate role. As a result most left-wing economic, sociological and political journal have given way to eco socialists and Marxist in the journals' columns.

3. ENVIRONMENTAL DEGRADATIONS

The environment is our basic source of life. People have roughed handle this basic source of life. Because of that, we exhaust our basic source of life day by day. As total population grows, and the integration between countries increases and incomes of people rise, we clearly see that environmental degradations worsen. While people pollute and damage the environment, this environmental degradation flow back to them in the form of a difficult living space. First of all, environmental degradation affects the health of people. Then environmental degradations will also aggravate the productivity of earth and people. So both national and global production will also reduce because of environmental degradations. This means that there is causality between economic growth and environmental degradations. When all these come together, the world became a difficult place to live in. In order to understand the consequences of environmental damage, we use the World Bank's table about the principal health and productivity consequences of environmental degradation[8] and modify it with the latest available evidence[9].

[8] See World Bank, (1992), " World Development Report: Development and the Environment, Oxford University Press, table 1 and Todaro (1997), p. 346-47

[9] We will give more information about the effects of global warming in Table 2

Table 3.1 Environmental Problems and Their Effects

Environmental Problem	Effect on Health	Effect on Productivity
Water Pollution and water scarcity	More than 3 million deaths and billions of illness a year.	Polluted water is unsuitable for drinking, agriculture and industry. These cause to declining in fisheries; agricultural productivity and rural household time and increase in municipal costs of providing safe water
Air pollution	Many acute and chronic health Impacts like chronic respiratory disease, lung cancer, hearth disease and damage to brain and nerves.	Restrictions on vehicle and industrial activity during critical episodes; effects of acid rain on forest and Some sectors
Global Warming	Increase in heat-related deaths, Many acute and chronic health like skin cancer and hearth disease. Perhaps 300000 additional care of Health problems like Skin cancer a year worldwide	Rising atmospheric temperature longer droughts and higher level of ozone gas worsen agricultural productivity in global sense. But in some regions like Siberia and Iceland, there are some positive effects. Sea-rise damage to coastal investment, disruption of marine food chain. Some studies suggest that climate change will affect economic growth by one fifth.
Solid Degradation	Reduced nutrition for poor farmers on depleted soils; greater susceptibility to droughts.	Field productivity losses in range of 0.5% to %1.5 of GDP common on tropical soils. Total annual loses are estimated at 10 billion $.
Deforestation	Localized flooding, leading to death and disease	Loss of sustainable logging potential and of erosion prevention and carbon sequestration provided by forest.
Loss of biodiversity	Potential loss of new drugs	Reduction of ecosystem adaptability and loss of genetic resources
Solid and hazardous wastes	Diseases spread by rotting garbage and blocked drains	Pollution of groundwater resources and its effects on agriculture

Source: World Bank 1992, Todaro 1997

3.1. Water Scarcity and Pollution

Yet at the start of the 21st century one in five people living in the developing world—some 1.1 billion people in all—lacks access to clean water. Some 2.6 billion people, almost half the total population of developing countries, do not have access to adequate sanitation. International norms set out by agencies such as the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) suggest a minimum requirement of 20 litres a day from a source within 1 kilometre of the household. Below this level people are constrained in their ability to maintain their physical well-being. Factoring in bathing and laundry needs would raise the personal threshold to about 50 litres a day (UNDP, 2006: 33-34).

There is big inequality in average water use per person among countries. Average water use is 575 litres in the USA, 380 in Japan, 380 in Mexico, 290 in France, 190 in Germany, 90 in China, 30 in Niger, 20 in Ethiopia and 10 in Mozambique (UNDP, 2006: 34).

Besides this water scarcity, humankind also continues to pollute scarce water. People and industries produce huge wastes and chemicals which enter rivers, lakes, oceans and other surface and underground waters resources. Thus we face with harmful effects of water scarcity and pollution. The direct effects of water scarcity and pollution will undoubtedly be on health. Drinking poor and dirty water cause to sickness and disease. Water-related diseases diarrhoea, malaria and schistosomiasis are among the commonest causes of illness and death. 2.2 million people in developing countries, most of them children, die every year from diseases associated with lack of safe drinking-water, inadequate sanitation and poor

hygiene (WHO, 2000). According to UNDP (2006), 1.8 million child deaths each year related to unclean water and poor sanitation.

Water pollution poisons fish and other animals and causes a reduction in biodiversity on the one hand. On the other hand, it deforms agricultural lands. Therefore, water scarcity and pollution also affect fishery and agriculture. Between 1950 and 1996 the worlds catch of fish increased from 20 million tons each year to 120 million tons. By 2000 the world's major marine fish stocks had either been depleted through water pollution and over fishing (Buckman, 2005: 176). In agricultural productivity, the quality of water is so crucial; this means that agricultural production could be affected directly through water pollution. In principal we will say that cause to declining in fisheries and agricultural productivity.

3.2. Air Pollution

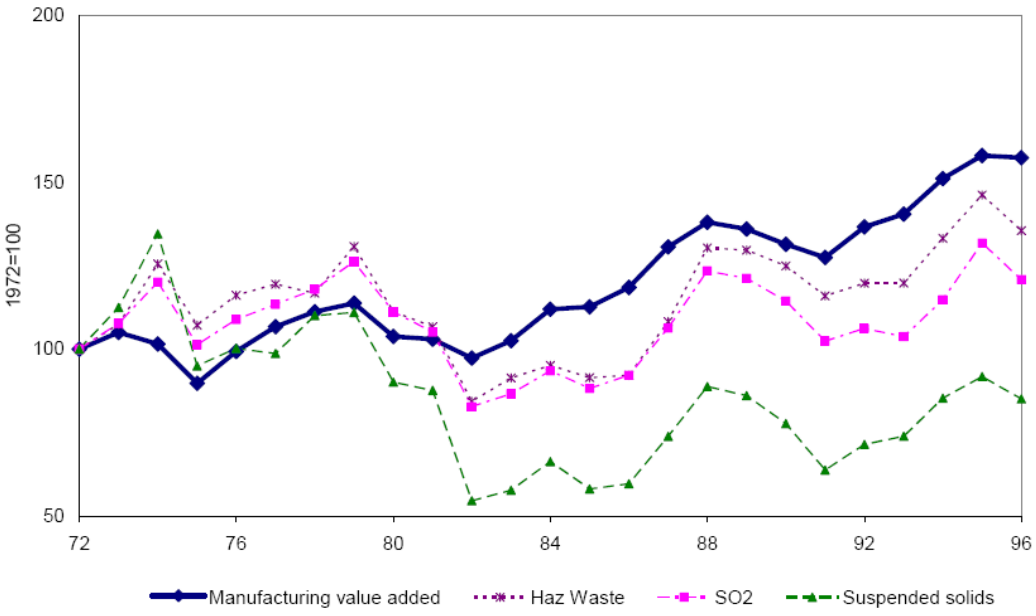
Humankind had rough-handled nature's benefits over its existence especially after the industrial revolution. Urbanization and industrialization accelerated this rough handling because developed countries tried to achieve their growth policies at any cost (Keles and Hamamcı, 2005: 95). Air pollution is one of the consequences of rough-handling. Air pollution damages the ozone layer which prevents most harmful wavelengths of ultraviolet light (UV light) from passing through the Earth's atmosphere, by mobile and stationary sources.

Mobile sources are variable sources of air pollutants, such as automobiles, buses, trucks, trains, aircraft and various other vehicles. Stationary sources are fixed emitters of air pollutants, like fossil fuel burning power plants, petroleum refineries, petrochemical plants

and some heavy industrial sources. It is well known that some heavy industries increase air pollution. While developed countries' manufacturing output and total pollution have declined, developing countries' manufacturing output and total pollution increased. Production composition of developed countries has moved away from polluting industries to cleaner industries since trade liberalization. Developing countries become "pollution havens" for developed countries.

When we look at dynamic changes in the structure of the economy, developed countries focus on the service sector, a relatively environment friendly sector, but developing countries mainly focus on the manufacturing sector. Manufacturing sectors in these countries are not energy efficient and environment friendly. We will see a dynamic trend of manufacturing and environmental degradation in Figure 3.1. There has been a sharp increase in manufacturing after the early 1980s and Hazardous waste, SO_2 and suspended soils also follow this trend and fluctuate with manufacturing.

Figure 3.1 Trends in Manufacturing and Pollution



Source: Ederington, Levinson, Minier 2004

Air pollution engenders climate change and endangers ecosystem. We will focus on this topic in the global warming section. Air pollution has also some health-endangering consequences. It causes dyspnea, lung cancer, bronchitis and hearth diseases and injures nerves and brain.

Air pollution is the main source of acid rain. Acid rain doesn't usually kill trees directly. Instead, it is more likely to weaken trees by damaging their leaves, limiting the nutrients for them and exposing them to toxic substance (Tietenberg, 2006:398). This means that acid rain can slow the growth of forest. Acid rain also abates some animals. Acid rain can worsen fishery, forestry and tourism.

3.3. Global Warming

As seen from Table 3.1, there are a number of serious problems directly related to economic degradation that affect humankind directly. Problems to do with the ozone layer, global warming, and water and air pollution are everybody's problems. These kinds of problem are really dangerous for the earth, and individual efforts are not sufficient to solving the problem. Global warming seems to be one of the biggest problems that the earth faces.

As Stiglitz (2006) mentioned, there are seven almost incontrovertible facts concerning global warming:

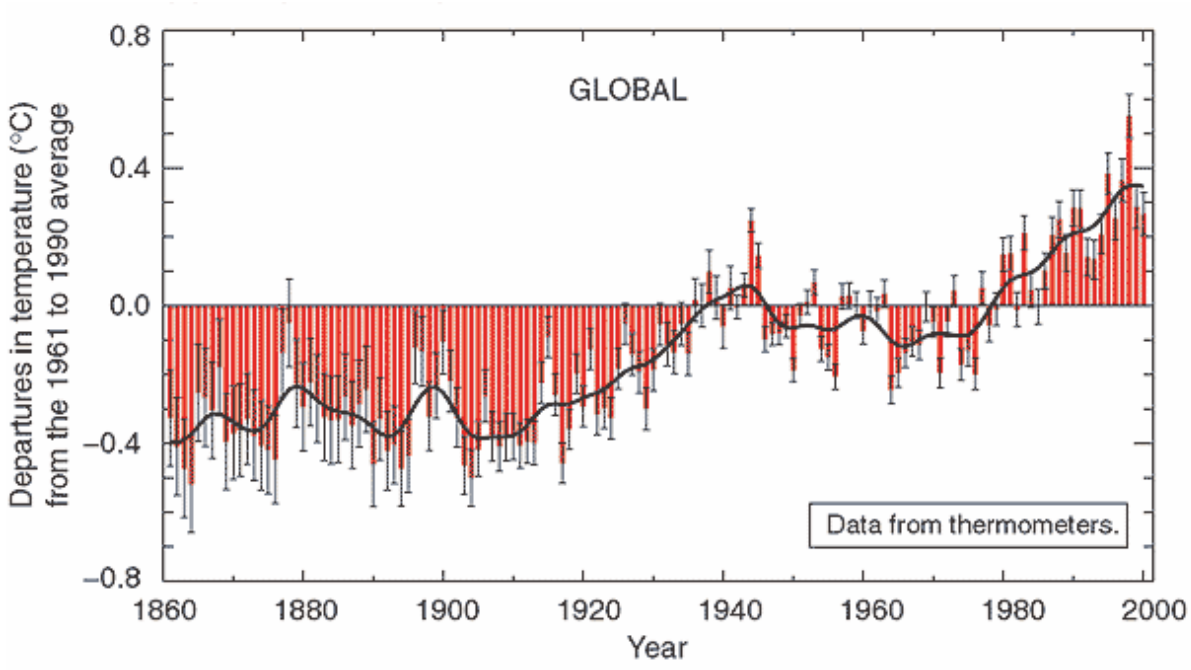
1. *The world is warming by about a degree Fahrenheit(0.6^0 C)*
2. *Even small changes in temperature can have large effects*
3. *This rate of warming is unprecedented.*
4. *Sea levels are rising by some four to eight inches in the last century*
5. *Even small changes in sea level can have large effects*
6. *There have been huge increases in greenhouse gases in the atmosphere*
7. *It is possible that the pace of change in temperature could accelerate, with small increases in the concentration of greenhouse gases leading to even larger changes in climate than in the past (Stiglitz, 2006: p.166)*

Greenhouse gases are the main reason for global warming. As seen from Figure 3.2 global warming started in the 19th century but it has accelerated and become more pronounced since the 1980's. Six of the 10 warmest years since 1860 have occurred within the last decade[10]. All these factors show that global warming started with the industrial revolution and

[10] The warmest years are: 1998, 2005,2002,2003, 2004 and 2006

has accelerated with globalization. Before the industrial era, CO_2 concentration was 280 parts per million in the atmosphere. If the current trend continues, that could reach 560 p.p.m by the mid century (Sachs, 2007a). Climate models referenced by the IPCC project that global surface temperatures are likely to increase by 1.1 to 6.4 °C (2.0 to 11.5 °F) between 1990 and 2100 (IPCC, 2007).

Figure 3.2 Variations of the Earth's Surface Temperature



Source: Stern Review 2006, p.5

World population has grown exponentially from 1 billion people in 1800 to 2.2 billion in 1950 to 6 billion in 1999 and is estimated to reach 8-10 billion by the year 2150 (Donohoe, 2003).While world population increases, the composition of consume also changes rapidly. Consumption society generally determines its consumption path not with its needs but its insatiate wills. An increasing number of products like automobile, computer and electronic equipments will also have adverse effects on global warming via greenhouse gases. For example there are 400 million personal computers worldwide. Producing one PC consumes

2800 gallons of water and uses 700 chemical compounds and creates 7 pounds of toxic waste. Energy inefficient cars are one of the big contributors of greenhouse gases like carbon emissions that pollute air and cause global warming (Donohoe, 2003).

Greenhouse gases mainly emanate from the burning of fossil fuels (oil, coal etc.), manufacturing production processes (energy related and chemical processes), transportation and agricultural activities (soils, rice, enteric fermentation, energy-related and livestock) (DPT, 2000: 2)

The concentrations of several greenhouse gases[11] have increased over time. While 157 GtC (gigaton or billion ton carbon) enter into the atmosphere per year, 153.5 GtC move away from atmosphere per year. This means that 3,5 GtC accumulate in the atmosphere per year (Uzmen, 2007: 58)

The largest emitter is the United States, with 21 percent of global GHGs emissions, followed by China (15 percent). If the European Union (EU) is treated as a single entity, it and the four other largest emitters—the United States, China, Russia, and India—contribute approximately 61 percent of global emissions. Turkey emits 1.1 percent of global emissions. Together, the 25 top emitters generate 87 percent of global GDP (WRI, 2005: 11).

Emissions growth rates are highest among developing countries, where collectively CO_2 emissions increased by 47 percent over the 1990–2002 period. Among the major developing country emitters in non-annex countries; growth was fastest in Indonesia (97 percent), South Korea (97 percent), Iran (93 percent), and Saudi Arabia (91 percent) during

[11] Carbon dioxide, methane, Nitrous Oxide and Fluorocarbons are the main greenhouse gases.

this period. Emissions in China grew about 50 percent, although preliminary estimates for 2003 and 2004 suggest extraordinary growth in China, about 35 percent over this two-year period alone (WRI, 2005: 11).

Table 3.2 Top Greenhouse Gases Emitters

	Metric tons of CO_2 equivalent	% of World GHGs
USA	6.928	20,6
China	4.938	14,7
EU-25	4.275	14,0
Russia	1.915	5,7
India	1.884	5,6
Japan	1.317	3,9
Germany	1.009	3,0
Brazil	851	2,5
Canada	680	2,0
UK	654	1,9
Italy	531	1,6
South Korea	521	1,5
France	513	1,5
Mexico	521	1,5
Indonesia	503	1,5
Australia	491	1,5
Ukraine	482	1,4
Iran	480	1,4
South Africa	417	1,2
Spain	381	1,1
Poland	381	1,1
Turkey	355	1,1
S. Arabia	341	1,0
Argentina	289	0,9
Pakistan	285	0,8
Top 25	27.915	83
Rest of the World	5.751	17
Developed C.	17.355	52
Developing C.	16.310	48

Source: WRI 2005, p.12

Altogether, in 22 Annex 1 countries GHG emissions decreased from 1990 to 2004 whereas in 19 countries the emissions decreased. GHG emissions increase by 72.6 percent in Turkey. This growth was the fastest among Annex 1 countries. Emission growth was 49 percent in Spain, 15.8 in USA, 6.5 in Japan, -0.8 in France, -17.2 in Germany and -60.4 in Lithuania (UNFCCC, 2006: 4).

Countries with large populations, large economies, or both tend to be the largest emitting countries. Under such circumstances, focusing only on absolute emission levels only gives a partial understanding of the greenhouse gas picture. Among the 25 major emitters, Australia, the United States and Canada have the highest per capita emissions (ranking 4th, 6th, and 7th globally). Their per capita emissions are more than twice those of the Germany (27th globally) UK (32nd globally) and Japan (39th globally, six times those of China (99th globally), and 13 times those of India (140th globally). While Turkey is in the 22nd rank in total emissions, it is in the 75th rank in emissions per capita (WRI, 2005: 21).

The International Energy Agency (IEA) mentions energy related CO_2 emissions as being one of the biggest contributors to greenhouse emissions. In its latest "World Energy Outlook 2007", the IEA (2007) focuses on energy related CO_2 emissions with three main scenarios (reference scenario, alternative scenario and high growth scenario)[12]. According to

[12] **Reference scenario:** *Demographic Assumptions*- World population is projected to growth by 1% per year on average, from 6.4 billion in 2005 to almost 8.2 billion in 2030. Almost all increase in the world population is expected to arise in developing countries 1.2% per year. *Macroeconomic Assumptions*- World GDP is expected to growth an average by 3,6% per year. Combining population and GDP growth assumptions yield s an average increase in per capita income of 2,6% per annum. Per capita incomes grow most rapidly by 3,9% in the developing countries, especially China, where they increase by 5,6% per year on average. Income in OECD countries increase by an average 1,7%.

Alternative scenario: Macroeconomic and population assumptions are the same as in the Reference scenario. Alternative scenario only takes into account policies of governments that are considering energy security and environmental problems.

the IEA (2007), rising global energy use will continue to increase energy related CO_2 emissions over the projection period (2005-2030). In the reference scenario, world emissions increase by 57% between 2005 and 2030 to 41,9 GtC, an average rate of growth of 1,8% per year. The increase is 27% in the alternative scenario, an average rate of growth 1% per year, and 68% (2.1% per year) in high growth scenario. As we see from Table 3.3, China, India and USA would be the top energy related CO_2 emitter in 2030. It is also clear that developing countries' share would increase by huge amount because of high growth potential, huge energy demand and relatively high population growth.

High growth scenario: Population assumptions are the same as in the Reference scenario. The difference of this scenario is the assumption that GDP growth in both countries is on average 1,5 percentage points per year higher than in the Reference scenario.

You can look international energy price assumptions from *World Energy Outlook 2007:* Table 3 (p.64)

Table 3.3 Energy Related CO_2 Emissions by Region and Scenario (gigaton)

		Reference Scenario		Alternative Policy S.		High Growth Scenario	
	2005	**2015**	**2030**	**2015**	**2030**	**2015**	**2030**
OECD	12.8	14.1	15.1	13.2	12.5	13.9	14.6
North America	6.7	7.5	8.3	7.2	7.1	7.5	8.1
USA	5.8	6.4	6.9	6.2	6.0	6.3	6.7
Europe	4.0	4.2	4.5	3.8	3.5	4.3	4.4
Pacific	2.1	2.3	2.3	2.2	1.9	2.2	2.1
Transition E.	2.5	3.0	3.2	2.9	2.8	3.0	3.2
Russia	1.5	1.8	2.0	1.7	1.7	1.8	2.0
Developing C.	10.7	16.4	22.9	15.2	17.9	17.4	26.3
China	5.1	8.6	11.4	8.1	8.9	9.5	14.1
India	1.1	1.8	3.3	1.6	2.4	1.9	3.9
Other Asia	1.4	2.0	2.7	1.8	2.1	2.0	2.6
Middle East	1.2	1.8	2.5	1.7	2.0	1.8	2.7
Africa	0.8	1.0	1.4	0.9	1.1	1.0	1.3
Latin America	0.9	1.2	1.6	1.1	1.3	1.2	1.6
World	**26.6**	**34.1**	**41.9**	**31.9**	**33.9**	**34.9**	**44.8**
EU	3.9	4.0	4.2	3.6	3.2	4.1	4.2

Source: IEA 2007, p. 199

When the source of emissions is considered, it is clear that coal remains the biggest contributor to global emissions throughout the projection period. Table 3.4 shows that with the exception of the alternative scenario, coal's share of emissions will increase over time.

Table 3.4 Energy Related CO_2 Emissions by Fuel and Scenario

	2005	Reference Scenario 2030	Alternative Scenario 2030	High Growth Scenario 2030
Coal	41%	45%	40%	46%
Oil	39%	34%	37%	33%
Gas	20%	21%	23%	21%

Source: IEA 2007, p.193

All these emissions levels and fossil fuels projections show that the global warming trend is getting worse day by day. According to the Stern Review (2006), carbon emissions have already increased global temperatures by nearly half a degree Celsius. Extreme weather will reduce global GDP by up to 1%. A two to 3^c C rise in temperatures could reduce global economic output by 3%.

If there is a 1^o C increase in temperature, at least 300000 people will die from climate related diseases like skin cancer, diarrhoea, malaria and malnutrition each year. 2^o C increase in temperature could decrease water resources in some region like Mediterranean and South Africa by 20-30% and crop yields in tropical region by 5-10%. In the past twenty five years alone the world has lost 30 percent of its biodiversity. If the current trends continue, by the second half of the twenty first century the world will have lost between one third and two thirds of its plant and animal species (Buckman, 2005: 176). The Stern Review also mentioned that if there is 2^o C increase in temperature, 15 - 40% of species will also face with extinction. As we see from Table 4.5, we see that people who die of climate related disease will increase because of high temperatures.

Table 3.5 Possible Climate Impacts

Temp. Eise	Water	Food	Health	Land	Environment	Abrupt and Large Scale Impcats
1^0 C	Small glaciries in the Andes disappear, threatening water supplies for 50 million people	Modest increases in cereal yields in temperate region	At least 300,000 people each year die from climate-related diseases Reduction in winter mortality in higher latitudes (N.Europe and USA)	Permafrost thawing damages buildings and roads in parts of Canada and Russia	At least 10% of land species facing extinction (according to one estimate) 80% of bleaching coral reefs including Great Barrier Reef	Atlantic Thermohaline Circulation starts to weaken
2^0 C	Potentially 20-30% decrease in water availability in some region (S. Africa and Mediterranean	Sharp declines in crop yield in tropical regions (5-10% in Africa)	40-60 million more people exposed to malaria in Africa	Up to 10 million more people affected by coastal flooding each year	15-40% of species facing extinction (according to one estimate) High risk of extinction of Arctic species including polar bear and caribou	Potential for Greenland ice sheet to begin melting irreversibly, accelerating sea level rise and committing world to 7m sea level rise Risking of abrupt changes to atmospheric circulations Rising risk of collapse of West Antarctic Ice Sheet Rising risk of collapse of Atlantic Thermohaline Circulation
3^0 C	In Southern Europe, serious droughts occur every 10 years 1-4 billion more people suffer water shortages while 1-5 billion gain water	150-550 additional millions at risk of hunger (if carbon fertilisation weak) Agricultural yields in high latitude likely to peak	1-3 million more people die from malnutrition (if carbon fertilisation weak)	1-170 million more people affected by coastal flooding each year	20-50% of species facing extinction (according to one estimate) incl. 25-60% mammals, 30-40% birds, 15-70% butterflies in S. Africa Onset of Amazon forest collapse (some models only)	
4^0 C	Potentially 30-50% decrease in water availability in Southern Africa and Mediterranean	Agricultural yields decline by 15-35% in Africa and entire regions cut of production (e.g. parts of Australia)	Up to 80 million more people exposed to malaria in Africa	7-300 million more people affected by coastal flooding each year	Loss of around half Arctic tundra Around half of all the world's nature reserves cannot fulfil objectives	
5^0 C	Possible disappearance of large glaciers in Himalayas affecting one quarter of China' s population and hundreds of millions in India	Continued increase in ocean acidity seriously disrupting marine ecosystems and possibly fish stocks			Sea level rise threatens small islands, low-lying coastal areas (Florida) and major world cities as New York, London and Tokyo	
More Than 5^0 C	The latest science suggests that the Earth's average temperature will rise by even more than 5-6^0 if emissions continue to grow and positive feedbacks amplify the warming effect of greenhouse gases (e.g release of carbon dioxide from soils or methane from permafrost). This level of global temperature rise would be equivalent to the amount of warming that occurred between the last age and today- and is likely to lead to major disruption and large scale movement of population. Such "socially contingent" effects could be catastrophic, but are currently very hard to capture with current models as temperatures would be so far outside human experience					

Source: Stern Review 2006, p.57

Sea level could also rise as a result of global warming. Estimations and observations in the Stern Review show that some cities and regions are in danger because of rising sea level if there is 5^{c} C Celsius increase on temperature. These coastal cities or regions are: Tokyo, Shangai, Hong Kong, Buenos Aires, New York, Miami, and London, some islands in the Caribbean and the Pacific, South East Asia.

Climate change related problems like rising sea levels, stronger tropical cyclones, coastal flooding, the loss of soil moisture, droughts and water scarcity will cause population movements (Sachs, 2007b). According to IPCC, by the middle of the century more than 200m people could have been forced from their native lands by rising sea levels, floods and droughts

Global warming sometimes creates dilemmas. For example while fossil fuels aren't efficient and cause greenhouse gases, new fuel technologies like biofuels have destructive effects on development. The growth of biofuels like biodiesel and ethanol, the impacts of climate change and the rising prosperity of developing countries are all driving retail food prices to their annual increase in 30 years. One of the chief causes of food-price inflation is new demand for ethanol and biodiesel which can be made from corn, palm oil, sugar and other crops. During the second half of 2006, ethanol demand tripled or quadrupled. That demand has driven up the price of those commodities, leading to higher cost for producers. In some cases, producers are passing the costs along to consumers.

Jacques Diouf, director general of the United Nations' (UN) Food and Agricultural Organization, said food represented about 10-20 percent of consumer spending in developed countries, but up to 65 percent in developing countries (FT, 2007). Developing countries'

import bill will increase. Ethanol demand increased the price of corn tortillas in Mexico and this causes a national crisis[13].

Climate-related disasters also hit global wheat supplies. Total wheat production fell from 622 million metric tons in 2005-2006 planting season to an estimated 593 million metric tons in 2006-2007 seasons (Sachs, 2007c). .

The cost of food in China is increasing more than twice as fast as other commodities. In India, annual food inflation is at its highest level since the late of 1990's and above 10 percent on a year on year basis. Turkey is also one of the country which suffer from food-related inflation (Barta, 2007).

In more recent years central banks have tried to ignore surges in food prices as long as they were short-lived and weather related. A change in weather, for example, could quickly turn a food shortage into a glut, sending prices tumbling. But a more sustained bout of food price inflation could force central banks to keep interest rates higher than they would otherwise be. This interest rate increase will hit both developing and developed countries' economic growth.

3.4. Soil Degradation

Soil degradation is another major problem for both health and productivity. Rural population, expansion of cultivated area, high diversification of agricultural production and poor management of water and land are associated with soil degradation. 3.2 billion hectares

[13] Nearly 75.000 Mexicans have taken to the streets in protest, forcing the government to institute price controls on tortillas.

of land surface are potentially arable. While 1.3 billion hectares of them are moderately to high productive, 1.3 billion hectares of them are low productive lands. Large land areas of 5 to 8 million hectares have gone out of production each year (Scherr, 1999: 16). The resulting annual loss in agricultural productivity is estimated to be between 0.5% and 1.5% of annual worldwide GDP (Todaro, 1997: 347).

While soil degradation has a harmful effect on productivity food production has been rising even more than population in order to meet new demands expected from income growth. Hereby, soil degradation will reduce food requirement of people especially in developing countries. According to the FOA (2007), there are roughly 855 million undernourished people in the world, with 820 million in developing countries, 25 million in countries in transition and 9 million in industrialized countries. Heavy soil degradation may increase this number and this will cause destructive consequences like migration, civil war, etc.

3.5. Deforestation

Every year global forests cover equal to the size of Norway is lost; 13 percent of the World's forest cover was removed between 1960 and 1990 (Buckman, 2005: 175). It is possible to discern a decline in the area covered by tropical forest between 1800 and 2000. There is a huge downward trend within this period. Some studies show that there is a relationship between deforestation and urban poverty. Forests were cleared to accommodate the individuals' growing needs for new land on which to grow their food crops. The majority of tropical forest destroyed, %60, is cleared for cultivation by small poor farmers (Todaro, 1997: 366).

It is estimated that deforestation alone accounts for roughly 25% of all CO2 emissions worldwide because trees consume carbon dioxide and release oxygen during the process of photosynthesis. Deforestation will intensify soil erosions and floods; there are lots of people who die from soil erosions and floods. Deforestation will have also effects on temperature because trees provide shade and the shaded area has a moderate temperature.

3.6. Loss of Biodiversity

The services provided by healthy biodiversity[14] are the foundation for human well-being. However, out of the 24 ecosystem services recently assessed by the Millennium Ecosystem Assessment[15], 15 are in decline. These include the provision of fresh water, marine fishery production, the number and quality of places of spiritual and religious value, the ability of the atmosphere to cleanse itself of pollutants, natural hazard regulation, pollination, and the capacity of agricultural ecosystems to provide pest control (CBD, 2006: 2).

The loss of biodiversity also affects humankind's health indirectly because some species are beneficial both for them and nature itself. Thus, any loss of biodiversity causes the potential loss of new drugs and also increases current drugs' prices. This means that million of additional people will suffer from lack of drugs.

Furthermore, the loss of biodiversity also affects socio-economic systems like agriculture and fishery which are so crucial for human development. This will threaten food supplies for millions of people. Apart from nature's immediate usefulness to humankind,

[14] Biological diversity, or biodiversity, is the term given to the variety of life on Earth.

[15] The Millennium Ecosystem Assessment (MA) is a research program that focuses on ecosystem changes over the course of decades, and projecting those changes into the future. It was launched in 2001 with support from the United Nations by the UN Secretary-General Kofi Annan

many would argue that every life form has an intrinsic right to exist, and deserves protection (CBD, 2006: 3).

3.7 Solid and Hazardous Wastes

Solid and hazardous wastes which are injurious to health and productivity are the main products of industrial development. Solid and hazardous wastes have harmful effects on underground water sources and agriculture. The waste generated by the fertilizer, cement, petrochemical, leather and energy production industries' damage environmental resources. Medical and domestic wastes also have harmful effects on the environment.

Solid and hazardous wastes cause water contamination worldwide. This reduces available water resources for human basic needs, agriculture and industries. Consequently it causes health and productivity effects as we mentioned above.

Consequently, each type of environmental degradation has both direct and indirect effects on nature, the economy and health. It is possible to see that there are some interactions between environmental degradation. For example there are some linkages between air pollution, deforestation and global warming. An understanding of each type of economic degradation and the interactions between them is vitally important to defining problems exactly and solving them.

4. ENVIRONMENTAL POLICIES

As we analyze in the previous chapter, humankind create externalities through their consumption and production modes. These externalities cause environmental degradations. It is urgently necessary to find the ways of protecting the environment upon which all life depends in order to give a habitable world to our next generations. Therefore, we try to illustrate environmental policies in this chapter. We classify environmental policies into three categories. These are: market based environmental policies, command and control policies and pure market based environmental policies.

4.1. Market Based Environmental Policies

Companies usually do not consider environmental externalities, when they construct their cost-benefit functions. So these externalities cause environmental degradation such as global warming, deforestation, etc. For this reason, governments intervene in markets via market based instruments like tax, subsidies, charges and pollution permits. As Stavins (2001) defines, market-based instruments are regulations that encourage behavior through market signals rather than through explicit directives regarding pollution control levels or methods.

4.1.1. Environmental Taxes

A theoretical attractive approach to resolve the externality problem is to internalize the externalities by using tax (Ekins, 2000: 26). Taxes influences environmental damage by changing relative prices. McMorran and Nellor (1994) categorize environmental taxes into 3 groups: 1. taxes on emissions or Pigouvian taxes; 2. Taxes on productive inputs or consumption goods whose use is related to environmental damage or indirect environmental

taxes; 3. environment related provisions in other taxes. In this part, we categorize environmental taxes within two groups: taxes on emissions or damages (Pigovian Taxes) and indirect environmental tax. As in the common literature, we define environment related provision in other taxes as an environmental subsidy.

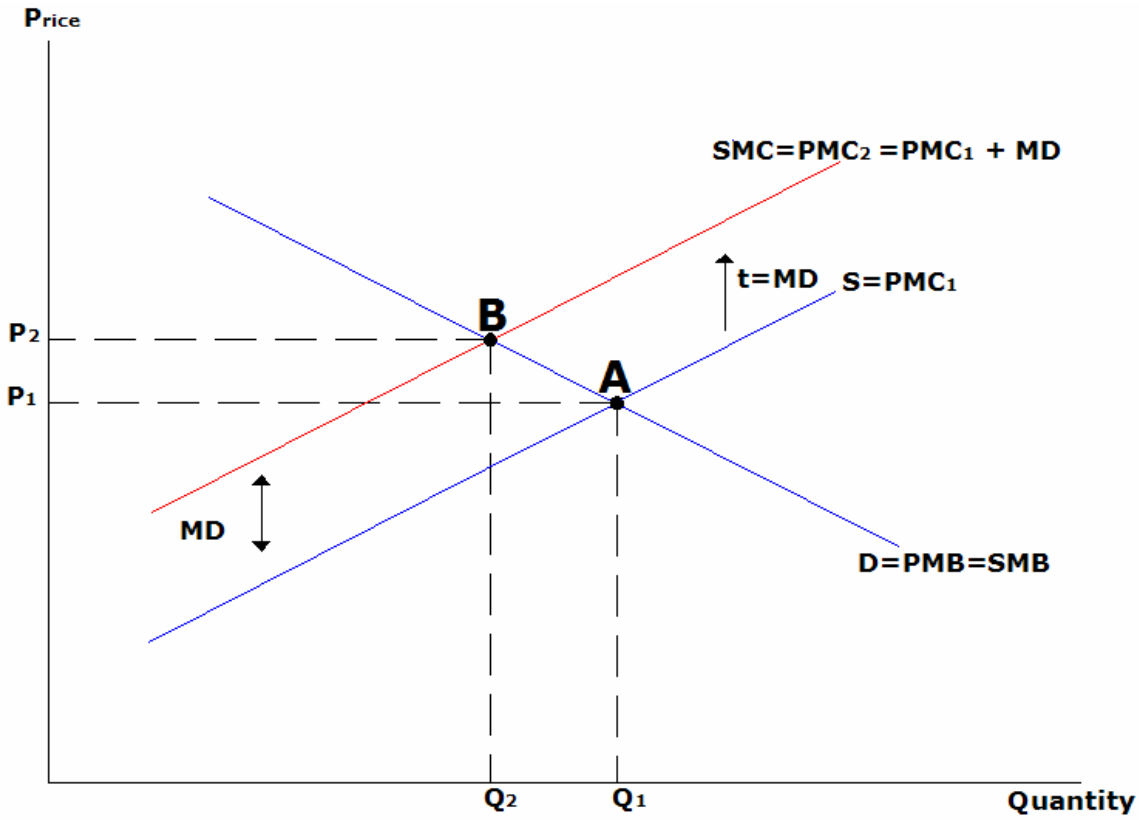
4.1.1.1 Piguovian Taxes

Pigovian taxes are taxes that imposed to correct the negative externalities. Pigouvian taxes are specific rate taxes on units of emissions or damage. The rate of tax is equal to marginal damage (cost) at the socially efficient level of emissions[16]. The socially efficient level of emissions occurs where the marginal benefit to firms from waste emissions equals the marginal social cost of these emissions (McMorran and Nellor, 1994: 2).

As we see from Figure 4.1, Pigovian tax (equal to the marginal damage of pollution) increases the firm's private marginal cost curve from PMC_1 to PMC_2, which coincides with the SMC curve. The quantity produced falls from Q1 to Q2, The price of production also increase from P1 to P2. The result is not a zero level of environmental externality but an optional level where the social marginal benefit from the reduction of environmental degradation equals its social marginal cost (Panyouto, 1994: 16).

[16] We have to know the definitions of private marginal cost (PMC), social marginal cost (SMC), private marginal benefit (PMB) and social marginal benefit (SMB) in order to understand negative externality. PMC is the direct cost to producers of producing an additional unit of a good. SMC is the private marginal cost to producers plus any costs (in this case marginal damage (MD)) associated with the production of the good that are imposed on others. SMC = PMC + MD. PMB is the direct benefit to consumers of consuming an additional unit of a good by the consumer. SMB is the private marginal benefit to consumers plus any costs associated with the consumption of the good that are imposed on others. This cost is generally zero, so that we don't consider this cost. This means that PMB = SMB

Figure 4.1 Pigovain Tax



Source: Gruber 2005 p. 134

Taxes on emissions or damage are applied directly to the harmful substances thereby providing maximum incentive and flexibility to polluter to reduce emissions or damage. So, Pigovian taxes are more efficient than indirect taxes on inputs or final products (Panyouto, 1994: 16)

Pigovian taxes increase the cost of emission or damage. This means that companies will face not only their private cost but also social cost. So it will reduce emission or damage effectively. Furthermore, government's revenue will increase by imposing Pigovain tax.

But high and/or variable inflation rates will limit the effectiveness of Pigouvain taxes because they are specific tax rates. Inflation quickly erodes the real value of tax rates that are intended to reflect marginal social cost (McMorran and Nellor, 1994: 12). Concentration rate of industries also affect the effectiveness of Pigouvian taxes. If concentration rate of industry is high, producers will reflect these taxes into their price. So inflation will accelerate.

Pigouvian taxes are used largely within Europe. Australia, Austria, Belgium, Denmark, Finland, France, and Norway impose waste disposal charges that resemble Pigouvian taxes because they are specific rate taxes related to emissions. Belgium, France, Germany, the Netherlands, and Switzerland impose aircraft landing taxes that relate the level of the charge to noise taxes. The economies in transition were perhaps most advanced in using Pigouvian taxes. For example, Estonia, Hungary, Poland, and Russia all imposed taxes on air and water emissions that take into account factors that affect the level of environmental damage such as quantity and toxicity of emissions (McMorran and Nellor, 1994: 6). Sweden and Norway has sizeable taxes on carbon emission[17] for some sectors. For instance, Sweden tax level is 0.63 SEK/kg CO_2. This corresponds to approximately 200 USD/ton of carbon (Sterner and Kohlin, 2003: 132).

But in some cases, tax rates would be low since it is hard to estimate marginal damage cost. For example, Poland's taxed on sulfur dioxide (SOx) and nitrous oxide (NOx) emissions was approximately US$80 per ton while abatement costs had been estimated by Bates, Gupta, and Fiedor (1993) to becin excess of US$500 per ton (McMorran and Nellor, 1994: 6).

[17] Carbon tax is a tax on the carbon content of fossil fuels like coal, oil, gas. If the carbon tax equals the social cost of carbon, it is an example of a Pigovian tax. If not, carbon tax is called indirect environmetnal tax.

4.1.1.2 Indirect Environment Taxes

An indirect environmental tax is intended to encourage pollution abatement by taxing productive inputs or final goods whose use is linked to environmental damage, rather than taxing emissions directly as is the case under a Pigouvian tax (McMorran and Nellor, 1994: 3). Taxes on fuels, industrial chemicals, pesticides and carbon, under some conditions, are examples of indirect environmental taxes. Other examples of indirect tax include the special energy taxes introduced by Denmark, Finland, the Netherlands, Norway and Sweden, fertilizer levies by Austria, Finland, the Netherlands and Sweden and taxes on beverage containers by Canada, Denmark, Norway, Finland and Sweden (McMorran and Nellor, 1994: 8). Denmark, Finland, the Netherlands, Norway and Sweden levy taxes on coal and coke use. A number of Canadian provinces, Ireland, Japan, Norway and a number of states in the United States impose tax on aviation fuel or aviation gasoline used on domestic flights (OECD, 2001: 60).

Taxes on products or inputs don't provide incentives for development and installation for degradation abatement (Panyouto, 1994: 16). This reduces the effectiveness of indirect environmental tax. As we mentioned above, Pigouvain taxes are more efficient than indirect taxes. The key to assessing the efficiency of an indirect environment tax is the nature of the linkage between the indirect environment tax base and the environment damage. The importance of this linkage is illustrated by comparing two indirect environment taxes; a carbon tax which is an efficient indirect tax and a gasoline or fuel tax which is not efficient.

In most cases an indirect tax such as gasoline tax is not as efficient as Pigouvian tax because there is not a fixed proportional relationship between the use of gasoline and local air

quality (McMorran and Nellor, 1994: 3). While these kind of taxes reduces the use of these products, they provide no incentive for degradation abatement.

Carbon dioxide emissions will be reduced efficiently whether the input (fossil oil) or emission (carbon dioxide) is taxed (McMorran and Nellor, 1994: 3). This shows that carbon taxes will be efficient because the pollution product coefficient is fixed. Contrary to other indirect taxes, carbon taxes act as a continuous incentive to adopt over clear technology and energy conservation. Carbon taxes can be also easily modified as new information comes to light. The science is changing rapidly and we should therefore seek a policy instrument capable of responding to successive revisions of data and science (Pearce, 1991: 942). Since the global warming become more important every day, carbon release should be reduced dramatically, as quickly as possible. So carbon taxes are the main instrument in order to achieve carbon emission targets as in the Kyoto Protocol.

A carbon tax is most likely to take the form of a specific excise tax on the carbon content of fuels. It needs to be distinguished from energy taxes such as ad valorem taxes (VAT). The carbon tax would vary for each of three main fuels: oil, coal and gas because their carbon content varies (Pearce, 1991: 945).

But it must be noted that Pigouvian type environmental taxes, such as per-unit charges on emissions, are only in limited use. However, there is a huge growing in indirect environmental taxes especially in OECD countries. Even if indirect environmental tax rates are generally not equal to marginal cost of negative externality, indirect environmental taxes will be one of the most efficient and real way to avoid environmental degradations because it is hard to find exact marginal cost of negative externalities. But, as in the case of carbon tax,

indirect environmental taxes must be imposed according to its damage to environment. For example Denmark, Finland, Italy, the Netherlands, Norway and Sweden have introduced levies named "carbon taxes" or "CO_2-taxes". As OECD (2001) also mentions, although these taxes often cover new fossil-based tax-bases and although the tax rates to some extent vary according to the carbon content of those fuels that are taxed, the taxes are not pure carbon taxes.

Another example is about taxes for diesel. Most of OECD countries apply three steps in their taxes for diesel: One tax rate for diesel with a sulphur content above 50 mg per kg fuel (or 50 ppm), a lower tax rate for diesel where the sulphur content is between 10 and 50 mg per kg, and a still lower tax rate for diesel where the sulphur content is below 10 mg per kg (or 10 ppm) (OECD, 2006: 32). Consequently, sulphur emission rates have fallen dramatically and are today very low in the high tax countries compared to other countries. SEPA (1997) suggest that the tax was responsible for 30% of the reduction between 1989 and 1995 in Sweden. Hammar and Löfgren (2001) find that the sulphur tax appears to have been important in reducing the actual sulphur content of fuel oil below the legal limits (Sterner and Kohlin, 2003: 133-4).

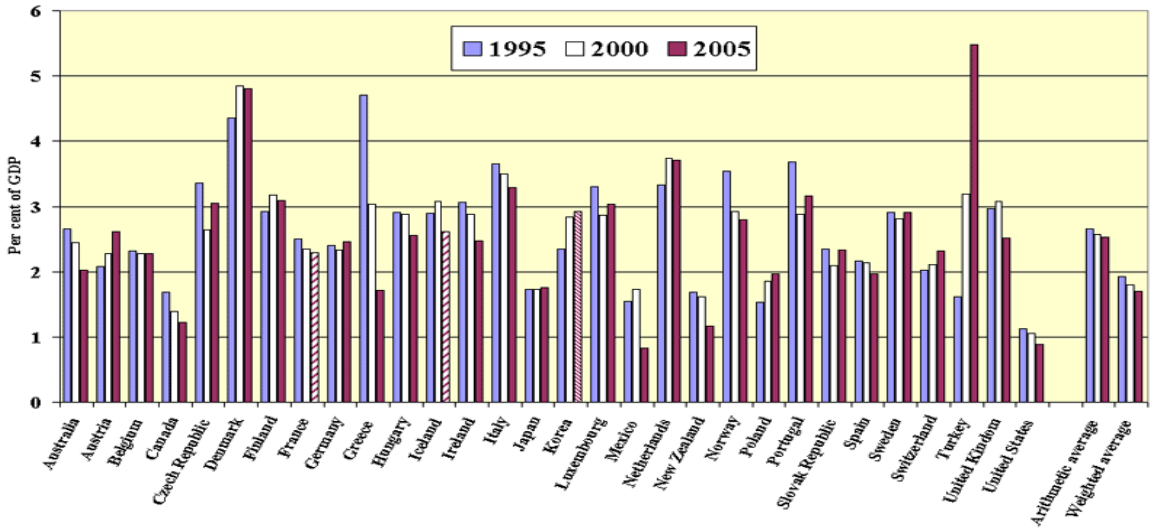
4.1.1.3. Tax Revenue from Environmental Taxation[18]

While USA prefers tradable permits European countries prefers environmental taxation in order to protect the environment. From the Figure 4.2 one could see that the revenues from environmentally related taxes declined on average in OECD countries between 1995 and 2005 when measured in per cent of GDP. While the revenues from environmentally related taxes in the percent of GDP declined in Australia, Canada, France, Norway, South

[18] We use OECD's environmental data bases. These data bases include both environmental taxes and charges.

Korea, Mexico and USA, revenues increased in countries like Belgium, Denmark, Japan, Finland and Turkey.

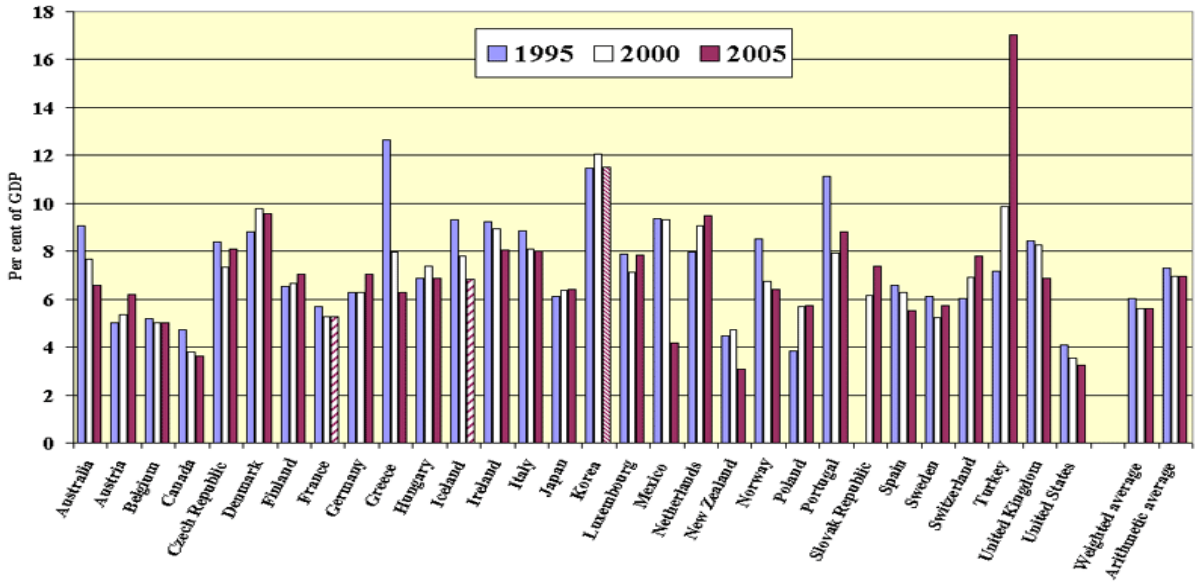
Figure 4.2 Revenues from environmentally related taxes in per cent of GDP



Source: OECD

Figure 4.3 shows that the revenues from environmentally related taxes in per centage of total tax revenues declined on average in OECD countries between 1995 and 2005. While the revenues from environmentally related taxes in percent of total tax revenues declined in Australia, Canada, Greece, Norway, South Korea, Mexico and USA, revenues increased in countries like Belgium, Denmark, Japan, Finland, Netherlands and Turkey.

Figure 4.3 Revenues from environmentally related taxes in per cent of total tax revenue



Source: OECD

When we interpret the environmental tax revenues above, we should bear in mind that most of these revenues are from the transportation sector: fuel taxes and vehicle or road related taxes (Sterner and Kohlin, 2003: 128). Since the latter are more complicated to compare as they are typically defined in different ways in different countries, we focus on fuel taxes like petrol tax and diesel tax. Table 4.1[19] shows the average rate of taxation on petrol and diesel. We can clearly see that petrol taxes in European countries are high compared with non-European countries like USA, Japan and Canada. Petrol tax in Turkey is the highest among OECD countries.

[19] This indicator is a weighted average reflecting the varying composition of fuels with different octane (premium and regular) in the proportions actually used in each country. It is expressed in international cents converted by purchasing power parity.

Table 4.1 Fuel Taxes in Eure/Litre in Selected Countries

	Petrol Tax	Diesel Tax
Italy	0,564	0,416
UK	0,709	0,709
Netherlands	0,679	0,37
France	0,607	0,428
Belgium	0,592	0,328
Finland	0,588	0,319
Germany	0,655	0,47
Norway	0,618	0,442
Sweden	0,547	0,402
Denmark	0,546	0,404
Turkey	0,753	0,461
Hungary	0,392	0,321
Czech. Rep	0,418	0,351
Japan	0,368	0,219
Australia	0,229	0,228
New Z.	0,219	0
Canada	0,171	0,134
USA	0,086	0,051
Korea	0,621	0,44

Source: OECD

There has been a growing drive to promote the use of diesel vehicles as environmentally less damaging, as they tend to have lower CO_2 emissions. Thus tax on diesel is usually lower than tax on petrol in OECD countries. But when we compare it with the level of tax on diesel in mid 90's, tax on diesel in 2007 is much higher. There are huge differences between EU member states' tax rates on diesel. Lorries often make long detours to low tax countries like Luxembourg and the Czech Republic, making big savings on the cost of filling their tanks but causing extra pollution in the process. Therefore, the European Commission proposed, on 14 March 2007, to raise the minimum tax on commercial diesel fuel by nearly 20% over the next seven years in two steps[20].

4.1.2 Charges

Charges are defined as payments for the use of resources, infrastructure, and services and are akin to market prices for private goods. They differ from market prices for private goods because they are not market determined but are administratively set by a government agency. This sets them apart from taxes which are not payments for services but a means for raising fiscal revenue. A second difference is that taxes are connected to the budget directly and part of the general government revenues while charges are extra-budgetary, aiming to recover cost for a specific public investment (Panyoutou, 1994: 19). We may divide charge systems into five groups: user charge, pollution charge (or effluent charge), product charge, administrative charge and betterment charge.

User charges are fees levied on the user of an environmental resource. It is based on the costs that affect the resource (Barde, 1994: 11). Environmental user charges are typically

[20] http://www.euractiv.com/en/transport/eu-seeks-higher-tax-diesel-fuel/article-162446

imposed to people who directly benefit from a specific environmental service in order to finance environmental service's provision (Nicolaison, Dean and Hoeller, 1991: 20). The user charge include utility charges like water, electricity, access fees to traffic, parks and beaches and collection of solid waste and sewage water. For sewage water systems, user charges are defined as the service rates that are paid by customers for wastewater collection and/or treatment facility. Countries like the USA, Switzerland and Turkey have imposed a user charge system for solid waste disposals in order to finance municipal solid waste collection.

Some countries have implemented user charges about traffic control. In Singapore, drivers must purchase monthly licences in order to drive a vehicle through the city center at peak travel periods. In Seoul, South Korea, drivers pay congestion surcharges for vehicles carrying fewer than three passengers through particular tunnels. Countries like Italy and Norway have also implemented charges on vehicles for entry into the urban (Stavins, 2001: 13).

Product charges are applied to the prices of products which create pollution either as they are manufactured, consumed or disposed of: for example, lubricant oil, fertilizer, mercury and cadmium batteries, non-returnable containers pesticides (Nicolaison, Dean and Hoeller, 1991: 20). Product taxes are used in many European countries to reduce the volume of materials in the waste stream. Charge on lubricant oil is used by Germany, France and Italy (Panayotou, 1994: 24). Countries like Belgium, Denmark, Italy and Sweden have imposed charge on batteries. South Korea imposes waste disposal charges on containers from insecticides and toxic substances, and on butane gas, cosmetics, confectionery packaging, batteries, and antifreeze (OECD 1997 as citied in Stavins, 2001: 15).

The pollution charge is a fee that is paid on discharges into the environment, based on the quantity and/or quality of discharged pollutants. When set at optimal levels (equal to the marginal damage cost), pollution charges are identical to Piguvian taxes (Panayotou, 1994: 19). In the past, pollution charges systems were so common in Soviet republics. The former Czechoslovakia introduced charges in the 1960's; Bulgaria, Hungary, and Poland in the 1970's, and parts of the former Soviet Union in the 1980's (Vincent and Farrow 1997 as citied in Stavins, 2001: 8).

Pollution charges have also been used in Western Europe in relation to water pollution. The Netherlands has imposed pollution charges on heavy metals discharges from large enterprises, and organic discharges from urban and farm households, and small, medium, and large enterprises since 1970's. The Dutch charges were originally earmarked for finance to the construction of wastewater treatment facilities. Germany also levies wastewater effluent charges, its revenues are used for water pollution control programs. France has a system of water pollution charges, the revenues from which are reinvested in water infrastructure and pollution control (Stavins, 2001: 8).

A number of Asian countries have also used pollution charges. For example, China assesses levies on 29 pollutants in wastewater, 13 industrial waste gases, and various forms of industrial solid and radioactive waste. These effluent charges appear to have helped reduce both water and air pollution intensity during the period of rapid industrial growth in China since 1979. Each 1 percent increase in the water pollution charge has reduced the intensity of organic water pollution by 0.8 percent; each 1 percent rise in the air pollution charge has reduced the pollution intensity of industrial air emissions by 0.4 percent (Wang and Wheeler 1996, Wang and Wheeler 1999 as citied in Stavins, 2001: 9-10). Malaysian, Philippines,

South Korea and Japan are among other Asian countries that have introduced pollution charges.

Pollution charges are also applied in solid waste management (Australia, Belgium, Denmark, Netherlands, United States) and in the abatement of noise from aircraft (France, Germany, Japan, Netherlands, Switzerland) (Nicolaison, Dean and Hoeller, 1991: 20).

Administrative charges or fees are generally designed to help fund licensing or license monitoring systems. A few countries already apply these tools; for example, in Norway a charge is levied when registering new chemical products (Barde, 1994: 11). Sweden imposes this charge for the cost of studying and authorising activity which will cause pollution and USA imposes this charge for inspection of motor vehicles (Nicolaison, Dean and Hoeller, 1991: 20). Belgium levies licensing charges on pesticides, radioactive materials, and hazardous waste import and export, which cover inspection and control costs. Malaysia uses a licensing system to reduce effluents from the palm oil industry (Stavins, 2001: 18).

Betterment charges are usually imposed on private property which benefits from public investment. For example, private property values may increase manifold as a result of new roads, parks, environmental clean ups, etc.

Charges are also based on polluter pays principle like taxes. Charges will increase governments' revenue. Charges give consumers and producers an incentive to reduce pollution. Companies adopt new technologies in order to lower the charges and consumers change their consumption pattern in order not to pay charges. But firms could pass on a

portion of the charges like in the environmental taxes. This will affect inflation expectations and rocket the inflation.

4.1.3 Subsidies

Instead of taxing the polluters to reduce pollution to the optimal level, polluters can be subsidized with the same amount. The optimal environmental subsidy is also equal to the marginal environmental damage at the level of optimal tax (Panyouto, 1994: 17). Subsidies are used in many ways. A distinction can be made between end-user or consumer subsidies and producer subsidies. Consumers are subsidized if consumer prices are kept lower than free-market levels, while producers are subsidized if producer prices are higher than they would have been in a non-intervention situation (Pigiola, Rajkumar and Xie, 1997: 44).

But, subsidies are not always easy to identify. For example in some cases tax provisions may not be seen a type of subsidy. But in OECD papers, the concept of subsidy includes transfers, payments, tax exemptions, assistance and protection (Pearce, 2002 and Barde and Honkatukia, 2003). Environment-related tax exemptions are the one of the most commonly used subsidy instrument. Exemptions have been introduced in personal income taxes, corporate income taxes, general sale taxes, fuel taxes and motor vehicle taxes. Tax exemptions in personal income taxes have been limited to industrial countries and include measures such as Portugal's incentives for expenditure on forms of renewable energy and Switzerland's incentives for expenditure on energy efficiency (McMorran and Nellor, 1994: 8).

Both developed and developing countries have tax exemptions in their corporate tax system that is intended to reduce environmental damage. The most common such instruments are investment tax credits and accelerated depreciation for pollution control equipment and

waste treatment facilities. Tax incentives for environmental investments, in the form of both tax credits and accelerated depreciation are practiced in developed countries like Canada, France, Korea and Taiwan, among others, while both Japan and Germany provide for depreciation and the Netherlands provides tax credits for environmental protection investments (Panayotou, 1994: 17). Kenya and Tanzania also provided accelerated depreciation for investment that are intended to prevent soil erosion and for planting permanent crops. In Latin America, incentives for reforestation are provided by Brazil, Chile and Colombia (McMorran and Nellor, 1994: 9).

There are also some examples of environment-related provisions in general sales taxes or VATs. Examples of such provisions include: Australia's exemption of recycled paper, solar power equipment and conversion of engines to natural gas or liquid propane from wholesale tax; Hungary's lower VAT rate that is applied to vehicles with catalytic converters and Argentina's higher VAT rate that is applied to some supplies of electricity (McMorran and Nellor, 1994: 9).

The outcome of environmental improvement is exactly the same as the environmental tax. But it is harder to determine a subsidy level than a tax level. While environmental taxes raise governments' revenue, subsidies are burden for government budgets. While environmental taxes are based on polluter pays principle, environmental subsidies are not. This means that tax payers to government pay the cost of environmental subsidies.

In the long run, as Panayatou (1994) mentions, subsidies tend to induce new entrants into the industry which results in both an increase pollution and increase the cost of subsidy. Environmental subsidies will worsen public deficit and income distribution and distort

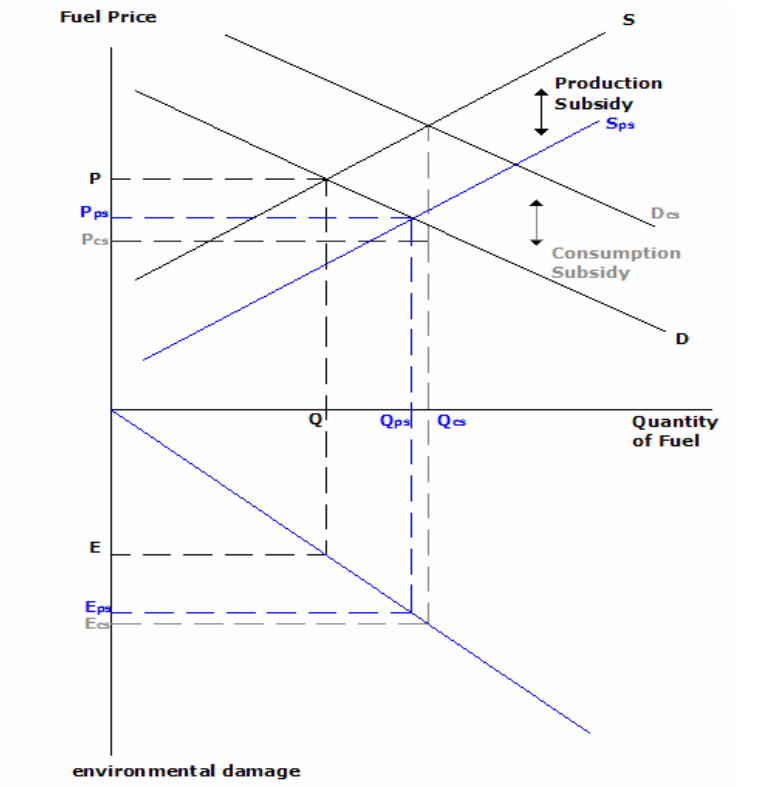
production structures especially in developing countries. But in the long run if government encourage environment friendly and energy efficient production equipment with environmental subsidies and set targets to the producers who take subsidy in order to achieve environment quality, environmental subsidies' efficiency will improve.

Apart from environmental subsidies, most countries have environmentally harmful subsidy policies. Even if subsidies are generally introduced for various social or economic reasons like promoting economic growth, employment and incomes and improving income distribution, subsidizing some sectors like agriculture, fishery, transportation, water, energy and manufacturing can have harmful effects on the environment (Barde and Honkatukia, 2003:1).

Figure 4.3 seeks to analyse the harmful effects of subsidies on environment with a specific example on fuel production. The graph on the above demonstrates how production and consumption subsidies on fuel production can be bad for the environment, assuming that the supply and/or use of the fuel results in some form of air pollution or climate destabilizing emissions. The introduction of a per-unit subsidy on fuel production shifts the supply curve down from S to Sps, causing the price to drop to Pps and the quantity of the fuel sold to rise to Qps. This equates to an increase in environmental damage from E to Eps. A per-unit consumption subsidy shifts the demand curve up from D to Dcs. This result in a drop in the net price paid by consumers to Pcs, an increase in the quantity consumed to Qcs and an increase in environmental damage to Ecs. The precise impact of any production or consumption subsidy depends on the shapes of the demand, supply and environmental damage curves. The less sensitive supply and demand are to price, the less impact subsidies have on the environment. Inter-fuel substitution will determine the overall environmental

impact of a subsidy on a given fuel, since that subsidy will normally affect the use of other fuels (IEA, 2002: 16).

Figure 4.4 Harmful Effect of Subsidy



Source: IEA 2002, p.16

Now we try to focus on the sectors which get high environmentally harmful subsidies. Subsidies reach over $1 trillion per year across the world. OECD countries give about USD 400 billion in subsidies to different economic sectors (Barde and Honkatukia, 2003: 3). Non-OECD countries mainly subsidise energy, water, fisheries and some agriculture. Relative to GDP, subsidies are twice as large in non-OECD countries (Pearce, 2000: 4).

4.1.3.1. Agricultural Subsidies

OECD countries are mainly directed towards agriculture. In 2002, the estimated total support to agriculture amounted to USD 318 billion (Barde and Honkatukia, 2003: 14), which represents 1.2% of GDP in OECD countries. During the 1990s many OECD countries began to take steps to reduce and restructure their support policies in an effort to reduce overproduction and trade distortions, and to encourage more environmentally sound use of land, soil and water. The pace of these developments has been modest and subsidies remain high in many OECD countries and for some commodities, causing adverse effects on the environment (Barde and Honkatukia, 2003: 14).

According to Barde and Honkatukia (2003), there are four types of agricultural subsidy. The first one is market price support or payments based on output. This type of subsidy increases the price that is received by producers. The higher this kind of subsidy, the greater is the use of inputs and environmentally sensitive land and the higher is the damage on environment.

The second one is payments based on input use. This kind of subsidy reduces the cost of inputs like fertilizer, pesticide for agricultural production. There are lots of scientific evidence that pesticide use in agricultural production endangers the environment and public health. As Pigiola, Rajkumar and Xie (1997) mention groundwater contamination and losses of other crops and other species are one of the harmful effects on environment. An estimated 10,000 people die and 400,000 suffer from acute pesticide poisoning annually in developing countries (Repetto 1985 as citied in Pigiola, Rajkumar and Xie, 1997: 52). In the Philippines prolonged exposure to pesticides has been found to cause chronic health problems for

farmers, including eye, dermal, pulmonary, neurologic, and kidney problems (Antle and Pingali 1995 as citied in Pigiola, Rajkumar and Xie, 1997: 52).

The environmental consequences of fertilizer use are much more ambiguous than those of pesticides. While excessive or inappropriate fertilizer use can lead to environmental damage, fertilizers properly used can have beneficial environmental effects. Sustained high yield agricultural production wouldn't be possible without using fertilizer. Low use of fertilizer can have two kinds of adverse environmental effects. First, it can result in the degradation of cultivated fields, and perhaps ultimately to their abandonment. Second, a much larger area would be required to produce any given amount of agricultural products. Fertilizers can have adverse environmental effects if they leave the fields on which they are applied. By some measures only about 50 percent of fertilizer applications are taken up by crops, meaning that substantial quantities of nutrients escape into the environment. Thus it causes degradation of water quality and eutrophication. Fertilizer based degradation of water quality also causes some health problems like blue baby syndrome (Rigiola, Rajkumar and Xie, 1997: 54-5).

The third kind of harmful subsidy is payments based on the area which has been planted or animal numbers. This kind of subsidy reduces the cost of land and animal for agricultural production. Thus producers bring additional land or animals into production and this would increase agricultural production with a non-environmentally friendly method.

The last one is payments based on farming income. When producers receive this kind of subsidy, they are not obliged to plant, own animals, or produce any particular commodities. They allow for individual choices on environmentally friendly production techniques, and do

not encourage production intensification. Therefore, the impacts of these payments on the environment are relatively benign or lower than the previous forms of support.

The share of market price support, output payments and input subsidies (such as water, fertilizers and energy subsidies), which are potentially the most environmentally harmful types of support, has decreased marginally since the mid-1980's, but they still account for nearly 80% of total support. This share varies across countries, and is highest in the countries with the highest levels of support. While the share remains persistently high in Korea and Japan, it has decreased in Iceland, Norway and Switzerland due to a shift to less distorting support (Barde and Honkatukia, 2003: 16).

New agriculture policies should consider environmental problems and be designed with environmental friendly subsidies. They must restrict using environmentally harmful inputs and prevent overproduction. Subsidies must be given in accordance with new techniques which are beneficial both for farmers and environment. Developed countries like USA and EU countries give subsidies to farmers in order to reduce the negative externalities of agricultural production. For example, New Jersey State (USA) provides technical assistance for soil surveys, and help for limiting source of pollution. Minnesota offers a wide range of loans, grants and cost-sharing to protect natural resources. EU countries give chemical reduction payments and payments for organic farming (Baylis et al, 2008: 756-757). Consequently, these kinds of subsidies should be the new generation agricultural subsidies.

4.1.3.2. Fishery Subsidies

Another sector to be focused on is that of the fishery sector. Subsidies for fisheries in OECD countries amounted to USD 6 billion in 1999 (Honkatauka). This corresponds to 20 % of the value of landings. Japan provides the largest fisheries subsidies in the OECD, followed by the European Union, United States, Canada, Korea, Spain and Norway (Barde and Honkatukia, 2003: 18).

The subsidization of fishery and the open access to marine resources have been one of the major factors in over fishing. Thus, it causes unsustainable harvests in many fisheries worldwide. Subsidies on fishery include: price and marketing support programs, direct transfers like subsidies for investment and modernization, direct income support and subsidies on inputs, lending support programmes, tax exemptions and some other general service supports (Gooday, 2002: 13).

The environmental impact of fisheries subsidies depends on the management regime in place. Most fisheries in OECD countries limit total catches and set catching restrictions for some fishes, but very few apply have truly effective management (Barde and Honkatukia, 2003: 18).

4.1.3.3. Transportation Subsidies

The number of airplane passengers, car demand and freight shipment have been growing exponentially because of globalization process and improving living standards of some segments. While GDP in OECD countries has grown by 46% from 1980 to 1995 the number of motor vehicles has increased by 59% and vehicle kilometres travelled by 72% from 1980 to 1997 (Kjellingbro and Skotte, 2005: 67). Countries especially developing ones

try to catch up developed countries all along the line. It is expected that the number of vehicles in developing countries like China and India will grow with by a significant percentage. According to OECD figures, aviation represents a relatively small but rapidly growing source of environmental impacts including global climate impacts from its growing CO_2 emissions compared to road transport, Commercial aviation releases more than 500 million tonnes of CO2 annually, equivalent to approximately 2.5% of global greenhouse gas emissions and representing 12.4% of transport emissions of CO_2. These numbers are likely to worsen in the future if transportation growth continues. Transportation growth in developing countries will be especially problematic (Kjellingbro and Skotte, 2005: 72).

Since transportation is so crucial for the economy, both developed and developing countries make use of subsidies. All transport activities have some costs and revenues. The costs cover capital charges, infrastructure, maintenance and renewal costs and vehicle operating costs. But there is also a broad range of externalities in connection with transport. Externality costs cover congestion, scarcity, accidents and some environmental effects. Revenues cover fares, freights, tariffs, fuel duty, VAT on fuel duty and vehicle exercise duty. (Nash et al, 2002: 5). So all costs that is not covered by revenues called transport subsidies.

Types of transport subsidies include transport-related services provided by government at less than full cost like direct investment in transport infrastructure or provision of traffic control services and police and emergency services; tax exemptions; direct financial transfers like risk compensation to private motorway concessionaires; and other regulations like free provision of parking space (Kjellingbro and Skotte, 2005: 68).

The subsidization of transport would increase traffic and cause serious health and environmental impacts like climate change, air pollution, noise, environmental ineffective land use and waste. One of the biggest environmental problems associated with transportation is air pollution from the combustion of fossil fuels in engines. The transport sector contributes with carbon monoxide (CO), nitrogen oxides (NOx), non-methane volatile organic compounds (NMVOC), particulate matter and a minor share of sulphur dioxide (SO_2) emissions. These kind of pollutants would cause air pollution and climate change and as we mentioned before these problems have harmful effect on health, productivity and other species.

Transport noise, particularly from road traffic and aircraft movements, is the prime source of external acoustic nuisance in urban areas. The emission of noise causes disturbance and has impacts on human health. Vibrations lead to amenity losses and damages of buildings (Nash et al., 2002: 15).

Land use for transport is another environmental problem. Additional road-building opens up for settlement along the roads leads to deforestation and thus habitat loss. Additional transport infrastructures and vehicles generate large waste streams of metals, plastics, tyres and used oil (Kjellingbro and Skotte, 2005: 72).

Considering all these negative effects, governments give weight to public transport like high-tech trains and encourage people to buy and use energy efficient vehicles like hybrid car.

4.1.3.4. Water Subsidies

Water is essential to life, health, economic activities and social development. Growing populations and economic growth and pollution of water resources put pressure on water resources. Users of the total global water supply can be divided into three groups: irrigation uses 65%, industry 25% and households use 10% of total water supply (Van Beers and de Moor 2001 as citied in Kjellingbro and Skotte, 2005:77).

Water subsidies are also another environmentally problematic issue. There are many forms of water subsidies. Water abstraction is subsidized when water is charged below cost recovery; Water supply is also subsidized through direct financial assistance like subsidizing water infrastructure for agricultural or industrial water supply. Irrigation subsidies are defined either as government expenditure covering all or some of the costs of installing and maintaining irrigation systems (Barde and Honkatukia, 2003: 7). Total water subsidies in OECD countries are around $15 billion. In developing countries total subsidies are estimated to be somewhat higher. It is estimated that water subsidies in developing countries reach $52 billion (Kjellingbro and Skotte, 2007:77).

Many countries especially developing countries subsidize water to support poor households or farmers. However, when the subsidies lower water prices, the subsidies generally don't benefit all poor people. According to Van Beers and de Moor (2001), this is mainly due to the fact that many poor people are not connected to public water systems and therefore must buy water at relative high prices (Kjellingbro and Skotte, 2005:78). Since subsidies to public water systems and irrigated area aren't usually beneficial for low income individuals, social equity concerns of water subsidies also don't work.

In general, water subsidies cause an inefficient use of waters meaning that too much water is being wasted. This not only causes pressure on water scarcity in some regions, but also causes some environmental/economic effects such as salinisation, water logging and negative biodiversity effects (Kjellingbro and Skotte, 2005:79).

4.1.3.5. Energy Subsidies

Energy is crucial for economic development process of countries and so energy subsidies are widespread in all countries. Historically, per capita energy consumption and wealth, as reflected by GDP, are nearly proportional. USA, followed closely by other highly industrialized nations, has a relatively high per capita energy consumption which is roughly equivalent to five times the global average. It is important to note that the U.S. high per capita energy consumption is directly responsible for its high standard of living. As the standard of living continues to rise globally and in developing countries in particular, it is not difficult to imagine that in the not too distant future the world will be using energy (and emitting CO2) at many times today's rate.

IPCC estimated that the demand for primary energy in developing countries and transition economies could increase by a factor of three to five by 2050. During this time period, all scenarios suggest that the main sources of primary energy will remain a combination of coal, oil, and gas, ranging from 60-80 percent in 2050. By 2050, the approximate distribution of projected demand for primary energy among developing countries and transition economy countries compared to developed countries will be about 80 percent to 20 percent, compared to about 53 percent and 47 percent in 2000. However, the per-capita use of energy will still be highest in developed countries (World Bank, 2006: 4). According to the World Bank data sets, worldwide, nearly 2.4 billion people use traditional biomass

fuels—wood, agricultural residues, and dung— for cooking and heating, and nearly 1.6 billion do not have access to electricity. Four out of five people without access to electricity live in rural areas. When we consider all of this high energy demand, we see that governments have manipulated energy prices through regulations, taxes and subsidies for the purpose of energy security, the diversification of domestic energy sources and social concerns for a long time. Thus, energy subsidies are one of the key aspects of economic development and environment.

Energy is subsidized in many ways, both direct and indirect. Among the more explicit are direct grants and tax breaks to producers and distributors. State-owned or state-managed companies are often heavily involved in the energy sector. Price controls are common. Countries with extensive energy resources often impose export restrictions, thus keeping domestic prices artificially low (Pigiola, Rajkumar and Xie, 1997: 44).

Subsidies to energy consumption and/or production, by lowering end-use prices, lead to higher energy use and reduced incentives to conserve or use energy more efficiently. An extreme example is the disregard for energy efficiency in housing blocks in Russia and other transition economies during the Soviet era. The situation has improved in the past decade. In Hungary, for instance, spending on energy efficiency jumped from $5–10 million to $80 million per year after consumer price subsidies were removed in 1997 (IEA, 2002: 13).

A subsidy is also deemed harmful to the environment if it encourages more environmental damage to take place than what would occur without the subsidy. Since fossil fuel energy sources like oil, natural gas and coal, which accounts 81% of total energy demand, have driven energy related CO_2 emissions, their effect on environment are huge.

Thus, subsidizing these kinds of fossil fuel energy sources pollutes the environment. Environmental problems are not limited to fossil fuels. As IEA (2002) mentioned, nuclear power production give rises to radioactive waste and risk of contamination and the production of certain types of renewable energy can also have severe environmental consequences, such as the ecological effects of hydroelectric dams.

A number of studies have demonstrated the harmful effects of various types of fossil-fuel subsidies. A recent study by the OECD shows that global carbon dioxide emissions would be reduced by more than 6 per cent and real income increased by 0.1 per cent by 2010 if all subsidies on fossil fuels used in industry and the power sector were removed everywhere in the world. As we see from the Table 4.2, the IEA's study shows that the removal of consumption subsidies in eight of the largest non-OECD countries would reduce primary energy use by 13 per cent, lower carbon dioxide emissions by 16 per cent and raise GDP by almost 1 per cent in those countries as a whole (IEA, 2002: 16).

Table 4.2. The Impact of Removal Energy Consumption Subsidies in Selected Countries

	Average Rate of Subsidy (% of market price)	Average economic efficiency gain (%of GDP)	Reduction in energy consumption (%)	Reduction in CO_2 (%)
China	10,9	0,4	9,4	13,4
Russia	32,5	1,5	18	17,1
India	14,2	0,3	7,2	14,1
Indonesia	27,5	0,2	7,1	11
Iran	80,4	2,2	47,5	49,4
South Africa	6,4	0,1	6,3	8,1
Venezuela	57,6	1,2	24,9	26,1
Kazakhstan	18,2	1	19,2	22,8
Total Sample	21,1	0,7	12,8	16
Total World	n.a.	n.a.	2,5	4,6

Source: IEA 2002, p.17

Certain other studies also show that the removal of energy subsidies would have positive impacts on environmental degradation. Removal of world energy subsidies of 230 billion dollar would reduce carbon emission by 7% worldwide and by as much as 21% percent in subsidizing countries (Larsen and Shah (1992) as citied in Kjellingbro and Skotte, 2005: 60).

Current investment and subsidy patterns are putting in place a carbon intensive energy infrastructure, with fossil fuel energy resources playing a dominant role. According to the

IEA, fossil fuels remain the dominant sources of primary energy, accounting for 84% of the overall increase in global demand between 2005 and 2030. Oil, natural gas and coal's share of global energy demand will remain very high -82%- in the IEA 2007's preference scenario. In the preference scenario, energy related world emissions jump by 57% between 2005 and 2030. The increase is 27% in the alternative scenario and 68% in the high growth scenario. UNDP (2007) also point out that energy-related CO_2 emissions could rise by more than 50 percent over 2005 levels by 2030 on the basis of current trends and present policies. The US$20 trillion projected to be spent between 2004 and 2030 to meet energy demand could lock the world on to an unsustainable trajectory (UNDP, 2007: 8).Thus, new alternative investments and subsidies are required in order to decarbonize economic growth and achieve sustainable development targets.

As the World Bank (2006) has noted, investment options include equipment to improve operations in existing coal or other thermal power generation, improvements in hydropower plant efficiency, insulation of buildings, district heating and a variety of existing technologies to improve efficiency of energy use and some forms of renewable energy. Hence, governments should subsidy these kinds of energy investment in order to both efficient and environmental friendly energy use.

For example, since a coal based power station is one of the most important energy source of industry clean coal technologies in power station could play an important role in reducing the environmental effects of coal use. CO_2 capture and storage (CCS) is one of the most promising option for mitigating emissions from coal fired power plants and other industrial facilities (IEA, 2007: 216). CCS is a method to reduce greenhouse gases emissions

by capturing CO_2 from large point sources such as coal based power plants and industrial facilities and storing it instead of releasing it into the atmosphere.

There are three main components of the CCS process: capture, transport and storage. All three components are found in industrial operations today, although mostly not for the purpose of CO_2 storage. The capture step involves separating CO_2 from other gaseous products. For fuel burning processes such as those in power plants, separation technologies can be used to capture CO_2 after combustion or to decarbonize the fuel before combustion. The transport step may be required to carry captured CO_2 to a suitable storage site located at a distance from the CO_2 source. To facilitate both transport and storage, the captured CO_2 gas is typically compressed to a high density at the capture facility. Potential storage methods include injection into underground geological formations, injection into the deep ocean, or industrial fixation in inorganic carbonates. Some industrial processes also might utilize and store small amounts of captured CO_2 in manufactured products (IPCC, 2005: 19).

As of mid-2005, there have been three commercial projects linking CO_2 capture and geological storage: the offshore Sleipner natural gas processing project in Norway, the Weyburn Enhanced Oil Recovery (EOR) project in Canada (which stores CO_2 captured in the United States) and the In Salah natural gas project in Algeria. Each captures and stores 1–2 MtCO2 per year. It should be noted, however, that CCS has not yet been applied at a large (e.g., 500 MW) fossil-fuel power plant, and that the overall system may not be as mature as some of its components. There are also some CCS projects in Turkey. Turkish Petroleum Cooperation performs CO_2 storage process. 638.768 ton CO_2 is transported from Raman Oil Field and Dodan Production Facility to West Raman Field and storaged in there. There is also

one project which is assisted by The Ministry of Energy and Natural Resources and The Scientific and Technological Research Council of Turkey[21].

Over the next 25 years more than a third of the power plants in OECD countries are due to be replaced, including nearly all of the coal-fired plants. OECD countries have an opportunity to change their power plants in order to lower CO_2 emissions. CCS would need to be adopted given that CO_2 emissions would be roughly six times less than those from supercritical coal-fired plants in to make a significant impact on reducing CO_2 emissions from coal-fired power plants (World Bank, 2006: 15). But the cost of CCS power plants is so high. The estimated costs of CO_2 capture at large power plants are based on engineering design studies of technologies in commercial use today, as well as on design studies for concepts currently in the research and development (R&D) stage. The electricity production costs for fossil fuel plants with capture (excluding CO_2 transport and storage costs) ranges from 0.04–0.09 US$/ kWh, as compared to 0.03–0.06 US$/kWh for similar plants without capture (IPCC, 2005: 27). Thus, in place of subsidizing environmentally harmful energy resources and technologies, this kind of a project that will be an efficient way to mitigate carbon emissions, should be subsidized.

Another efficient and environmental friendly investment and subsidy pattern will be renewable energy. Energy is essential to economic and social development and improved quality of life in all countries. Much of the world's energy, however, is currently produced and consumed in ways that could not be sustained if technology were to remain constant and if overall quantities were to increase substantially. Renewable energy offers an option that emits little or no greenhouse gases and so put our civilization on a more sustainable world.

[21] http://www.globalenerji.com.tr/hab-23000205-14,32@2300.html (accessed in 10.01.2008)

Renewable energy includes biomass, hydropower and wind, solar, geothermal, tidal and wave energy. According to World Bank and the EIA's data sets, renewable energy share of total primary energy today is between 15-17 percent and it is consumed about 10-11 billion tons of oil equivalent (Btoe) globally with the majority of energy being obtained from traditional uses of biomass for heating and cooking and large scale hydropower.

According to the IEA's preference scenario, Hydropower demand would increase by 2% between 2005 and 2030. Biomass and waste demand would increase by 1,4%. Other renewables like wind, solar, geothermal, tidal and wave energy would increase by 6,7% which is the biggest growth rate among all energy resources.

Global renewable energy capacity grew at rates of 15–30 percent annually for many technologies during the five-year period 2002–2006, including wind power, solar hot water, geothermal heating, and off-grid solar PV. The growth of grid-connected solar PV eclipsed all of these, with a 60 percent annual average growth rate for the period. Bio-fuels also grew rapidly during the period, at a 40 percent annual average for biodiesel and 15 percent for ethanol. Other technologies are growing at more ordinary rates of 3–5 percent, including large hydropower, biomass power and heat, and geothermal power, although in some countries these technologies are growing much more rapidly than the global average. These growth rates compare with global growth rates for fossil fuels of 2–4 percent in recent years (REN21, 2008: 10).

Renewable energy replaces conventional fuels in four distinct sectors: power generation, hot water and space heating, transport fuels, and rural energy. In power generation, renewable energy comprises about 5 percent of global power-generating capacity and supplies about 3.4 percent of global electricity production (excluding large hydropower). Hot water and space heating for tens of millions of buildings is supplied by biomass, solar, and geothermal. Solar hot water collectors alone are now used by an estimated 50 million households worldwide, most of these in China. Biomass and geothermal also supply heat for industry, homes, and agriculture. Biofuels for transport make small but growing contributions in some countries and a very large contribution in Brazil, where ethanol from sugar cane displaces over 40 percent of the country's gasoline consumption. The most common applications of renewable energy for rural (off-grid) energy services are cooking, lighting and other small electric needs, process motive power, water pumping, and heating and cooling. (REN21, 2008: 11).

It is known that renewable energies will have an important role to play in reducing the level of energy imports with positive implications for balance of trade and energy security. But renewables still have difficulties in taking off. In fact many renewable technologies need little effort to become competitive. Many of these costs are still higher than conventional energy technologies. Higher costs and other market barriers mean that most renewables continue to require policy support. However, economic competitiveness is not static. The costs of many renewables technologies have been declining significantly with technology improvements and cost of conventional energy sources like oil and natural gas have been increasing since 2002. Future cost competitiveness also relates to uncertain future fossil fuel prices and future carbon-related policies.

Some technologies, in particular biomass, small hydro and wind, are currently competitive and economically viable in particular compared to other decentralised applications. According to EC (1997), solar photovoltaics, although characterised by rapidly declining costs, remain more dependent on favorable conditions. Although the cost of generating electricity using solar PV systems is still substantially higher than the cost of fossil fuel generation, solar heating is more competitive and costs are expected to decline further. Globally, solar heating, mostly for water and space heating, is estimated to provide 25 times more power than PV systems and has been growing rapidly, China is the leading country in using solar heating; other major users include India, the United States, Japan, the European Union, Turkey, Israel and Australia (UN, 2006: 14).

Policies to promote renewable energy existed in a few countries in the 1980s and early 1990s, but renewable energy policies began to emerge in many more countries, states, provinces, and cities during the period 1998–2007, and especially in the past five years (REN21, 2008: 21). While Turkey's energy reqıirement for efficient and environmental friendly energy remains high[22], Turkey has not been so active as far as renewable energy subsidies go. Turkey only feeds tariffs and capital subsidy into the types of renewable energy promotion policies. Table 4.3 shows renewable energy promotion policies for these countries.

[22] It is expected that the demand for electric energy in Turkey will be 300 billion kWh by the year 2010 and 580 billion kWh by the year 2020. Turkey's electric energy demand is growing about 6–8% yearly due to fast economic growing. Turkey's use of renewable energy such as hydropower, geothermal and solar thermal energy has increased since 1990. However, the total share of renewables in the total primary energy supply (TPES) has declined, owing to the declining use of non-commercial biomass and the growing role of natural gas in the system[22] (Yüksel, 2008: 805).

Table 4.3 Renewable Energy Promotion Policies

Country	1	2	3	4	5	6	7	8	9	10
Australia		√	√			√			√	
Canada	(*)	(*)	√	√	√			(*)	√	(*)
Denmark	√				√	√		√	√	√
France	√		√	√	√				√	√
Germany	√		√	√	√					
Israel	√									
Japan	(*)	√	√			√		√		
Korea	√		√	√	√				√	
Netherlands	√		√	√		√	√			
Norway			√	√		√				√
Russia			√			√				
Spain	√		√	√					√	
Sweden		√	√	√	√	√	√			
UK		√	√		√	√				
USA	(*)	(*)	√	√	(*)	(*)	√	(*)	(*)	(*)
Argentina	√		√	(*)	√		√			
Brazil	√								√	√
China	√		√	√	√				√	√
India	(*)	(*)	√	√	√		√		√	√
Indonesia	√									
Mexico				√		√				
Turkey	√		√							

Source: REN21 2008, p.23-24

1. Feed-in tariff, 2. Renewable Portfolio Standards, 3.Capital Subsidizes or rebates, 4. Investments and other tax credits, 5. Sales tax, energy tax, excise tax and VAD reduction. 6. Tradable renewable energy certificafacets, 7 Energy production payments or tax credits, 8. Net metering, 9. Public investments, loans or finance and 10. public competitiveness bidding.

Note: Entries with an asterisk (*) mean that some states/provinces within these countries have state/province-level policies but there is no national-level policy.

Guaranteed price systems, feed-in tariffs and preferential rates are all terms for tariffs at above-market rates. Generally the government sets a premium price to be paid for power generated from renewable energy sources. The price is usually differentiated by technology, and is paid by either consumers or tax payers through the utility. The first feed in tariffs system was used in California in the 1980's. Turkey is among the countries which prefer feed in tariffs system. Germany adopted a "feed-in law" requiring utilities to purchase all renewable energy offered to them at a minimum of 90% of the retail price in order to promote private investment in renewable energy systems. For wind energy, Germany guarantees a minimum purchase price of 8.5 euro cents ($0.11) per kWh for the first five years and 5.4 euro cents ($0.07) for the rest of a 20-year period. These policies have made Germany the global leader in wind energy capacity. For private solar photovoltaic installations, Germany began in 1999 to offer interest-free 10-year loans and a guaranteed "feed-in" price of 8.5 euro cents per kWh. With the Renewable Energy Law in 2000, the guaranteed purchase price jumped to about 50 euro cents per kWh for 20 years and this create a strong incentive for private investments in solar power. Solar thermal water heaters are also subsidized in Germany (UN, 2006: 14).

Renewable energy portfolio standards, also known as quota systems, place an obligation on suppliers to provide a set quantity or percentage of their supply from renewable energy sources. These systems encourage the development of renewables at lowest cost. Australia, Belgium, Italy, Japan, Poland, Sweden and UK are among the countries that use energy portfolio standards.

Capital subsidies, investment incentives and tax credits are used to reduce the capital cost of deploying renewable energy technologies. Tax policy is used to encourage production

or to discourage consumption. On the production side, investment tax credits and property tax exemptions reduce tax payments for project owners. Tax credits, especially used in the USA, Japan and Denmark, reduce the cost of renewable energy production. India is a leader among developing countries in wind power development, with capacity currently growing at about 40% per year. Policies, which are developed and coordinated nationally by the Ministry of Non-Conventional Energy Sources, include tax incentives, expedited clearances of foreign investment, and requirements that utilities source a certain share of the electricity from renewable sources, providing opportunities for the private sector, including small-scale investment. Investment in co-generation facilities, energy efficient buildings and the like are also exempt from fixed asset taxes in China (UN, 2006: 15).

Renewable energy certificates provide a mechanism to track and register renewable electricity production. Firms that generate electricity from renewable sources declare the amount of electricity that they produce to the government institutions These institutions give them certificates that can be sold to induce customers in a voluntary green power market. While this system gives firms an opportunity to increase their profits from production, it also registers renewable energy production (Unal and Gozmen, 2007: 463-463). Most EU countries use this system in order to encourage renewable electricity production.

Bidding systems are based on competition for contracts to build projects with the lowest generation costs. Firms give their offers to the governments for building pre-determined specific projects. Policy makers rank these orders from the firms which desire low subsidy to high subsidy. At the end policy makers subsidy some firms that desire low subsidy (Unal and Gozen, 2007: 461). India, China, Denmark, France, Latvia and Brazil are among the countries that use binding systems.

Net Metering is generally a consumer-based renewable energy incentive. Net metering is a electricity policy for consumers who own renewable energy facilities, such as wind or solar power, or uses vehicle-to-grid systems. Energy consumers become energy produces under this system and they start to sell their surplus electricity. Net is used in the sense of meaning that consumers pay the difference between their production and consumption as electricity bill. Under net metering, a system owner receives credit for at least a portion of the electricity they generate. Japan, Tailand, Canada and USA are among the countries which use this system.

Consequently, a 'good subsidy' is the one that enhances access to modern energy or has a positive impact on the environment, while sustaining incentives for efficient delivery and consumption. There is no single right approach or model. Every country needs to take account of national and local circumstances, including its own set of policy objectives and priorities, its stage of economic development, market and economic conditions, the state of public finances and the institutional framework. But there are a number of basic principles that countries need to apply in designing subsidies and implementing reforms to existing programmes (IEA, 2002: 19).

Experience shows that subsidy programmes should be:

● **well-targeted**—subsidies should go only to those who are meant and deserve to receive them;

● **efficient**—subsidies should not undermine incentives for suppliers or consumers to provide or use a service efficiently;

● **soundly based**—subsidy programmes should be justified by a thorough analysis of the associated costs and benefits;

● **practical**—the overall amount of the subsidy should be affordable and the administration of the subsidy programme should be at a reasonable cost;

● **transparent**—information on the amount of government money spent on the subsidy and on subsidy recipients should be disclosed; and

● **limited in time**—sunset clauses should be included in the design of subsidy programmes to avoid consumers and producers becoming overly dependent on this support and costs spiralling out of control.

4.1.4 Tradable Permits

While the earnestness of environmental degradation increases, a variety of instruments is also on the increase. First, command and control policies were more popular than environmental taxation. Later, environmental taxation progressed because of its efficiency relative to command and control policies. The comparison between environmental taxation and tradable permits is currently a very hot debate.

In its most general use, a tradable permit can be defined as a transferable right for a common pool resource. In environmental applications, the common pool resource is air or

water that does not contain concentrations of substances that harm human health or that degrade air or water quality in some manner. A narrower and more specific definition for environmental applications is then: a transferable right to emit a substance that can create pollution (Ellerman, 2005:124). Tradable permits have already been used to deal with various environmental degradation since the 1970s, notably air pollution, fisheries, water management, waste management and land-use. But, applications of tradable permits have been focused on climate change since mid 1990's.

Their origins are usually traced back to a famous article by Ronald Coase (1960) that favors market solution rather than government intervention in order to solve environmental problem. J.H. Dales (1968) suggested introducing transferable pollution rights to deal with pollution externalities (Philibert and Reinaud, 2004: 8). Since experience of direct government intervention like command and control policies reduced the confidence of effectiveness of this policies and rising of liberal movement had forced to find new market based instruments for environmental degradation. Then, tradable permits became new generation of environmental policy. Politic inducement is a key reason why tradable permits are chosen. Although European countries have used environmental taxation, taxation has always been politically difficult at a federal level in the US (Ellerman, 2005: 127).

While tradable permits present some advantages as a market based instrument, they also attract some controversies. The most fundamental objection is that tradable permits are immoral. When you give right to governments and firms to pollute, you also give them a private property. At first, all emissions no matter how small in amount are socially damaging. Second, private property is inappropriate for common resources. Thus, some critics mention that tradable permits are immoral (Ellerman, 2000: 5).

A secondary objection to tradable permit systems arises from the almost complete elimination of the environmental regulator. Once the cap has been set and the permits allocated, the regulator's task is limited to that of monitoring emissions and withdrawing permits. The regulator need no longer decide what is required of each and every source to meet the environmental goal (Ellerman, 2000:5). According to some critics efficient government and inter-government intervention are needed to conduct a tradable permits system.

All policies generate advantages and disadvantages and controversies. In this part, two kinds of tradable permits, baseline and credit programme and cap and trade programme are analysed. Theoretical explanations and country experiences are provided in order to understand the advantages, disadvantages and effectiveness of tradable permits relative to other environmental policies.

4.1.4.1 Credit Programme

In the credit programmes there is no explicit cap on aggregate emissions. Instead, each firm has the right to emit a relative level of emissions. This relative may be derived from historical emissions or from a performance standard that expressed as an emissions rate per unit of output or activity such as GDP or energy consumption, or per unit of input. In a credit programme a set of polluters that are not under an aggregate cap can create credits by reducing their emissions below a baseline level of emissions. These credits can be purchased by polluters that are under a regulatory limit.

A distinctive feature of credit trading is certification, the process by which the regulator determines that credit-worthy activity has occurred and that the credit can be transferred (Ellerman, 2005:125). The US established air emissions trading regimes that were based on credit programme especially after mid 1970's. These regimes had limited results, so US has turned to cap and trade regimes since mid 90's (Philibert and Reinaud, 2004: 11). As in the case of the US, it is generally accepted that a credit programme is not as efficient as cap and trade programme.

A number of authors (Burtraw et al. 2001, Haites and Mullins 2001, Harrison and Radov 2002, Gielen et al. 2002) have noted the economic incentive to increase output under a relative target but not under an absolute target. Other authors note that input or output as well as emissions must be monitored under a relative target, whereas only emissions need to be monitored under an absolute target (as in the case of cap and trade programme). Relative targets will likely require two sets of measurement, verification and reporting systems. Thus all of these increase the complexity of credit programme and reduce the efficiency of credit programme (Philibert and Reinaud, 2004: 26). Consequently, cap and trade programme is more efficient that credit programme and it has been mostly used since this millennium. So, we will focus more on cap and trade programme when we analyse tradable permits. But there are some new mechanisms which are project and credit based programmes. Now, we try to understand these new mechanisms.

The Kyoto Protocol established Flexibility Mechanisms or Kyoto Mechanisms like the Clean Development Mechanism (CDM) and Joint Implementation (JI) to lower the overall costs of achieving its emissions targets. The individual targets for Annex I Parties are listed in

the Kyoto Protocol's Annex B. These add up to a total cut in greenhouse-gas emissions of at least 5% from 1990 levels in the commitment period 2008-2012.

The Clean Development Mechanism and Joint Implementation are project based activities in which the buyer purchases emission credits from a project that can credibly and verifiably demonstrate that it reduces greenhouse gas emissions compared with what would have happened otherwise (Capoor and Ambroisi, 2006). Thus they are kind of credit programme. Article 12 of the Protocol creates the Clean Development Mechanism (CDM) by which emissions trading can be conducted with non-Annex B parties. Kyoto's "Clean Development Mechanism" is intended to provide a way for developing countries to reduce their emissions without emissions caps. Abatement activity in the non-Annex B party's territory creates a Certified Emission Reduction (CER) that can be transferred to an Annex B party in order to meet its emission limitation obligations under the Protocol (Ellerman, 2000:8).

Between the end of 2004 and 2007, there were 771 registered projects with a declared reduction commitment of 162.5 Mt CO2e. Just four countries—Brazil, China, India and Mexico—accounted for three quarters of all projects, with sub-Saharan Africa representing less than 2 percent (UNDP, 2007: 129).

Another Kyoto mechanism nearly identical to CDM is joint implementation. However, instead of the project taking place in a developing nation, it is created in an industrialized nation (Writer, 2007). Article 6 of the Protocol allows Annex B countries to engage in Joint Implementation (JI). One Annex B country finances project-specific emission reduction activity in the territory of another Annex B party and thereby earns Emission Reduction Units

(ERUs) that can be transferred to its own country in order to meet its emission limitation obligations under the Protocol (Ellerman, 2000: 7).

Project-based activities primarily through the Clean Development Mechanism and Joint Implementation grew sharply from $2,89 billion in 2005 to $5,47 billion in 2006 (Capoor and Ambroisi, 2006). Even if their market is growing and they are beneficial for development process, as we see in the above these kinds of programmes will concentrate on some specific countries. This will increase lobbying efforts and also corruption between countries. Thus efficient inter-government intervention is needed for monitoring, regulating and enforcing. This is so crucial in order to achieve a better environment with an efficient and fair way. The rules governing the generation of mitigation credits must be based on principles of 'supplementary' and 'additionally'. The former requires that domestic action on mitigation should be the primary source of emission reductions; the latter requires evidence that the abatement would not have occurred in the absence of investment.

4.1.4.2 Cap and Trade Programme

Under this programme, a central authority like a government or intergovernmental organization decide how many tons of greenhouse gases can be emitted each year and sets a limit or cap on the amount of a pollutant that can be emitted. After that government or intergovernmental organization issues a fixed number of permits or "rights to pollute" equal to the permissible total emissions and distributes them among polluting firms or governments in a given area. A market for permits is established and permits are traded among firms or governments. Firms or governments that maintain their emission levels below their allotted level can sell or lease their surplus allotments to other firms or countries. The Kyoto Protocol binds developed nations to a cap and trade system for the six major greenhouse gasses. The

greenhouse gases included in the limit are listed in Annex A and they are CO_2, methane (CH_4), nitrous oxide (N2O), hydro fluorocarbons (HFCs), per fluorocarbons (PFCs), and sulfur hexafluoride (SF_6) (Ellerman, 2000:6). Under the Kyoto, for the 5-year compliance period from 2008 until 2012, nations that emit less than their limit will be able to sell surplus to nations that exceed their limit.

Allocation of permits to firms is rightly seen as one of the most difficult issues to deal with in implementing a cap-and-trade system. The two basic alternatives are either to "auction" the permits or to "grandfather" them, that is, to grant them without payment to incumbents based on some principle, usually historical use (Ellerman, 2000: 21). In the case of auctions, participants in the trading system have to purchase the allowances from the government to cover their expected emissions. In the case of grandfathering, the distribution of allowances is free of charge and is based on the past emissions levels. The base period or historical emissions principle starts from emissions in a chosen period, either one reference year or the average over several years (Philibert and Reinaud, 2004: 24).

Governments that implemented carbon taxes before may be reluctant to relinquish the revenue benefits, especially if some other distortionary taxes had been cut when the carbon tax was introduced. Thus a auctioning will be preferable under that case. The reason of this is that it has an opportunity to create a double dividend, if revenue from auctioning is used to cut distortionary taxes. However, allocation with grandfathering will be politically preferable for government in order to get along with business sector because its cost for companies is cheaper than auctioning.

Another difficult issue to deal with in implementing a cap-and-trade system is monitoring. It represents technical difficulties like whether monitoring would occur

"upstream" or "downstream". In an upstream design, the entities accountable for meeting a cap are producers and importers of fossil energy like refinery, port, gas pipeline, coal mine. In a downstream design, the regime applies to end-users of fossil fuel energy like the emitter, government agency, household (Philibert and Reinaud, 2004: 23).

Although carbon is ultimately emitted by hundreds of millions of fossil-fuel users— including vehicles, buildings, and factories— it enters the economy through a relatively small number of fossil-fuel suppliers. Thus an upstream regime will minimize monitoring costs. In contrast to upstream regime, downstream regime will require monitoring and regulating many more entities. These show that the monitoring cost of upstream regime will be lower than the downstream regime's one. But it has to be retained that downstream regime could cover most carbon emissions (CBO, 2001). But it is not so realistic to monitor and regulate this amount of entitles and this would reduce the possibility of abatement of carbon emissions. An upstream regime would limit fossil-fuel production that increases prices for those fuels and for energy-intensive goods and services. Even if high price affects the economy in the short term, the higher prices will encourage using environment friendly and energy efficient technologies and reduce carbon emissions in the long run. Thus, upstream regime seems to be more efficient way for better development.

A penalization system is another difficult issue raised by the introduction of a cap and trade programme. An efficient cap and trade programme must require a credible and non-discretionary penalization system. If penalties are low relative to meeting the cap or limit of emissions, then the firms or governments will not try to improve its technology and reduce its emission level. Therefore, the cap and trade programme would become meaningless. Ellerman (2000) observes that penalties are usually several times the expected market price.

For example, in the U.S. SO^2 allowance trading system, the penalty was set at $2000 in 1995 and escalated with inflation thereafter. While penalties that proposed in European systems are high, Danish and French systems had low penalties in the past. For instance, the Danish penalty was 40 DKK per ton CO_2 (≈US$22/ton C) (Ellerman, 2000: 26).

It is generally accepted that a cap and trade programme must be a global regime. Even if it is hard to constitute a global regime in the short run, the more realistic option will be for rich countries to develop carbon pricing structures under cap and trade programme. As these structures evolve, developing countries would start integrate this programme over time as institutional conditions allow (UNDP, 2007: 10). While a global regime would cut down the emission level and the cost of the programme, it would also avoid the leakage of industry problem. Firms would try to beware the cost of cap and trade programme. So, they could move their facilities to a country, especially a least developed or developing country, where there is no cap and trade programme. This means that the leakage problem would occur and struggle for reducing emissions level fall through.

While cap and trade programme is a preferable market based instrument, it has some objections and difficulties as we mentioned above. Allocation, monitoring, regulating and penalization systems must be selected with an acceptable and efficient way.

The United Kingdom, the USA, Denmark, Norway and the EU are some of the important countries that have used cap and trade programme since mid 1990's. It is important to examine US, UK and EU emissions trading schemes in detail now. As mentioned above, after the mid 70's, the USA's credit based tradable permits programmes weren't effective on both the environmental and cost side. Therefore, cap and trade programmes have been

increasingly popular since the 1990's. The Acid Rain 2Programme is one of the largest and most successful emissions cap and trade program in the USA. It was established in 1990 to reduce industrial emissions of sulphur dioxide (SO), which cause acid rain and directly affect human health. Programme did not begin immediately, but was implemented in two stages: Phase I (beginning January 1, 1995) and Phase II (starting January 1, 2000).

Under the programme SO_2 emissions are expected to be reduced by 50% from 1980 to 2010 into two phases. The Programme's emissions cap and allowance trading approach has achieved a strict environmental goal at dramatically lower costs than traditional forms of regulation. Results from the first few years of operations (since 1995) show that plants overachieved pollution reduction goals, at compliance costs of less than half those predicted by EPA, and many times lower than those predicted by industry (Tietenberg et all, 1999: 27).

Since, the US currently lacks a national target for overall emission reductions, states and cities setting out quantitative goals of their own For instance Cities are also setting emission reduction targets. In total, around 522 mayors, representing 65 million Americans, are aiming to reach what would have been the United States Kyoto target of a 7 percent reduction below 1990 levels by 2012. Cap and trade programs in states like Massachusetts and California are one of them. California's is the biggest one among the US states[23] (UNDP, 2007: 115). One of the important experiences was that of The Regional Clean Air Incentives Market (RECLAIM) programme which began in 1994. It scheduled a reduction from 1994 to 2003 of 8.3 per cent per year in NOx emissions and 6.8 per cent per year in SO_2 emissions, in the Los Angeles/California. The programme included power plants, refineries, cement factories and other industrial sources (Philibert and Reinaud, 2004: 11). NOx emissions

[23] According to UNCTAD World Development Report 2007, If California were a country, it would be the world's fourteenth largest source of CO2 emissions—that is why its leadership is of global importance.

declined 60 percent, from approximately 25,000 tons in 1994 to 10,000 tons in 2004. SO_2 emissions declined 50 percent, from approximately 7,000 tons in 1994 to 3,500 tons in 2004 (EPA, 2006: 12)

There is a new programme being implemented in the USA called The Regional Greenhouse Gas Initiative (RGGI). The RGGI, established in 2005, is the first mandatory cap-and-trade programme in the United States, setting limits on emissions from power plants. It now extends to 10 states. The target is to cap emissions at current levels from 2009 to 2015 and then to reduce them by 10 percent by 2019 (UNDP, 2007: 115). All of these programmes show that even if US government hasn't took any action and set a national target, conscious cities and states would be a starting point via cap and trade programmes in order to reduce US emission levels.

Another experiment in the cap and trade program was the United Kingdom Trading Scheme. The Scheme began with an auction in March 2002, in which companies and other organisations which are known as 'Direct Participants' bid emission reductions over the five years 2002 to 2006. They committed to reducing their emissions by 3.96m tones of carbon dioxide equivalent (CO_2e) by the end of the Scheme. (NAO, 2004: 9). The objective of the scheme is twofold – to enable business to gain practical experience with trading, and to assist in achieving the UK's Kyoto target (-12.5% over 1990 by 2010) and domestic target (-23% over 1990 by 2010). By the end of 2002, two of the smaller Direct Participants had withdrawn from the Scheme and a third withdrew during 2003. There were 31 remaining Direct Participants, with total targets to deliver emissions reductions of 3.96 million tonnes by 2006 (NAO, 2004: 13). Over the lifetime of the scheme Direct Participants have achieved

emissions reductions of over 7.2 million tones of CO_2e [24]. This figure shows that the scheme came to a successful conclusion. United Kingdom gain huge experience with this scheme in order to achieve its Kyoto and domestic target.

According to Article 4 of the Kyoto Protocol, the EU has a commitment to reduce its overall emissions jointly by 8 per cent over 1990. EU members have different targets as can be seen from the Table 4.4. (Ellerman, 2000:7).

Table 4.4. EU Countries' Target in Emission Reduction

Country	% Change in Emissions from 1990 level	%Share of 1990 EU emissions	Country	% Change in Emissions from 1990 level	%Share of 1990 EU emissions
Luxemburg	-28	0,3	Finland	0	1,7
Germany	-21	27,7	France	0	14,7
Denmark	-21	1,7	Sweden	+4	1,6
Austria	-13	1,7	Ireland	+13	1,3
UK	-12,5	17,9	Spain	+15	7
Belgium	-7,5	3,2	Greece	+25	2,4
Italy	-6,5	12,5	Portugal	+27	1,6
Netharlands	-6	4,8	EU	-8	100

Source: Ellerman 2000, p.7

Accordingly, the EU should use certain policies in order to achieve this target. European Union's Emissions Trading Scheme (ETS) is one of them and the world's largest cap-and trade programme. EU ETS has two phases. The first phase of the EU ETS ran from 2005 to 2007. Phase II will run for a 5-year period to the end of 2012. In the first phase of the EU ETS, 95 percent of allowances were distributed free of charge and 5 percent of allowances were distributed by auctioning. In the second phase 10 percent of allowances will be distributed by auctioning (UNDP, 2007: 129).

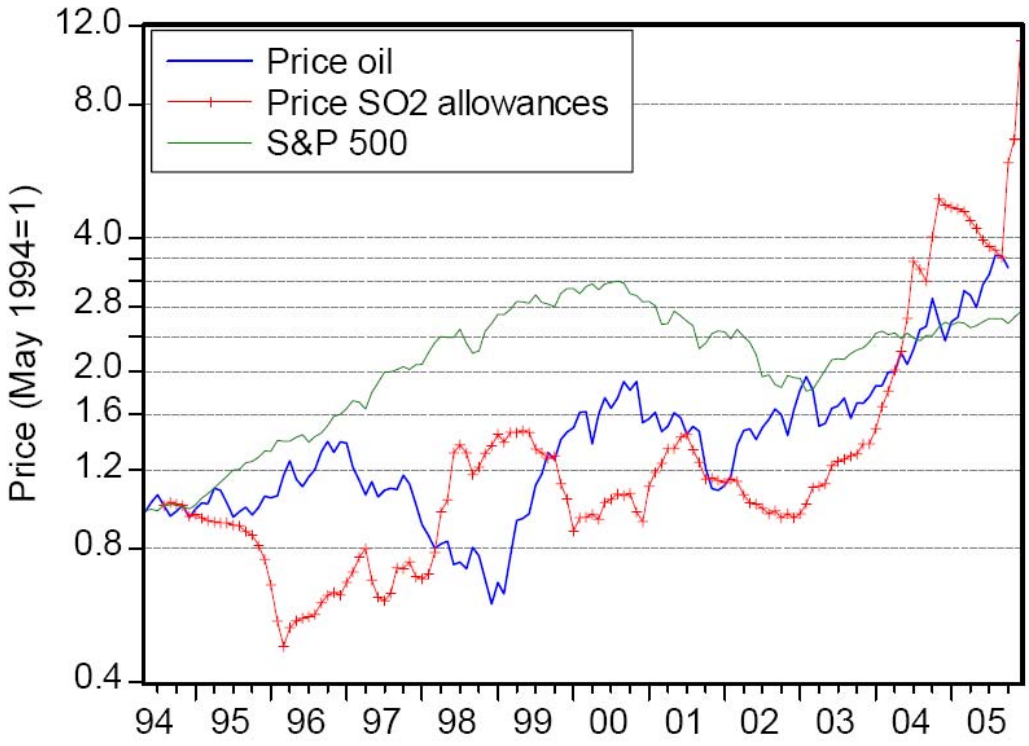
[24] This numbers are taken from UK Department for Environment Food and Rural Affairs. http://www.defra.gov.uk/Environment/climatechange/trading/uk/index.htm

According to the UNDP (2007), the EU has faced some systemic problems during the first phase. First of all, allowance prices climbed to €30/t CO_2 in April 2006, and then prices reduces to €1/t CO_2 in 2007. Thus, this creates huge volatility and uncertainty. This kind of volatility and uncertainty would affect firms' costs. This would also reduce the efficiency of scheme. While, the ETS scheme had little effect to reduce overall emissions during the first 3 years, it generated very large profits for some firms. The United Kingdom Government estimates that large electricity generators gained £1.2 billion (US$2.2 billion) in 2005. Estimates for the power sectors in France, Germany and the Netherlands put the windfall profit generated through emissions trading at around €6 billion (US$7.5 billion) for 2005. These figures corroborate the views of environmentalists who see tradable permits as a new profit area and proliferation of the free market. Another problem is about the allocation of allowances. Allowances have been distributed on the basis of grandfathering. Therefore, government has skipped huge revenue that will be used to cut other distortionary taxes. It is generally accepted that the caps on emissions have been set far too high through lobbying of efforts of powerful vested interests. Since the caps are too high, it becomes too hard to achieve Kyoto target.

After analyzing some experiments in the field of cap and trade programmes, now we compare cap and trade programme and environmental taxes like emission tax. The following text attempts to determine which one is better. While cap and trade programme is a quantity instrument because it fixes the overall emission level and allows the price to vary, emission tax a price instrument because it fixes the price and allows the emission to vary according to economic activity. In effect, taxes offer greater price certainty, while cap-and-trade offers greater environmental certainty. This shows that permit prices may become unstable and therefore unpredictable. As wee see from the Figure 4.5, More extensive evidence comes

from the history of the U.S. sulfur-emissions trading program. SO_2 trading prices have varied from a low of $70 per ton in 1996 to $1500 per ton in late 2005 (Nordhaus, 2005: 15). Volatility in allowance prices has been higher than volatility in oil price and stock market. Thus it would create uncertainties

Figure 4.5 Prices of SO2 Allowances 1994-2005



Source: Nordhaus 2005 p.30

Parry and Pizer (2007) mention that volatility in permit prices may accentuate energy price fluctuations and deter carbon-saving investments in capital or R&D because of uncertainty and high costs. Therefore, it would affect economic activity negatively and frustrate better environment by hindering environment friendly technology investment Therefore, it would affect economic activity negatively and frustrate better environment by hindering environment friendly technology investment. But we have to note that marginal tax

rates would have to be adjusted to reflect undershooting or overshooting of environmental effect and uncertainties over marginal tax rates could become a source of instability in energy prices (UNDP, 2007: 127). Thus, policy makers must determine the tax rate carefully after considering its effects on environment and economic activity.

Consequently, all of these show that uncertainties in price and environmental effects are crucial when we compare tax and trade programme and emissions tax. Weitzman (1974) analyzed this uncertainty problem. The choice between price and quantity regulation under imperfect information is analysed in Weitzman 1974. It is shown that the choice between the two regulatory instruments depends on the sign of the sum of the curvatures of the cost and benefit functions. If the marginal benefit function is steep and the marginal abatement cost function is flat quantity regulation is preferred over price regulation, while price regulation is preferred over quantity regulation if the marginal benefit function is flat and the marginal abatement cost function is steep (Nordhaus, 2005: 14). With steep marginal benefit and flat marginal abatement cost curves, a tax that is too high will generate big increase in abatement costs and a small increase in abatement benefits. So cap and trade would be preferable. With flat marginal benefit and steep marginal abatement cost curves, a cap that is too high will generate a big increase in abatement costs and a small increase in abatement benefits. So, tax would be preferable. Nordhaus (2005) argued that the structure of the costs and damages in climate change gives a strong presumption to price-type approaches. While the costs are related to the flow of emissions, the benefits are related to the stock of greenhouse gases. Since, abatement costs are likely to be highly nonlinear as a function of emissions, emissions tax is preferable in the case of uncertainties.

Another difference between cap and trade and emissions tax occurs in terms of administration and corruption. Advocates of tax-based approaches point out that tax offers wider administrative advantages. In principle, the standard tax system with a little modification would be enough to conduct the system. It would be also a pretext to improve its taxation system for countries who suffer from taxation system. On the other hand, cap and trade programme requires additional intuitions, markets, brokers and information tools even if its cost is not so expensive (Parry and Pizer, 2007: 7). Since the concentration of CO_2 emissions in large-scale power plants and carbon-intensive industries makes it possible to operate cap-and-trade schemes through a relatively small number of enterprises, it would reduce these administration costs (UNDP, 2007: 127). The Cap and trade programme is generally seen to generate more corruption than tax system. Since cap and trade represents quota rent to business and it is also a new cost burden for business, it is open to manipulation by power companies, oil companies, etc. (UNDP, 2007: 126). As mentioned above, there has been huge pressure from vested interest on European governments for high caps and allocation based on grandfathering.

4.2. Command and Control Policies

Command and control instruments are environmental policies that rely on regulations like prohibition, enforcement and usually standards. When environmental policies were adopted in the late 1960's and early 1970's in industrialized countries, the authorities turned largely to regulatory controls (Barde, 1994: 7). While command and control instruments remains one of the most commonly used environmental policies, market based instruments like tax, subsidy, tradable permits are becoming increasingly important day by day. From a theoretical framework, a command and control instrument like emissions standard will be

efficient, if emission chosen where the marginal costs of abatement equal the marginal social costs of pollutant damage.

Command and control approach generally consists of standards. There are four categories of standards (Barde, 1994: 7):

1. Ambient quality standards specify the characteristics of the receiving environment, e.g, the maximum concentration of nitrates in drinking water, of sulphur dioxide in the atmosphere, or the maximum noise level in front of houses; in fact, they constitute an environmental objective. One of the good examples about this standard is the U.S. Clean Air Act. The Clean Air Act for six common air pollutants. They are particle matter, ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides and lead.

2. Emission or discharge standards are maximum allowable discharges of pollutants into the environment, e.g., maximum BOD discharge into waters, maximum SOx emission into the atmosphere by an industry. In its extreme form, an emission standard is a ban on the use or discharge of a substance, usually toxic substances.

3. Process and technology standards specify the type of production process or emission reduction equipment that polluting plants must install (e.g., a specific type of scrubber, pipe, water purification device etc.).For instance, The U.S 1972 Water Pollution Control Act Amendments identify the best available technology for preventing and reducing pollution.

4. Product standards define the characteristics of potentially polluting products such as chemicals, detergents, fertilizers, automobiles, fuels etc. For example, U.S Congress

established the Corporate Average Fuel Economy (CAFE) program, which required automobile manufacturers to increase the average fuel economy of motor vehicles sold in the US. Congress set the standards, they are 27.5 miles per gallon (mpg) for new cars and 20.7 mpg for new light trucks and sport utility vehicles (Bezdek and Wndling, 2005: 407).

The main advantage of command and control instruments is that there is a longstanding experience with them in other fields of public concern such as health and safety, labor, etc. (Barde, 1994: 8). Command and controls are also the more widely understood form of environmental policies.

In general market based instruments seem more cost effective than command and control instruments at achieving a given emissions reduction (Harrington and Morgenstein, 2004: 15). The financial cost of command and control instruments is generally so high because they require special staffs, monitoring and enforcement. An optimum standard is difficult to determine especially with non-marketable goods.

Under a command and control instrument, companies have no incentive to reduce pollution beyond the standard. For example, the requirement to install a specific technology discourages research and development (R&D) activities, since discovering new ways to reduce emissions can lead to more stringent regulations Harrington and Morgenstein, 2004: 15-16). So this means that while market based instruments have the potential to provide powerful incentives for companies to adopt cheaper and better pollution control technologies, command and control instruments have little incentive to do that (Stavins, 2002: 3). Regulations may be too easily subject to bargaining and negotiations between public

authorities and private sector and possibly subject to corruption (Barde, 1994: 8). Thus, there could be political costs involved in this approach.

4.3. Pure Market-Based Environmental Policies

Traditionally, environmental policies have been regarded as the responsibility of national governments. But neoclassical economists argue that public sector policies have been less cost effective due to friction caused by inefficiency, administrative problems and a limited choice of instruments. In brief, a common feature of neoliberal theories is their deep mistrust of the state. In this framework, state seems like evil. Therefore, market solutions without and government interventions seek to find efficient ways in order to internalize the externalities.

Government intervention began to sweep the whole world from the early 1980's. During this period, many countries embarked on the path of extensive restructuring of the relation between state and economy, including regulatory reforms, budget cuts and privatization. When we look at this transformation from the point of environmental policies, we clearly see that environmental policies like command and control instruments, in which government has a pivotal role, give their place to market based policies like tradable permits system and pure market based instrument like voluntary approaches. Tradable permits system and voluntary approaches policies' origins come from The Coase Theorem. We analyze tradable permits before because even if government's role is minimal, it has. Thus this policy is called market based public policy. Before we analyze voluntary approaches which is a pure-market based policy, we focus on the Coase Theorem in order to understand unconscious of this policy.

4.3.1 The Coase Theorem

The Coase Theorem Solution proposes negotiation among parties who face externalities in order to secure an optimal solution (Ozsabuncuoglu and Ugur, 2005: 258). Coase (1960) clarifies the conditions under which the private market works perfectly well on its own, without government intervention[25]. The Coase Theorem states that when there are well defined property rights and costless bargaining, externalities don't necessarily create market failures because negotiations between parities can lead to internalize the externalities (Gruber, 2005: 130). The Coase Theorem suggests that governments' role is only to establish property rights in dealing with externalities.

To see how a market might compensate the externality under the Coase Theorem, let's assume that there is a fisherman and cement factory operate along a certain riverside. The fisherman owns the river and uses this river in order to fish. In other words, the fisherman has a property right over the river. But, the cement factory pollutes the river and its production hurts the fisherman's livelihood. The fisherman will demand an end to the factory's polluting of the river because of his property right over the river. If there is no environment friendly production technology available to the cement factory, this will lead to the shutting down of the factory.

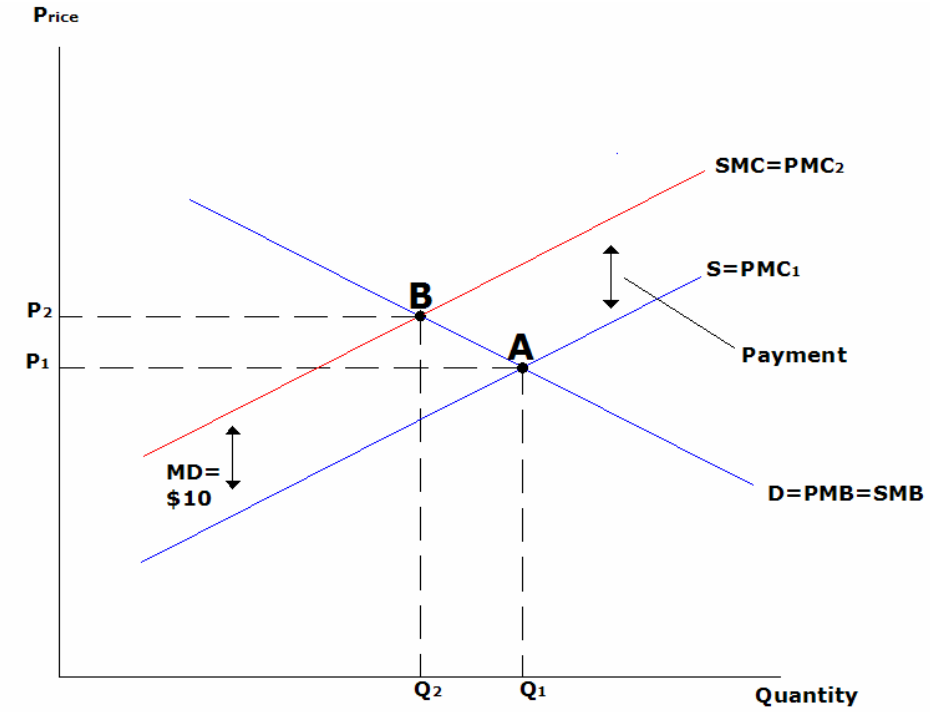
In this case, the cement factory owner might propose a compromise: he will pay the fishermen $10 for each bag of cement produced. So, the fisherman will be fully compensated for the damage to his fishing ground. As long as the cement factory can make a profit with this extra $10 payment per bag, then this is a better deal for the factory than shutting down.

[25] Ronald H. Coase won 1991 Nobel Price in economics for his discovery and clarification of the significance of transaction costs and property rights for the institutional structure and functioning of the economy.

There is a mutual benefit in this case. This type of resolution is called internalizing the externality.

Initially, the cement market is in equilibrium at point *A*, with quantity *Q*1 and price *P*1, where $PMB = PMC_1$. On the other hand, the socially optimal level of cement production is at point *B*, with quantity *Q*2 and price *P*2, where *SMB* = *SMC*= *PMC*+*MD*. Because the marginal cost of producing each bag of cement has increased by $10, the private marginal cost curve shifts upward from PMC_1 to PMC_2, which equals *SMC*. That is, social marginal costs are private marginal costs plus $10, so by adding $10 to the private marginal costs, we raise the *PMC* to equal the *SMC*. There is no longer overproduction because the social marginal costs and benefits of each unit of production are equalized.

Figure 4.6 The Coase Theorem



Source: Gruber, 2005

Three conditions are required for the Coase Theorem. First, property rights must be well defined. Second, bargaining costs must be low enough for these parties to find each other. Third, exclusion must be feasible. This means that there are no other parties are able to free ride on agreement (Fullerton, 2001: 13). While there are three main conditions, theoretically this theorem also require perfect knowledge of one another's (convex) production and profit or utility functions, competitive markets, costless court system, profit-maximizing producers and expected utility-maximizing consumers, agents will strike mutually advantageous bargains in the absence of transactions costs and no wealth effects. (Hoffman and Spitzer, 1982: 73)

Varian (2006) has also noted that in very special circumstances, where preferences are quasilinear, the strict version of the theorem may hold. The assumption of Quasilinear preferences[26] implies that the demands for the good causing the externalities don't depend on the distribution of income. Therefore a reallocation of endowments doesn't affect the efficient amount of the externalities. This is sometimes expressed by saying that the Coase Theorem is valid if there are no income effects (Varian, 2006: 631-632).

All these requirements show that this theory would appear to rescue the standard competitive model from market failures like externality and make government intervention unnecessary (Gruber, 2005: 131). The first question about this theory is that how can we assign the blame. If there are two parties (affected party and party who create externality), it

[26]Quasilinear preferences is a special case of a utility function for which

$u(x,y) = v(x) + y$

That is, the consumer's utility increases linearly with y. Increasing income don't change the demand for good x at all and all the extra income goes directly to the consumption of good y. If preferences are quasilinear, we sometimes say that there is a zero income effect.

will be easy to assign the blame. But as in the case of global warming, there is no more choice to assign the blame clearly. So, this becomes a big hamper for negotiations between parties because global warming is a multilateral problem.

Assigning the damage is also another problem. Parties would overstate the damage in order to ensure largest possible payment (Gruber, 2005: 131). Governmental or intergovernmental intervention will be required in order to assemble the parities and assign the damage. This also doesn't guarantee that the negotiation resolve the problem as in the Kyoto. Another problem is holdout problem which can arise when the property rights in questions are hold by more than one party. The shared property rights give each party power over all others (Gruber, 2005: 131-132). This will also obstruct the negotiations. Free rider problem will likely occur among party that creates externalities.

4.3.2 Voluntary Approaches

As Börkey, Glachant and Leveque (1998) observed, voluntary approaches (VA) involve voluntary initiatives, voluntary action plans, voluntary programmes, voluntary codes, voluntary accords, voluntary agreements, voluntary instruments, pollution control agreements, environmental agreements, negotiated agreements, non-regulatory agreements, self-regulation, self-regulatory arrangements, co- regulation, and covenants. Unlike economic instruments, voluntary approaches do not originate from economic theory. Whereas hundreds of papers in economic reviews deal with taxes and tradable permits, there are less studies which are dedicated to voluntary approaches. There is also no systematic data collection that is carried out about voluntary approaches. But as far as we learn from literature, Environmental agreements between industry and government first appeared in OECD

countries during the 1960s and the early 1970s. In Japan the first agreement of this sort was signed in 1964 between the city of Yokohama and an electric power company[27]. The first voluntary agreements in EU countries were implemented in France (1971) and United Kingdom (1972) (Dalkmann et all, 2005: 27).

The OECD (1999) distinguished between four types of voluntary approaches depending on the parties involved. They are the following (OECD, 2003: 18):

Unilateral commitments consist of environmental improvement programmes which is set up by firms and communicated to their stakeholders (employees, shareholders, clients, etc.). The definition of the environmental targets, as well as of the provisions governing compliance is determined by the firms themselves. Nevertheless, firms may delegate monitoring and dispute resolution to a third party in order to strengthen the credibility and the environmental effectiveness of their commitments. In fact, most individual unilateral commitments are now designed in the framework of either ISO 14000 or the European Eco-Management and Auditing Scheme (EMAS) (Börkey and Leveque, 2000: 36).

One example of such a unilateral arrangement is the Responsible Care initiative undertaken by the Canadian Chemical Producers' Association. Responsible Care was devised in response to a decline in public confidence in the chemical industry and to a threat of more stringent regulations (Börkey, Glachant and Leveque, 1998: 9).

[27] Yokohama City was suffering from air pollution in its coastal industrial area. In 1964, Electric Power Development Co., a company controlled by the former Ministry of International Trade and Industry (MITI), was planning to build a new coal-fired thermal power plant in the Yokohama. It was expected that this power plant would aggravate the air pollution in the city. In order to avoid this, Yokohama City developed a pollution control contract in which EPDC committed to take measures to achieve agreed targets beyond the levels required by law (OECD, 2003: 34).

Private agreements: Contracts between a firm or sometimes a group of firms and those who are harmed by its emissions (workers, local inhabitants, neighbouring firms, etc.) or their representatives (community organisations, environmental associations, trade unions, business associations). The contract stipulates the undertaking of an environmental management programme and/or the setting of a pollution abatement device.

To illustrate this point, the Canadian Automotive Workers Union has negotiated cleaner production provisions into collective agreements with the motor industry, involving 50 000 workers in 30 plants, as well as suppliers and part manufacturers. In another instance, the Swedish Confederation of Professional Employees (TCO) has developed the "6E model" (Ecology, Emissions, Efficiency, Economy, Energy, Ergonomics). This model provides a framework for plans to improve both the external and working environment. Another example is an agreement between a Volvo plant and a British Petroleum refinery near Göteborg in Sweden. BP changed its oil supply for less costly petroleum but with a higher content in sulphur. As a result, the Volvo cars parked next to the refinery were damaged by corrosion. Within the agreement, BP paid for Volvo to cover its parking lot in order to protect cars against sulphur emissions (Henry, 1994 as citied in Börkey, Glachant and Leveque, 1998: 10).

Negotiated agreements: Negotiated agreements (NAs) are contracts resulting from negotiations between public (national, federal or regional) authorities and industry. They contain a target and a time schedule to achieve it. The public authority commitment generally consists of not introducing a new piece of legislation like environmental standard or an environmental tax) unless the voluntary action fails to meet the agreed target.

While all member states use NAs as a substitute for traditional regulation or market-based instruments, only one member state, The Netherlands, uses negotiated agreements for dealing with all major environmental themes. Most countries have a rather selective use of agreements. In fact The Netherlands is the only member state where negotiated agreements have become the key instrument of environmental policy. In this country, negotiated agreements are now pervasive. In the 1990 National Environmental Policy Plan (NEPP), the 'target group approach' (which relies on the use of NAs) has been elected to be the main tool of environmental policy, addressing all areas of priority environmental concern (Börkey and Leveque, 2000: 46).

Public voluntary programmes: Within this type of voluntary approach, participating firms agree to standards which have been developed by public bodies such as environmental agencies. The scheme defines the conditions of individual membership, the provisions to be complied with by the firms, the monitoring criteria and the evaluation of the results. Economic benefits in the form of R&D subsidies, technical assistance, and reputation can be provided by the public body.

An example of such a no mandatory regulation is the EcoManagement and Auditing Scheme (EMAS) implemented within the European Union since 1993. To register under EMAS a firm must establish a company environmental policy; conduct an environmental review of its sites; set and implement an environmental improvement programme and an environmental management system; have its policy and sites reviewed, and its improvement programme and management system examined. Registered firms are then able to use and display a statement of participation. Another example is provided by the voluntary

programmes set by the US EPA, like Energy Star, Green Lights and 33/50 (Börkey, Glachant and Leveque, 1998: 10).

Börkey, Glachant and Leveque (1998) charaterised these four different types of voluntary approaches in their consideration of several other criteria. The following criteria are:

- **Individual/collective voluntary approaches**: Voluntary approaches may be developed by single firms as well as by coalitions of firms. For example, Canada's Responsible Care is a sector based program.

- **Local/global voluntary approaches**: Voluntary approaches cover the whole spectrum of geographic delimitations. They may take place at a local, national, federal or regional level. There are also worldwide level voluntary approaches. One such case is the agreement signed between the International Federation of Building and Wood Workers and IKEA. It concerns working conditions, the natural environment and health and safety for workers at enterprises throughout the world that manufacture and supply goods for the Swedish company. It covers almost one million employees in 70 countries.

- **Binding/nonbinding agreement**: The legal form of voluntary approaches is an important element of their success. Agreements are binding for both parties when they include sanctions in the case of non-compliance and are enforceable through a court's decision. For instance, in Germany the constitutional law does not allow the

government to sign negotiated agreements. In the Netherlands, on the other hand, negotiated agreements are legally binding

- **Open/closed access to third parties**: As they operate outside the regular legislative process, voluntary approaches are not necessarily transparent and open to all vested interests. In essence, the voluntary approaches' arena is limited to one or two parties.

- **Target-based and implementation-based voluntary approaches**: Voluntary approaches may concern setting pollution abatement objectives and/or the implementation of measures to achieve them. Where the environmental objective is set by the party(ies) involved in the voluntary approach, the voluntary approach is called target based. Where the target is set within the framework of the regular legislative process by government and the voluntary approach only consists of selecting and implementing the measures to achieve it, the voluntary approach is termed implementation based. To illustrate, most Dutch negotiated agreements belong to this second type.

Even if regulations or market based instruments like tax are not an attractive environmental policy for companies, the voluntary approach seems to be attractive. So, the question is why companies become voluntary for an environmental subject. There is variety of answers about this question. First of all a commonly expected gain associated with voluntary abatement is avoiding the costs of public regulations. The government may plan to introduce a new standard or a new tax. Thus companies may choose voluntary approaches in order to avoid regulations or tax. By signing a VA, firms can avoid or postpone the

introduction of more costly regulations or regulatory instruments, or weaken the pressure from existing or forthcoming public intervention policies (Brauand and Carraro, 2004: 12).

Secondly, companies may have improved the efficiency of their manufacturing processes, generating environmental improvements as a happy byproduct (Lyon and Maxwell, 1999). This may be achieved by better use of inputs. To illustrate, according to the EPA (1996), the US public voluntary scheme Green Lights (a programme which provides participants with technical information for the use of efficient lighting) has resulted in energy savings of about US$100 million per year and participants have experienced rates of return of up to 50 per cent. Most of the potential of no-regret actions is based on the lack of information or know-how of firms with respect to new clean technologies (Börkey, Glachant and Leveque, 1998: 16). Brauand and Carraro (2004) state that an input saving may also arise from a reduction of labour costs. For example, the adoption of environmental friendly technologies could reduce the 'premium' which employers must pay to convince their employees to work in firms with a bad environmental performance, in particular if the environmental damage is likely to affect health conditions within and nearby the factories where workers and their households work and live.

Another expected gain for firms is provided by product differentiation on environmental performances and their signalling to consumers via advertisement and labelling. Firms may be rewarded according to different mechanisms. Increasing numbers of consumers, especially in the developed countries, have high income levels, therefore, they are willing to buy environmentally-friendly products High environmental friendly products will then be sold at higher prices. Examples of such environmentally friendly products include organic produce, tuna caught with dolphin-safe nets, biodegradable plastic bags, reformulated

gasoline, and McDonalds Corporation's substitution of paper wrapping for styrofoam "clamshell" sandwich containers (Lyon and Maxwell, 1999: 7). Another example is from Germany where there was a general switch in demand from paints containing solvent to solvent free paints which is labelled with the Blue Angel[28]. This took place in spite of a relative price increase for the types of paint that qualify for the Blue Angel (OECD, 2003: 57).

The OECD (2003) examined a few econometric studies of the impacts of voluntary policy approaches. One example supplied by Khanna and Damon (1999) used several econometric methods in order to disentangle the contribution of the US EPA's 33/50 Program[29] to the observed reduction in toxic releases over the period 1991-1993. Khanna and Damon (1999) showed that total releases by the firms fell 54% over the 1991-1993 period. However, after correcting sample selection bias and the effects of other factors on releases Khanna (2001) shows that only 28% of the reduction relative to the pre-program level could be attributable to the program. Bjoner and Jensen (2002) present an econometric analysis of industrial energy demand in order to quantify and compare the effect of the Danish CO2. tax, the related energy efficiency agreements and of subsidies given to investments in energy efficiency projects. The energy efficiency agreements have two opposing effects on energy use. On the one hand, the companies had to carry out certain activities like realising proposed energy saving projects from the energy audits and to increase energy management activities. The effect of these activities was estimated be a 9% reduction in energy use. On the other hand, companies with an agreement obtained tax reduction which increased their energy use. The increase in energy use was estimated to be 1-5%. Hence it appears that the agreement

[28] The Blue Angel (Blauer Engel) is a German certification for products and services that have environmentally friendly aspects.
[29] The 33/50 Program was launched by US EPA in 1991 to induce firms to voluntarily reduce their emissions of 17 high priority toxic chemicals. The program aimed to reduce the aggregate releases of these chemicals by 33% in 1992 and by 50% by 1995.

resulted in a reduction in energy use overall. Weber et al. (2002) present estimates of energy saving due to the US EPA's Energy Star program[30]. They conclude that Energy Star has already proven successful in its established programs, having saved 4.7 quads of energy and prevented carbon emissions of 9 metric tonnes in 2000 alone.

Even if voluntary approaches are an attractive and new generation environmental policy, they have also some shortcomings. Voluntary approaches may have strong anti-competitive effects. Market power will be enhanced when Voluntary approaches are adopted. Brauand and Carraro (2004) express that consumers' sensitivity to environment quality may also provide a firm with an incentive to increase its own demand and market share vis à vis its competitors. This can be done by differentiating its products with respect to those offered by competitors, thus creating a niche market where a higher market price can be imposed. Additionally, voluntary approach may create a barrier to entry in terms of economies of scale or of absolute cost advantages since voluntary target is reached through large R&D investments or by building a new large plant. Moreover, Lyon and Maxwell (1999) mention that firms with higher R&D intensities are more likely to undertake voluntary environmental initiatives.

Another shortcoming is free-riding. This is threatening those negotiated agreements where firms are collectively liable for the implementation of targets. The rationale for free riding is as follows: even if pollution abatement generates a collective benefit (e.g. via escaping new legislation), an individual firm may be tempted not to reduce its emissions and bet on other firms to reduce theirs. The problem is that all firms together benefit from

[30] It is a voluntary labelling program that promotes the use of energy efficient home appliances, computer equipment etc.

pollution abatement, but each firm individually has an even greater benefit if it does not abate pollution while all the others do (Börkey and Leveque, 2000: 50).

One of the most important questions about voluntary approaches is whether they are economically efficient. As understood from the above, in theory voluntary approaches can be more cost efficient than command-and-control approaches, but less efficient than economic instruments like tax and tradable permits. Economic efficiency depends on how the pollution abatement efforts are allocated among the different pollution sources. Thus, pollution abatement cost should be minimized in order to achive economic efficiency. To minimize total abatement cost, marginal costs of abatement should be equal among all contributors. The equalization of marginal abatement costs can be achieved by providing all polluters the same incentive at the margin to abate. Trading scheme and tax would create abatement incentive (OECD, 2003: 66).

Another issue related to economic efficiency is the impact different types of instruments might have on: diffusion of existing technologies and development of new technologies. The spread of existing technology and the development of new technology can lead to dynamic gains. A tradable permits system or a tax provides a continuous incentive for firms to apply existing technologies and to develop new technologies. For example, permit or credit price provide an incentive to develop new Technologies that can be free up permits or credits at a later stage. But, once a firm which participate in a voluntary approach has fulfilled any individual obligation, the firm is no longer has any economic incentive to developed new technologies (OECD, 2003: 92).

These are pros and cons to voluntary agreements. Finally it is necessary to answer how voluntary approaches work better. According to the OECD (2003), voluntary approaches work well under:

- *Clearly defined targets*; the targets should be transparent and clearly defined. Voluntary approaches should define quantitative targets

- *Credible regulatory threats*; made at the negotiation stage, a threat of regulation by public authorities provides companies with incentive to go beyond the Business-as-Usual trend

- *Credible and reliable monitoring*; provisions for monitoring and reporting are essential for keeping track of performance improvements. Monitoring should be made at both the company level and the sector level.

- *Third party participation*; involving third parties in the process of setting the Voluntary approaches' objectives and in its performance monitoring increases the credibility of Voluntary approaches.

- *Penalties for non-compliance*; sanctions for non-complying firms should be set.

- *Information-oriented provisions*; in order to maximise the informational soft effects of voluntary approaches, support for activities in technical assistance, technical workshops, edition of best practice guides should be promoted.

- *Provisions reducing the risk for competition distortions*; in the case of collective voluntary approaches, safeguards against adverse effects on competition could be provided by notification of new voluntary approaches to anti-trust authorities

5. THE EFFECTS OF ENVIRONMENTAL POLICIES ON ECONOMIC DEVELOPMENT

It is so clear that we must limit global environmental degradations in order to live in a habitable world and also give this chance to our next generations. Thus environmental policies will play a crucial role for a clean environment. As such in all policies, environmental policies have also some plus and minus. Discussions about environmental policies, as in the Kyoto Protocol, occur about these effects. Some countries, especially developing countries, don't want to undertake the costs of environmental policies in order to achieve their development targets. Environmental policies seem a bottleneck for them. Some developed countries like USA also don't desire to undertake strict environmental policies in order not to slow down their economic growth.

In this chapter, we try to analyze whether environmental policies are harmful for economic development or not. We saw that environmental policies have impacts on economic growth, employment, income distribution, productivity & technology and health. These items also represent economic development of countries. Thus we view some studies about effects of environmental policies with considering these items. Now, we check growth, employment, income distribution, productivity & technology and health effects of environmental policies respectively.

5.1. Growth Effects

As we see above, dark green environmental approach and deep ecologism seem economic growth as a one of the major reason of environmental degradation. Marxist economists also mention that capitalist-style economic growth engenders huge environmental degradations and sooner or later this system dissolves itself. In the literature, the relationship between environmental policy and economic growth is a controversial issue. In this debate there are two polarized side. On the one side, there are those who predict a drastic slowdown and even the economic collapse if the societies do not change their capitalist-style economic and if they do not forbid the emission of stock pollutants and the consumption of natural resources. According to them, environmental policies would be an option to reduce future losses from environmental degradations and policies would bring some positive growth. On the other side, there are some people who think that, at least in the developing countries, the environmental policies tend to inhibit economic growth and thus, it is better to wait (Cordero et all, 2005).

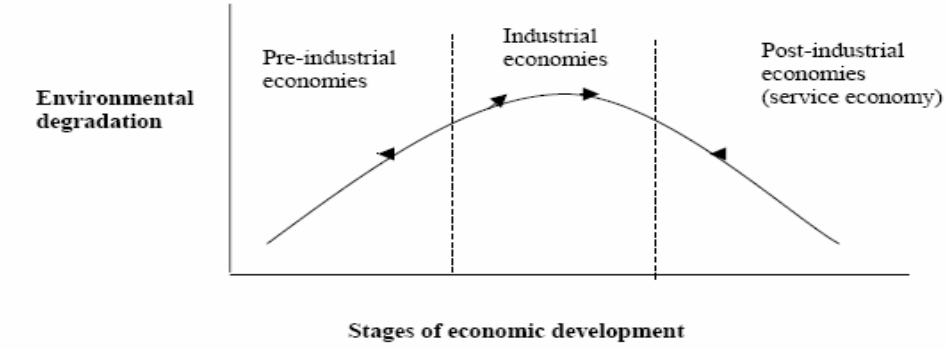
In other words, some people argue that countries face a trade-off between economic growth and a better quality of the environment. In other words, environmental policies which are crucial for environmental policies have some costs like investments in pollution control equipment, energy efficient technologies and clean up of hazardous wastes. Thus these costs would be harmful for economic growth of some countries. But others argue that environmental policies which are crucial for environmental quality are necessary in order to guarantee the quality of life in the present and in the future and so achieve sustainable economic growth.

In the literature, there are mainly two kinds of studies about the link between environmental policies and economic growth. The first one is about the Environmental Kuznets Curve and environmental policies' effect on this curve. The second one is about the effects of environmental policies on economic growth. In this section we focus on these studies in order to understand whether environmental policies are harmful for economic growth or not.

5.1.1. Environmental Kuznets Curve

There is an argument based on the assumption that at the beginning of a growth path in a country increase in GDP corresponds with high environmental degradation but after a turning point increase in GDP corresponds with low environmental degradation. This relationship can be shown in an inverted U-shaped curve. This relationship is sometimes called as the "Environmental Kuznets Curve" (EKC), following the observation of Kuznets (1955)[31]. ,

Figure 5.1. Environmental Kuznets Curve



Source: Panayotou 2003 p.3

[31] Kuznets (1955) illustrated that the shape of the relationship between income per capita and income inequality is inverted-U.

Panayotou (1997) identifies the different types of effects that income has on environmental quality, or rather the different effects of economic development that are transmitted through the income variable. This enables us to identify the determinants of environmental quality:

- the scale of economic activity;
- the composition (or structure) of economic activity;
- the effect of income on the demand and supply of pollution abatement effort (what we might term the 'pure' income effects).

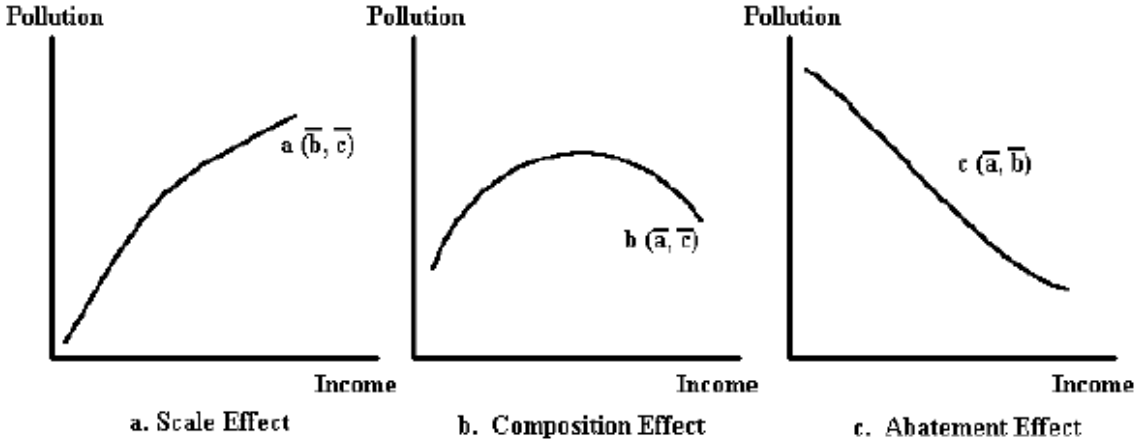
The larger the scale of economic activity per unit of area, the higher the level of environmental degradation is likely to be, since increased economic activity results in increased levels of resource use and waste generation. Therefore, the scale effect on pollution is expected to be a monotonically increasing function of income since the larger the scale of economic activity per unit of area the higher the level of environmental degradation.

The composition of economic activity influences environmental quality because of the differential pollution intensity of different sectors of the economy. As income grows, the structure of economy tends to change and gradually increases cleaner activities that produce less pollution. Environmental degradation tends to increase as the structure of economy changes from rural to urban or agricultural to industrial, but it starts to fall with another structural change from an energy intensive industry to services and knowledge based technology intensive industry. Since the share of industry in GDP first rises with economic growth and then declines as the country moves from the pre-industrial to the post-industrial

stage of development, we expect an inverted-U shaped relationship between environmental pollution and GDP.

While the generation of pollution is driven by the scale and composition of economic activity, the abatement of pollution is driven by demand and supply factors, both of which are influenced by income. On the demand side, at low income levels, people are more concerned with food and other material needs and less concerned with environmental quality. At higher income levels, people begin to demand higher levels of environmental quality to go along with their increased prosperity. On the supply side, low incomes mean that countries and individuals cannot afford much expenditure on pollution abatement even if the demand were there. Economic growth not only creates the demand for improved environmental quality, but it also makes the resources available to supply it.

Figure 5.2 Decomposition of Income Effects on the Environment



Source: Panayotou 2003 p.19

While Panayotou (1997) identifies three different types of effect under which economic growth affects the quality of environment, there are also some different effects in the literature like the displacement effect (Stagl, 1999; Giegis et all, 2007). Displacement effect is an alternative explanation which put the view of the increasing demand for environmental quality as a consequence of increased income. In displacement effect, it is expected that trade liberalization or openness will lead to more rapid growth of pollution intensive industries in less developed economies as developed economies enforce strict environmental regulations. Thus, developed countries start to specialize on more clean goods and inverted U-curves may be the result of this specialization[32].

Apart from these theoretical explanations of the EKC, there are also a number of empirical analyses that have been completed. One of the earliest empirical studies to examine the relationship between environmental quality and income per capita is Grossman and Krueger (1991). They found that "Economic growth tends to alleviate pollution problems once a country's per capita income reaches about $4,000 to $5,000" (1991, p. 35-6). Another earliest empirical study is Shafik and Bandyopadhyay's (1992) one. Shafik and Bandyopadhyay (1992) estimated EKCs for different indicators for environmental degradation, including lack of clean water and sanitation, deforestation, suspended particulate manner, municipal waste, and sulfur oxides and carbon emissions. They found that lack of clean water and urban sanitation declined with increasing incomes and over time. They also found that 1 percent increase in per capita income for an economy with income above $12,240 would lead to a more than one percent decline in sulfur dioxide concentration. Pollution from particulates; gets worse initially as countries become more energy intensive, and then improve. The improvement begins at a per capita income level of around $3,280.

[32] Displacement effect will be also explained by pollution Haven Hypothesis. This hypothesis refers that multinational firms, particularly highly polluting ones, relocate their activities to countries with lower environmental standards (generally developing countries).

However, they found that carbon emissons per capita and solid waste do not improve with rising incomes They showed that per capita income appears to have very little bearing on the rate of deforestation.

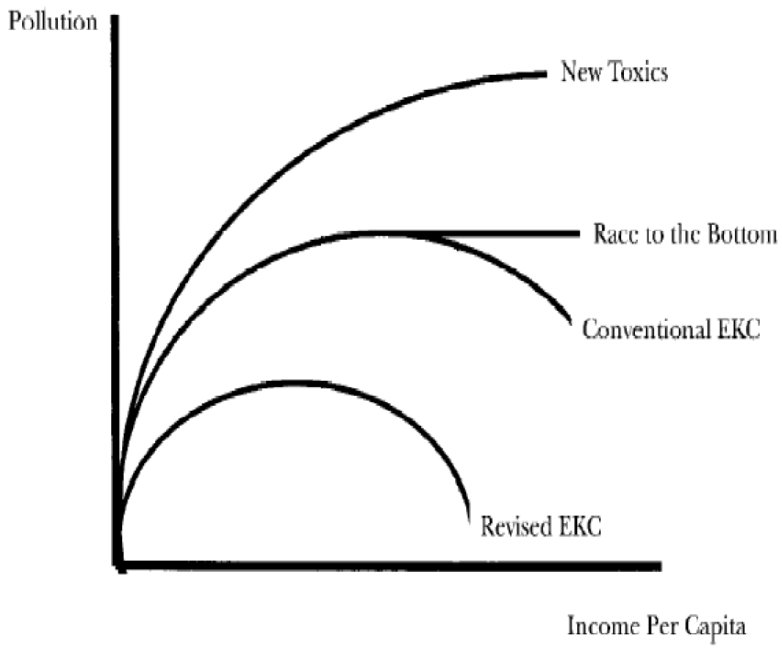
Selden and Song (1994) found that SO_2 starts to decline at US$ 8,709, nitrogen oxide at US$ 11,217, SPM at US$ 10,289, and carbon monoxide at US$ 5,963. Generally, for most of the pollution indicators, the estimated turning point lies within the income range of US$ 3,000–10,000 (at a constant price, 1985 US dollar) (Giegis et all, 2007: 45).

However, there was controversy even from this early stage of empirical investigation as Hettegi et al. (1992) found no evidence to suggest that the inverted U-shape relationship exists for toxic intensity from manufacturing industries (Webber and Allen, 2004: 7). Cole et al. (1997) estimated income-environment relationships for many environmental indicators, including total energy use, transport emissions of SO_2, SPM and NO_2, nitrates in water, traffic volumes, chlorafluorocarbons (CFC) emissions and methane. They found inverted-U shaped curves only for local air pollutants and CFCs and concluded that meaningful EKCs exist only for local air pollutants, while indicators with a more global, more indirect, environmental impact either increase with income or else have high turning points with large standard errors" (Panayotou, 2003: 14-15).

Dasgupta et al. (2002) compare different beliefs and results about EKC. Dasgupta et al. (2002) mentions that some pessimists hold that, even certain pollutants are reduced as income increases; industrial society continously creates new, unregulated and potentially toxic pollutants. Thus pollution would increase an income increases. Some other pessimist scholars claim that the curve will rise to a horiziontal line, as we see in Figure 5.3, at maximum

existing pollution levels as globalization promotes a "race to bottom" in environmental standards. In that case, total pollution around the world will not change but distribution of pollution changes. According to some pessimists, the level of the EKC is actually dropping and shifting to the left, as growth generates less pollution in the early stages of industrialization and pollution begins falling at lower income leves, as shown by the "revised EKC" in Figure 5.3.

Figure 5.3. Environmental Kuznets Curve under Different Scenarios



Source: Dasgupta et al. 2002 p.148

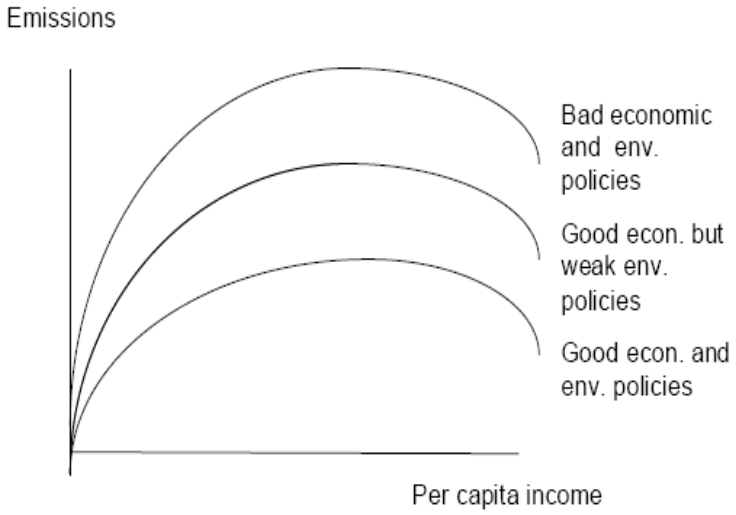
Some researchers have examined the relationship between economic growth and environmetal degradation and find N shaped EKC. N shaped EKC means that that pollution increases as a country develops decreases once the threshold GDP is reached, and then begins increasing as national income continues to increase. For instance, Grossman and Krueger

(1991) find, for instance, that between income levels of $10,000 and $15,000 there was a secondary turning-point, at which the levels of ambient air pollution

Panayatou, (1997) and Panayotou (2003) state that it is not the higher income per se which brings about the environmental improvement but the supply response and policy responsiveness to the growing demand for environmental quality, through enactment of environmental legislation and development of new institutions to protect the environment. The effect of good policies on environmental quality is expected to be positive. The height or degree of convexity of the curve is already largely a function of policies and markets (Panayotou, 1997: 467).

The height of the EKC reflects the environmental price of economic growth: the steeper its upward section, the more environmental damage the country suffers for each increment in its income per capita. In order to reduce the environmental price of economic growth and lower the EKC below ecological thresholds, as seen in Figure 5.4, it is recommended removal of environmentally harmful subsidies, better-defined and enforced property rights, full cost pricing of resources to reflect growing scarcities, and internalization of environmental costs through pollution taxes or tradable permits.

Figure 5.4 The Effects of Environmental Policies on EKC



Source: O'Connor 1996 p.13

Panayotou (1997) estimates the effects on economic growth and a policy variable on SO_2 and finds that a 1 per cent increase in the growth rate results in 0.56 mg/m3 increase in the ambient concentration of SO_2, while an improvement in the quality of institutions (enforcement of contracts) by one unit (or by 15 per cent) results in reduction of ambient SO_2 concentration by 3.4 mg/m3. He also finds that better policy results in dramatically lower ambient SO_2 levels while faster growth and higher population density result in marginally to moderately higher ambient SO_2 levels.

O'Connor (1996) state that some East Asian economies have done quite well in implementing economic policies that encourage less environmentally damaging patterns of development, but some of them have been so weak in the area of environmental policy. For example, Japan and Singapore are represented by the lowest curve in the figure. In Japan, a number pollution control mechanisms and waste treatment plants became effective in the

early 1970s. Thus Japan outperformed nearly every other OECD countries in economic growth and environmental performance. Singapore has been among the most innovative countries anywhere in the world in terms of environmental policy design. O'Connor (1996) also mentions that countries like Indonesia, Thailand and Malaysia is on the highest curve.

The World Bank (1992) has also stated that economic policies, environmental investments and environmental policies affect environmental quality. Economic policies affect the scale, composition and efficiency of production which can result in positive or negative effects on the environment. Efficiency gains and change in output structure (the composition effect) from economic policies will often reduce the demand for natural resource inputs and so increase environmental quality. Environmental policies can reinforce efficiency in resource use and provide incentives for adopting less-damaging technologies and practices. The investments that are induced by environmental policies will change the way in which goods and services are produced and may result in lower output but will also generate benefits that can increase human welfare. Thus both environmental policies and environmental investments have positive effects on environmental quality.

5.1.2 Direct Effects of Environmental Policies on Economic Growth

The question- whether environmental policies are attractive instrument to enhance environmental quality without seriously damaging economic growth or not- is really tough to answer clearly. It is accurate that environmental policies have some costs, but it is also accurate that our consumption and production patterns have some excessive burden on the environment.

On the one hand, some scholars suggest that the burden of environmental policies is harmful for economic growth. Their main finding is that increased production costs that result form compliance with environmental policies reduces output, increases prices and reduces income growth (Christiansen and Haveman, 1982; Siegel and Johson, 1993 as citied in Feiock and Stream, 2001).

Jorgenson and Wilcoxen 1990; Jorgenson et al, 1993; Babiker and Eckaus, 2006 also find that environmental policies would slowdown economic growth. The purpose of Jorgenson and Wilcoxen (1990) is to analyze the impact of environmental regulations on the US economy by simulating the growth of the economy between 1974 and 1985 with and without these regulations They states that the consequence of this legislation was a large and abrupt shift of economic resources toward pollution abatement. They consider three costs of environmental regulation: operating costs resulting from pollution abatement, costs of investments required by industry to meet environmetnal standards and costs of emissions controls on motor vehicles. Jorgenson and Wilcoxen (1990) find that removing environmental regulation increases real GDP by 2.592%.

Jorgenson et al (1993) also examine the effects of eliminating the Clean Air Act's costs on economic growth. They find that elimination of all Clean Air Act's costs boosts leaves real income, consumption and GNP approximately 0.7 percent higher, on average, over the period 1973-1990. Moreover, the capital stock expands by an average of 0.9 percent and consumption of goods, services and leisure increases by an average of 0.2 percent.

Babiker and Eckaus (2006) models the GNP and unemployment effects of a Kyoto like emissions restrictions. Slowdown in GNP resulting from the emissions constraints is substantially higher in Europe, for Japan, in between the U.S. and Europe. China and India gain quite a bit. They also compare the GNP in policy solutions with and without the labor market imperfections. They find that labor market imperfections impose greater losses in GNP. They also include labor subsidy into their analysis. They conclude that there are two clear benefits from these subsidies. First, there are more substantial improvements in GNP, as compared to the situation in which emissions restrictions policies and labor market imperfections and the subsidy completely eliminates unemployment resulting from the emissions restriction policy.

On the other hand, some scholars take into account huge environmental degradation and suggest that environmental policies create an opportunity to change our industry and growth patterns with energy efficient and environmental friendly one, so these policies are beneficial for our sustainable economic growth targets.

Feiock and Stream (2001) investigate the effects of state environmental policies in USA on economic growth through investments. They identify four dimensions of state environmental policies that may influence the risk and return of private investments These are state spending for environmental protection, imposition of regulatory costs on private pollution producers, tax incentives to private sector for pollution control activities to the private sector for pollution control activities and provisions for administrative and decision making institutions Feiock and Stream (2001) find that state environmental expenditures had a positive effect on new capital investments because state expenditures typically include actions to subsidize private costs of pollution. Imposing the costs of pollution control on the

private sectors reduce growth. The effects of tax incentives for pollution control on new capital investment were positive. But these two effects are not significant. Lastly, they find that states' environmental administrative institutions have positive effect on new investments by reducing uncertainty. We can draw a conclusion from this study that better institutions and active role of government on spending and investment for environmental protection will be crucial for the effects of environmental policies on economic growth.

Some other state level studies also investigate the correlations among state rankings on economic and environmental indicators. For instance, Meyer (1992) ranks the 50 states on the basis of the stringency of their environmental laws and then compared the environmental rankings with measures of economic growth and job creation between 1973 and 1989. Meyer finds that the states with the most ambitious environmental programs had the highest levels of economic growth and job creation over the period. But in his another study Meyer (1993) mentions that states with better environmental standards tended to have higher growth in their gross state products, total employment, construction employment, and labor productivity, but the positive relationship between state-level environmentalism and economic prosperity may be the consequence of some third factor like size of economy and diversity of economy. Finally he concludes that shifts in environmental policy have no discernable effect on state economic performance.

Consequently, we see that picture is not clear about whether environmental policies are harmful for economic growth or not. But, in the literature most of the studies analyze the effects of environmental policies on economic growth by taking into account some other factors like employment and competitiveness. Thus, we focus on these studies in the next sections and the picture will become clearer.

5.2. Employment Effect

The global unemployment rate was about %6 in 2007. In other saying, there were 189.9 million unemployed people in the world (ILO, 2008). Since employment is so important in so many counts, governments should take into account employment effect when they determine countries' policies. As it does in other kinds of policies, environmental policies have also some effects on employment. So the question is "do environmental policies destroy jobs or create jobs?"

The controversies about employment effects of environmental policies continue in two different axes. In the first one, the controversy is about validity of double dividend hypothesis. Imposing taxes, also tradable permit system with auction, on polluting activities can have two kinds of benefits. The first is an improvement in the environmental quality, and the second is an improvement in economic efficiency from the use of environmental tax revenues, or revenue from auction, to reduce other taxes such as payroll taxes that distort labor market. According to this hypothesis, environmental taxes and tradable permit systems with auction will provide positive effect on employment.

The other controversy is about direct effects of environmental policies on employment. As we mentioned above, since environmental policies increase cost of production in some sectors, companies in these sectors reduce their production and lay off some of their labors. But there will be also some sectors that rise up and engage new labors. So, controversy is about whether net effect on employment is about positive or negative.

5.2.1. Double Dividend Hypothesis

It has been widely accepted that environmental taxes and tradable permits are a more efficient instrument to protect the environment than the classical environmental policy instruments of command and control. Some economists have suggested that environmental taxes and tradable permits with auction may yield other benefits in addition to that of cleaner environment[33].They argued that tax revenues from environmental taxes can be used to cut distortionary taxes. This can reap a second dividend. This seemed to offer a way of killing two birds with one stone. The first dividend is an improvement in the environment and the second dividend is an improvement in economic efficiency from the use of environmental tax revenues to reduce other taxes as income taxes that distort labor supply and saving decisions. Since one of the possible distortionary effects of taxation is a reduction of employment, there is a connection between a double dividend and employment (OECD, 2004: 46). We know that a high unemployment rate is an obstacle to the development process of countries especially developing and least developed countries. Thus, environmental taxes have become an alternative policy for sustainable development process of countries by means of better environmental quality and higher employment.

Before the double dividend terminology, Gordon Tullock (1967) might be the first to recognize the potential significance of the revenue from environmental levies. Tullock's "Excess Benefit" article gives the idea that properly designed environmental levies don't generate burden but rather benefit (Fullerton and Metcalf, 1997: 12).

[33] Discussions about double dividend hypothesis had started for environmental taxes. Thus main literature is about environmental taxes. After tradable permits system become one of the most used environmental policy, most authors suggest that double dividend hypothesis will be also valid for tradable permits with auction. In order to adhere strictly to literature, especially in the theoretical explanations, we analyze tax system in the explanation of double dividend hypothesis.

David Terkla (1984) was one of the first to estimate that revenues could be raised by shifting to a system of environmental taxes. Tekla focuses on particulates and sulphur oxide emissions and he estimates that taxes on these two pollutants would provide enough revenue to reduce excess burden from labor taxes by an amount $1 to 5 billion (in 1982 dollars) (Fullerton and Metcalf, 1997: 12).

After these studies Lee and Misiolek (1986) constructed a simple cost benefit framework to analyze whether the pre-existing tax distortions make the optimal environmental tax rate higher or lower than the Pigouvian tax (Fullerton, 1997: 15). So they have tried to analyze the optimal environmental tax rate. If we denote the marginal social damages (measured in monetary terms) due to pollution as *MD*, the tax rate will be t:

$t = MD$

Lee and Misiolek (1986) suggest that a tax on pollution raises welfare and raises revenue for the government, and this revenue can then be used to reduce a distortionary tax. Because of the potential welfare gain from revenue recycling, Lee and Misiolek conclude that a pollution tax should in fact be greater than the value of the marginal social damages from the pollution.

If we denote revenue effect by RE, Lee and Misiolek argue that the pollution tax should be

$t = MD+RE$.

Note that, even if we are uncertain about the size of *MD*, as is usually the case, we know *RE*>0, so as long as *MD*>0, pollution tax will be welfare-improving (McKitrick, 1997: 419).

After the late 1980's, concerns about environmental taxes were increasing because of accelerated environmental degradation in the period. David Pearce became the first writer to use "double dividend hypothesis" in 1991. Pearce (1991) mentioned that:

Given the widespread use of these fuels, any tax would inevitably be revenue raising, even though the tax works best if it is avoided through the introduction of low or zero carbon technologies. Governments may then adopt a fiscally neutral stance on the carbon tax, using revenues to finance reductions in incentive - distorting taxes such as income tax, or corporation tax. This 'double dividend' feature of a pollution tax is of critical importance in the political debate about the means of securing a 'carbon convention". (Pearce, 1991, p.940)

While environmental taxes yield environmental quality, the revenue from environmental taxes can be rebated either directly (lump sum rebates) or through the reduction of other taxes like taxes on the labor market. If this can be done in such a way as to yield economic benefit through the removal of an existing economic inefficiency, then it may be said that there is a revenue recycling dividend from the tax. Revenue recycling dividend is as an economic benefit resulting from the revenue neutral imposition of a tax[34] (Ekins, 2000: 219). Environmental taxation with "revenue-recycling" does, indeed, produce a higher welfare gain than would be the case if those revenues were simply returned, lump-sum to the economy. For instance, the labor market is a significantly distorted market in the sense that

[34] All the revenue from the tax is returned to taxpayers by cuts in other taxes or lump sump rebates.

there typically exist large wedge between the gross wage paid by the firms and the net wage received by workers because of income tax and social security tax.

The "Double dividend" term is used in different ways and has very different interpretations. In the literature the double dividend term is use with these different interpretations. Therefore, it is possible to distinguish between different double-dividend interpretations for purposes of developing a better analysis. Here we focus on two of them:

Weak Form: By using revenues from the environmental tax to finance reductions in the marginal rates of an existing distortionary tax, one achieves cost savings relative to the case where the tax revenues are returned to taxpayers in lump-sum fashion (Goulder, 1994: 4).

Let $C(t_E, T_R)$ denote the gross cost of the new environmental tax t_E accompanied by lump-sum tax reductions T_R sufficient to make the policy revenue neutral. Similarly, let $C(t_E, t_D)$ denote the gross cost of the new tax t_E accompanied by cuts in the distortionary tax t_D sufficient to achieve revenue-neutrality. The first proposition asserts that:

$$C(t_E, T_R) > C(t_E, t_D)$$

The gross cost is lower when revenues are replaced through cuts in the distortionary tax than when revenues are replaced lump-sum. Under this proposition the 'second dividend is the lower distortionary cost in the former case (left-hand side) relative to the cost in the latter case (right-hand side). The weak double dividend notion is relatively uncontroversial. So long as the tax t_D, deserves its title as a distortionary tax, it will have a positive efficiency cost and the weak double-dividend claim will hold (Goulder, 1994:6)

Strong Form: The revenue-neutral substitution of the environmental tax for typical or representative distortionary taxes involves a zero or negative gross cost (Goulder, 1994:.4).

The intermediate and strong double-dividend notions involve assertions about the sign of the gross cost of a revenue-neutral policy in which an environmental tax replaces (some of) an existing distortionary tax. The assertion is:

$C(t_E, t_D) < 0$

The assertion here is that swapping an environmental tax for a distortionary tax involves a negative gross cost overall (Goulder, 1994: 6-7).

The weak form of the double dividend hypothesis is widely accepted among economists. As a consequence, green tax reforms are nowadays preferred to other environmental tax instruments that do not raise public revenues. But this is not the main controversy. The main controversy is whether the strong form holds or not.

The validity of the double dividend hypothesis has been challenged by a set of theoretical papers (Bovenberg and de Mooij 1994; Parry 1995; Bovenberg and Goulder, 2001) which appeared to show that, despite the presence of positive "revenue recycling effect," the optimal environmental tax would actually be lower than the Pigouvian rate when revenue-raising taxes were present (Jaeger, 2003: 7-8). Bovenberg and de Mooiji (1994), Parry (1995)

and others, noted that models such as that of Lee and Misiolek (1986) and Nordhaus (1993)[35] implicitly assume other tax rates are zero. They instead explored analytical models which derive the optimal tax on a polluting activity in the presence of pre-existing tax distortions. They find that, in addition to the marginal-damage reduction effect (*MD*) and the revenue effect (*RE*), a pollution tax generates an "interaction" effect, which we denote *IE*. If it is welfare-reducing (as it is in the three papers cited above), accounting for the *IE* in setting the pollution tax rate will lead to a lower optimal tax level than suggested by the analysis of Lee and Misiolek (1986) (McKitrick, 1997: 419).

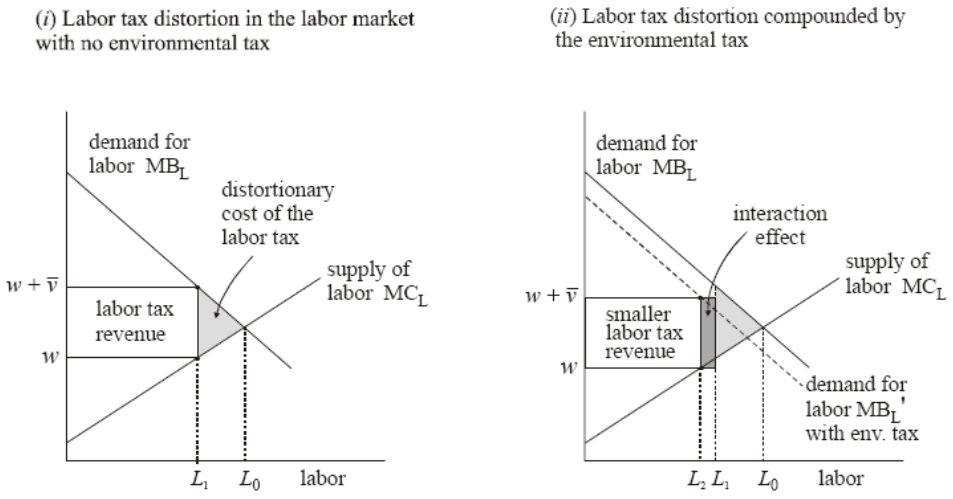
$t = MD + RE - IE$

This states that the optimal tax t on pollution should equal marginal damages plus the benefits derived from reducing other taxes, less the costs arising from the exacerbation of pre-existing distortions by the new pollution charges.

It will be useful to analyse this tax interaction effect via Figure 5.5. Figure (*i*) shows the labor market, when there is a tax *v* on labor, thus total labor cost become w (wage)+v, and initially carbon is untaxed. As before the producers' demand for labor is MBL, and the labourers' supply MCL, and the distortionary cost of the labor tax is the shaded triangle, with equilibrium labor employment $L1$. Now it is necessary to consider what happens to the labor market when an environmental tax is used to reduce labor tax.

[35] Nordhaus (1993) show that using a carbon tax of $ 56 per ton to cut emissions in 1995 by 20 percent from 1990 levels and recycling the revenue through lump sum rebates caused a annualised global GDP loss of $762 billion. But when carbon taxes are used to reduce distortionary taxes which assumed to have a deadweight loss of $0.30 per $ of revenue raised, then the optimal tax rate become $59 per ton, emissions go below 20 percent cut and annualised GDP rises by $206 billion (Ekins, 2000:235)

Figure 5.5. Interaction Effect



Source: Page 2004 p.15

Panel (*ii*) shows the effect in the labor market of taxing carbon by the environmental tax. This environmental tax is used for cutting labor tax when compared with the tax level in Panel (i). In response to the increased price of carbon, producers reduce their carbon emissions. The producers may also reduce their production, and thereby carbon emissions with the reduction. These actions lead to social benefits of cleaner air, but they reduce the private benefits to the industry from production. With lower private benefits, and typically lower private *marginal* benefits, the producers' demand curve for labor is pushed downward to MBL′ as shown in Panel (*ii*).

With the demand curve pushed down the wage adjusts downward a little and labor employment is further distorted from *L*1 to *L*2. Moreover, the distortionary cost in the labor market increases by the amount shown by the shaded rectangle. This increase in distortionary costs is what public economists mean when they say that environmental taxes "exacerbate" or

"compound" the distortionary costs of pre-existing taxes. The increase in distortionary costs represented by the rectangle is called the tax interaction effect.

Parry (1995) constructs a model that includes a good that creates negative externality and labor taxes which distort the labor market. Imposing an environmental tax raises the price of a polluting good[36]. Since this good is a substitute for leisure, this causes still more leisure to be taken. Consequently, all these increase distortions in labor market. This not only imposes a welfare cost, but reduces revenue from the labor tax. Consequently, more labor taxes are required, thus increasing the welfare burden from that source. This combined effect Parry calls the tax interaction effect of environmental taxation. His analysis finds that RE/IE<1 (or RE<IE).

If *RE>IE*, then the pollution tax should be greater than *MD*. Or, equivalently, we would be certain of generating a welfare gain even if the damage reduction effect were nil. If *RE<IE*, then the optimal pollution tax should be less than marginal damages. Some recent authors, including Parry, have suggested that this will generally be the case; therefore they reject the double dividend hypothesis (McKitrick, 1997: 419).

Where Parry talks of an interaction effect, Bovenberg and de Mooij (1994) find that the erosion effect of environmental tax rules out any efficiency divided (Ekins, 2000: 227). Consider an economy where the government's budget is entirely financed by a tax on nominal labor income. If a pollution tax on dirty production equals social marginal damage, it will increase the cost of production. Even if the revenue from pollution tax is used to lower the tax

[36] Parry and Oates (2000) mention that even if some macroeconomic simulations of the effects of environmental regulation on prices find only a very small inflationary effect, existing estimates suggest that the combined effect of income, payroll and sales taxes effectively reduces the net wage at the margin some 40 percent below the gross wage (Browning, 1987 as citied in Parry and Oates, 2000: 605)

on labor supply, the real net wage falls (Fullerton and Metcalf, 1997: 25). These will also increase the cost of consumer goods. As real wages fall, the labor supply falls and the excess burden of the income tax will typically increase[37]. The drop in the real after tax wage comes about because the lower tax rate on labor income doesn't fully compensate workers for the adverse effect of a pollution tax on their real after tax wage. This incomplete offset is due to the erosion of the tax base of the environmental tax. In particular, the higher environmental tax induces households to switch from the dirty to clean consumption commodities. If the initial tax rate on the dirty commodities is positive, this behavioral effect erodes the base of environmental tax and therefore produces a negative tax base effect (Bovenberg and de Mooij, 1994: 1087-88). RE is also smaller that IE in this case. Consequently, Bovenberg and de Mooij (1994) and Parry (1995) accept weak form of double dividend hypothesis but reject the strong one.

Even if their model rejects the strong form of double dividend, relaxing and adding some assumptions raise the likelihood of generating a strong double dividend. Critiques of double dividend generally assume that if the tax system is initially raising revenue optimally, then increasing the tax on the dirty good and reducing other taxes cannot improve the efficiency of tax collection. Theoretically, this is the case[38] but not in practical terms. In

[37] In this basic model the employment effect depends on the supply elasticity of a change in net wages (*Bovenberg* and *De Mooij,* 1994:1087). An increase in employment could only occur if labour supply increases with declining net wages (backward-bending labour-supply curve), maybe because employees try to compensate lower wages by offering more labour. But, Bovenberg and De Mooij assume that labor supply curve is upward slopping because mathematical studies yield positive estimates for this elasticity.

[38] In the case of optimal taxation, labor bears the ultimate burden of any tax in the form of reduced real wages—a wage tax directly reduces the real wage, and a tax on the dirty good increases the price of consumption, which also reduces the real wage. Both taxes involve an efficiency cost because they distort relative prices and, therefore, behavior. Raising the wage tax reduces the supply of labor, which erodes the base of the tax. Raising the tax on the dirty good reduces the real wage, thus people consume less and the tax base is reduced. Also, consumers substitute away from the dirty good toward the clean good, which erodes the base even more. In other words, both taxes are ultimately a wage tax, but the tax on the dirty good is a less efficient revenue raiser because it has a narrower base.

especially developing and least developed countries, the taxation system is not an optimal one. Their existing tax structure is generally non-optimal, so the burden of taxation is not distributed effectively. While a green tax reform is likely to fail to increase non-environmental welfare in economies with functioning labor markets, it may succeed in economies suffering from involuntary unemployment (Schoeb, 2003:1)

This means that the environmental tax may increase the efficiency of the taxation system and yield non-environmental welfare. For example, starting from a position where the labor tax is greater than optimal, and the tax on the dirty good is smaller than optimal, a small increase in the dirty good tax and a small decrease in the labor tax would raise welfare. Bovenberg (1999) also mentions that if the government would marginally reduce the environmental tax below its Pigovian level, welfare would rise in the presence of a distortionary tax on labor[39].

The second assumption is that environmental quality is separable from consumption and leisure. It is relatively straightforward to make the case that environmental quality should not be treated as separable from leisure and consumption. In the case of leisure, the typical examples of non-separability include the effect of health status and of road traffic congestion costs on work-related decisions. Improved air quality may have important effects on health which will increase supply of labor through, for example, fewer sick-leave days. Also, improved road traffic may translate into a higher participation rate in the labor market (Eissa and Blundell, 2000:14-15). Bovenberg (1999) also mentions that if environmental quality is a close substitute for leisure, a higher level of environmental quality boosts labor supply, thereby alleviating the labor market distortions on account of the distortionary labor tax

[39] In Bovenberg's paper, Bovenberg mentions that only reducing the pollution tax below its Pigovian level will boost overall welfare. According to him, higher pollution taxes again exacerbate the pre-existing distortions.

The third one is that early theoretical papers focused on only one distortionary tax (labor tax). A tax on capital will also be distortionary. So, we have to consider that the marginal efficiency costs of taxation of capital and labor are different. While labor taxes distort the labor-leisure margin - the margin of choice between enjoying leisure and enjoying consumption - capital taxes distort the intertemporal margin -- the margin of choice between consuming today and consuming in the future. For a given labor tax, the distortion in the labor-leisure margin is greater the larger is the (compensated) wage elasticity of labor supply. Thus, the relative marginal efficiency costs of labor and capital income taxes depend on these elasticities and on the magnitudes of labor and capital income tax rates (Goulder, 1994:13-14). Thus when we also consider taxes on capital, economic efficiency from the use of environmental tax revenues to reduce distortionary taxes will increase. In other words, possibility of achieving double dividend will increase.

But it is necessary to note here the distributional effect of double divided. We know that the double dividend can be achieved if it is possible to shift the tax burden from workers (or capital owners) to other groups like owners of any other production factors, other domestic consumers who are not workers (old-age pensioners and unemployed) and other countries via tradable goods (OECD, 2003: 47).

When we also consider the tax on capital, distributional effects, the gross costs of a revenue-neutral environmental tax will be lower and the prospects of increased employment are higher if (Goulder, 1994:14, OECD, 2003:50)

(1) the difference in marginal efficiency costs (marginal excess burdens) is large in the initial tax system,

(2) the environmental tax can be passed on the factors that are inelastically supplied. So, the owner of this factor will not decrease its output and try to new way to produce its output in a environmental-friendly way in order to avoid tax costs.

(3) the burden of the environmental tax falls primarily on the factor with relatively low marginal efficiency cost,

(4) the base of the environmental tax is relatively broad, so that the gross distortions it generates in intermediate good and consumer good markets are small, and

(5) revenues from the tax devoted to reducing tax rates on the factor with relatively high marginal efficiency cost

(6) the real wage rises little when unemployment falls, so that the reduction in the taxes on labor are not offset by wage rises[40]

(7) the international market power is high. So it is possible to shift the tax burden of environmental tax to other countries.

(8) there are some beneficial instruments for non-workers in order to compensate their welfare loss.

[40] Social dialogue is required among government, firms, workers and labor unions in order to reduce unemployment

5.2.1.1 Empirical Studies for Double Dividend Hypothesis

This section presents some econometric and simulations based models of employment impacts of taxes on energy or on any gases that cause greenhouse effect. In the literature, most of the studies show that environmental tax with revenue recycling has additional positive effects on GDP and employment along with environmental benefits.

McKitric (1997) used a static Computable General Equilibrium model of the Canadian economy. The Canadian economy is divided into six production sectors and ten commodities. He considers 5 different types of taxes in his model. These taxes are: goods and services tax (GST), corporate income tax (CIT), personal income tax (PIT), employees' payroll tax and employers' payroll tax (PAY). The level of the tax per unit of carbon is determined endogenously, through the criterion that the tax must be sufficient to force a 12.5 percent reduction in carbon dioxide emissions

Carbon tax revenues are used for, respectively, lump-sum transfers to households, reductions in the goods and services tax, reductions in corporate income taxes, reductions in personal income taxes, and reductions in payroll taxes. The carbon emissions reduction achieved (12.5 percent in each case). Under lump-sum revenue recycling (LS) there is a 0.8 percent real GDP and employment loss. There is 0.5 percent real GDP loss and 0.4 percent employment loss under GST. There is 0.9 percent real GDP loss and 0.8 percent employment loss under CIT. There is 0.3 percent real GDP loss and 0.1 percent employment loss under PIT. There is 0.6 percent real GDP gain and 1.1 percent employment gain in PAY (McKitric, 1997:424-425).

Shah and Larsen (1992) used static partial equilibrium models for two developed countries (the US and Japan) and three developing countries (Indonesia, Pakistan, and India). Reductions in capital income taxes financed by a US$10 per ton carbon tax yield gross welfare increases in some of the countries, especially the developing countries, where the pre-existing profits taxes are higher (McKitrick, 1997: 420).

Barrett et al (2002) also estimates the macroeconomic impact of alternative climate and energy policy in USA. This alternative policy package has four main elements:

• a modest carbon/energy tax on major energy sources, with most of the revenues returned through cuts in taxes on wages;
• a set of policies to promote the development of new energy-efficiency and renewable energy technologies;
• policies to offset competitive impacts on energy-intensive industries like a border tax adjustment on carbon/ energy tax payments (tax on imports and some export rebates)
• transitional assistance to compensate any workers and communities harmed by the policies like professional training and income assistance.

Under this policy package, Barrett et al. (2002) shows that U.S. carbon emissions would decline by 27% in 2010 and by 50% in 2020, GDP would increase by a modest 0.24% in 2010 and by 0.6% in 2020, an additional 660,000 net jobs would be created in 2010, 1.4 million in 2020. But, Barrett et al (2002) also state that benefits do not come without cost. While employment in some sectors likes coal mining and some energy intensive ones would reduce, construction, auto, trucking, and paper industries would see gains in employment.

OECD (2004) reviews some studies that investigate growth and employment impacts of environmental taxes with using simulations based models. As we see from Table 5.1, most of them also show that double dividend hypothesis is valid.

Table 5.1. Employment and Growth Effects of Environmental Taxes

	Model	Country	Policies and Scenarios	Change in GDP	Change in Employment
CAC, 1993	HERMES	EU-6 (Germany, France, Italy, UK, NL, Belgium	CO2/energy tax that is fully redistributed through a reduction in social security taxes	%0,2	%0,6
Hayden, 1999	QUEST	EU	Reduction of 8% in CO2 emissions by 2010, compared to the 1990, together with a tax on oil products, the revenues of which are redistributed by reducing the cost of labor. Three scenarios emerge: S1. Businesses alone bear the cost of the tax; S2. it is borne by households; and S3. Households are taxed and households agreed to moderate their wage demands.	%-1 (S1) %0,4 (S2) %0,9 (S3)	%0,1 (S1) %0,9 (S2) %1,3 (S3)
Bach et al. 2002	PANTA-RHEI	Germany	Taxes on certain energy products. Revenues are redistributed in the economy in the form of a reduction in social pension contributions	%0,4	%0,55
Komen and Peerlings 1999	GEM	Netherlands	Compare the employment and welfare effects of a "small-user" energy tax (S.U), with exemptions for large energy users, that was already in place in the Netherlands, to a hypothetical general energy tax (G). The tax revenue is redistributed with reduction in taxes on capital and labor	%0,06 (S.U)* %-0,02 (G)*	%0,1 (S.U) %0,15 (G)
Kouvaritakis *et al.* 2003	GEM	EU-14	EU allowance scheme for electricity and heat generators and energy intensive sectors, combined with a carbon tax levied on all the sectors not covered by the allowance scheme in 2010, the level of the tax being determined such as to reach the Kyoto target. The tax revenue was recycled through a reduction in social security contributions.	%-0,1	%0,4

Source: OECD, 2003

* Change in welfare

5.2.2. Employment Effects of Environmental Policies without Revenue Recycling

In the literature most of the studies which analyze the employment effects of environmental policies show that environmental policies, protections or expenditures provide new job opportunities. Many new opportunities for job creation are emerging, ranging from recycling and remanufacturing of goods, to greater energy and materials efficiency and the development of renewable energy (Renner, 2000).

Bezdek et al. (2008) estimate that in 2003 protecting the environment generated $301 billion in total industry sales, $20 billion in corporate profits, 4.97 million jobs, and $45 billion in Federal, state, and local government tax revenues in USA. Most of the 5 million jobs created are standard jobs for accountants, engineers, computer analysts, clerks, factory workers, etc., and the classic environmental job (environmental engineer, ecologist, etc.) constitutes only a small portion of the jobs created. This study also shows that jobs for secretaries, environmental scientists, management analysts, environmental engineers bookkeepers, hazardous materials workers, janitors, computer systems analysts, chemical engineers, truck drivers, biological technicians increase with environmental protection. They also suggest that blue-collar workers' job opportunities are as high as white-collar workers and in some case higher than them.

On the other hand, Goodstein (1996) mentions that 1,300 people per year lost their jobs a result of USA's environmental regulation in the late 1980s according to U.S Labor Department data. But it was not so much when you compare it with other factors. For example, U.S Labor Department also showed that environmental spending accounted for less

than one-tenth of 1% of all mass layoffs nationwide. But, layoffs resulted from ownership changes were 40 times higher than resulted from environmental spending (Goodstein, 1996).

Regional Economics Applications Laboratory (2004) propose *Repowering the Midwest*'s Clean Energy Development Plan which promotes modern, energy efficient technologies and development of renewable energy resources, especially wind power and biomass energy in Midwest (Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, South Dakota, North Dakota and Wisconsin). The results of this study indicate that the energy efficiency measures outlined in plan will generate as many as 84,000 jobs by 2010 and 141,000 jobs by 2020. The plan will increase Midwest economic output by as much as $7.1 billion by 2010 and $12.7 billion by 2020. It shows that this job gain and economic growth would greatly outweigh the projected loss of jobs and income in the electric utility industry caused by reducing demand for power from coal and nuclear plants. These kinds of energy modernization plans will also increase blue-collar workers' job opportunities, as in the construction of renewable energy's power machines, besides technical specialists.

Bezdek and Wendling (2005) estimate the economic and related impacts of changes in CAFE standards. This paper simulates the effects of enhanced CAFE standards through 2030. There are two scenarios: CAFE standards increase by 20% as of 2010 in the moderate scenario and CAFE standards increase by 30% as of 2010 in the advanced scenario. Bezdek and Wendling (2005) find that CAFE increase scenarios analyzed will increase employment by between 70,000 (under the moderate scenario) and 380,000 jobs (under the advanced scenario). However, while the net employment effects are strongly positive under the enhanced CAFE scenarios, in both cases substantial job displacement is also occurring. The motor vehicle and related industries would be major winners, whereas employment in petroleum products and related industries would decrease.

While Bezdek and Wendling (2005) finds that CAFE standards have positive employment effect, Motor Vehicles Manufacturers Association (2000) predicts that tighter CAFE standards would result in the loss of between 159,000 and 315,000 jobs in the motor vehicle industry (Bezdek et al.,2008)

Morgenstern et al. (1998) also estimate the effects of environmental spending caused by U.S regulations on employment in heavily polluting industries (pulp and paper, plastics, petroleum, and steel). They find that employment increase by 2-3 jobs per million dollars of increase in environmental expenditures caused by the overall increase in costs. They suggest that environmental activities are more labour intensive than conventional production. Thus, environmental spending also increases labour demand by 2-3 jobs per million dollars of increase in environmental expenditures through factor shifting. But they also find that environmental spending associated with a drop in demand for final products as prices rise also reduce labour demand by 3-4 jobs per million dollars of spending. At the end, combining these three effects they find significant job gains in plastics and petroleum because of relatively small demand elasticities and insignificant effects in pulp and paper and steel.

Consequently, as we see from studies above environmental policies promote new sectors and these sectors create new job opportunities. Even if these opportunities will occur in the long run and environmental policies give chance to countries, especially developing countries, in order to achieve better environmental quality without damaging the labour market.

5.3 Competitiveness and Technology Effects of Environmental Policies

A major policy goal of countries is to promote the creation of competitive economic capacities in order to achieve sustained growth Economic growth is, however, associated with increasing environmental pressures via environmental polices. It is clear that any environmetnal policy instrument should cause changes in consumption and/or production patterns by internalising negative environmental externalities If a policy fails to create such changes it simply cannot deliver any environmental improvements. But, environmental policy should also make polluters bear all costs of production.. This should make polluting products and/or production processes more expensive. Since environmetnal polices affect cost of polluting products and production process, this will affect price and production level both directly through its own expenditures on pollution reduction and indirectly through the higher prices it must pay for certain factors of production that are affected by policies. Thus, both direct and indirect costs will affect competitiveness.

This competitiveness effect will be at industrial (domestically) or/and international level. At the level of industry, competitiveness is mainly about the ability to increase productivity, generate sufficient profits and raise market shares for products. At the international level, competitiveness effects will arise if the additional costs incurred by environmental policies are not shared by all trade partners. This loss in competitiveness could turn to a decline in net exports and the relocation of these industries to countries where their environmental regulation are low. The latter effect is called leakage effect. As we know that labor costs, quality of labour force, tax rates, market size, quality of regulations, geographical position, quality of transport and access to infrastructure are major determinant of foreign direct investment (FDI) flows. But even if it is not a major factor, environmental policies are

minor determinant of FDI flows because it is generally accepted that countries with lax environmental regulations like developing countries would provide opportunities for pollution-intensive firms to escape more stringent environmental policies in their home countries like developed countries. Thus strigent policies are hypothesized to lead to the flight of industry to the countries called "pollution haven." Competition between developing countries in order to attract FDI will cause to "race to bottom" in environmental policies. This will also increase the possibility of leakage effect (Stewart, 1993). But Hesse (2007) mentions that local firms that want to be part of international production networks organized by multinational firms should also be a part of stringent environmental policy because of increased environmental awareness and green consumerism.

While all of these factors seem to affect competitiveness negatively, firms can benefit directly through new technologies and clean production techniques that cause energy efficiency and waste reduction because environmental policies try to reallocate resources towards cleaner production and processes. Alternatively, policies may lead the firm to find ways of converting the waste into saleable products which provide additional revenues (Jenkins, 1998).

Porter and van der Linde (1995) states that the conditions defining competitiveness has been shifting for the last 20 to 30 years, away from the static model in the above. The new conditions of competitiveness are a dynamic one which is based on innovation. According to Porter and van der Linde (1995), environmental policies signal companies about likely resource inefficiencies and potential technological improvements. They also create pressure that motivates innovation and progress and technological first mover advantages by expoloiting niche markets. Therefore, new technology and innovation processes are not only a

tool for improving environmental conditions; they are also a major tool for promoting growth and economic development.

Increased environmental awareness and green consumerism, the growth of eco-labelling and the development of environmental management standards like ISO 14000 create potential positive feedback effects from more stringent environmental policy to firms' competitiveness (Jenkis, 1998, Frankel, 2003). Thus firms trend to environmentally friendly good because their profit margins are high.

There can be also financial benefits for firms that manage environmental issues well. For instance, Estey and Winston (2008) suggest that there are some funds whose total assets are about 200 billion dollar want to invest their asset to firms that have social and environmental senses. Some pension funds also invest in firms that manage environmental issues well (NHEEPA, 2005). The banking and insurance sectors, which provide strategic business advice and insure, look more favorably on those with a good environmental record and low environmental risks (Estey and Winston, 2008, NHEEPA, 2005).

We discussed theoretical explanation of possible technology and competitiveness effects of environmental policies. Now, we turn our attention to the empirical and survey studies that investigate the technology and competitiveness effects of environmental policies. OECD (2006) analyzes the effects of carbon tax levied at USD 25 per tonne of CO2 emissions, equivalent to a CO2 Emission Trading Scheme with auctioned allowances**,** on steel industry in OECD area with simulation techniques. The imposition of a CO2 tax reduce total steel production by 9% in the short to medium term. Global emissions from the sector are predicted to decline by over 4.6%. If the tax revenues were recycled back to the steel industry

as an output subsidy, the decline in OECD steel production would be quite small (< 1%). But, revenue recycling would reduce global emission reductions in the sector from 4.6% to around 3%. OECD countries that adopt comparatively stringent carbon tax can, however, prevent international competition from harming their industry by increasing import taxes and subsidizing export. If border tax adjustments (BTA) like import taxes and export subsidies are implemented in steek sector, the decline in OECD steel production stemming from an OECD-wide tax might be as small as 1%. At the same time, the reduction in global emissions (5.1%) would be larger than without border tax adjustments.

OECD's second case study that addresses the competitiveness and leakage issues is about the cement sector. In this case study a business-as-usual scenario (BaU) from 2000 until 2030 and three climate policy scenarios were built. These are:

- A CO2 tax or an Emission Trading Scheme (ETS) with auctioned allowances is implemented in the Kyoto Protocol for Annex B countries. Assuming a CO2 price of EUR 15 per tonne.

- In the "Complete BTA" scenario (BTA), exported production is completely exempted from the climate policy and imports of cement from the rest of the world are taxed in accordance with the CO2 intensity of the cement production in the exporting country.

- In the "WTO BTA" scenario, exports benefit from a rebate corresponding only to the least CO2 intensive technology available on a large scale, and imports are taxed to the same level.

In the first scenario, there is around 20% decrease in CO2 emissions in these countries. This decrease in emission can be explained by a using energy-efficient technologies, a decrease in the rate of the CO2 intensive input in cement, a quicker switch to low-carbon fuels and a decrease in cement consumption. The impact on cement production in theses countries is significant (–7.5% in 2010) because of both a cut in their domestic consumption level and a loss in competitiveness. Since Annex B countries' share decrease, production turns to other countries and thus emissions in the rest of the world increase. The corresponding leakage rate is around 25% in 2010 (around 15% after).

Under the complete BTA, the loss in production of Annex B countries is limited to 2% instead of 7.5% in 2010. Annex B emissions decrease by 13.5% in 2010 thanks to both a production drop and an improvement in the CO2 efficiency of production. Emissions from the rest of the world also decrease, although very slightly, due to a decrease in their production (around –0.1%). Cement production of the rest of the world decrease by 1%. So there is no leakage effect.

Under the WTO BTA scenario, Annex B countries suffer from a slightly higher cost increase than their competitors, thus cement production in Annex B countries reduce by 3% in 2010. Total production actually rises a little in the rest of the world. Thus leakage effect is limited when we compare with first scenario. Emissions from Annex B countries decrease by 15% in 2010, more than in the complete BTA scenario due to the higher drop in their production level. Global CO2 reduction is more than the first scenario but higher than complete BTA scenario. This study clearly shows that countries that have stringent environmental policies prefer to use border tax adjustments in order to reduce negative competitiveness effects.

Oberndor et all (2006) reviews some studies that deliver a sector by sector analysis of the effects of the EU ETS on competitiveness. (The Carbon Trust (2004), Reinaud (2005), Klepper and Petterson (2004) and COWI (2004)). The Carbon Trust (2004) investigates the electricity, cement, newsprint, steel and aluminium sectors. The study results demonstrate that allowance trading probably only has a minor influence on the productivity of the relevant sectors. Only the aluminium sector may prove to be a loser of the EU ETS. Klepper and Petterson (2004) shows that the ETS decreases total output in the EU are only by around 0.3 percent. The losses are higher in the energy sectors coal and gas. COWI (2004) suggests that competitiveness is negatively affected in Europe due to the ETS introduction. There is -0,36% recuciton in overall production.

Reinaud (2005) also investigates the effects of ETS on certain sectors like steel, cement, newsprint and aluminium under two scenario (industry would be allocated permits covering either 98 or 90 percent of its CO2 emission needs. In both scenario, sectors face with cost increases. But, cement and aluminium face with higher cost than other sectors.

Camecon and AEA Technologies (2003) analyzes the UK Government's Envirowise programme. This program as set up to help companies improve resource efficiency by producing case studies of the resource efficiency methods used by a range of companies. Camecon and AEA Technologies (2003) finds that the annual savings from improving resource productivity derived from the kind of waste minimization covered in the Envirowise case studies of manufacturing industry would be £2-2.9 billion pound, equivalent to around 1¼-2% of UK manufacturing value added or 5-7% of the sector's profits in 2000. Manufacturing industry could also save 2.8 billion pounds through energy efficiency.

There are also some studies that attempt to measure the effect of environmental regulation on net exports, overall trade flows, and plant location decisions. Low and Yeats (1992) analyzes trade patterns in exports of dirty industries in different countries. They founds that the relative proportion of dirty product exports in various countries' total exports fell for the developed countries and increased significantly in developing countries in Eastern Europe, Latin America, and West Asia during the 1965-88 period. But they also underlines that pollution control expenditures are a relatively small percentage of production costs and thus lower-cost labor or natural resources would be the main factors of this shift

Some environmental and union groups have asserted that North American Free Trade Agreement (NAFTA) will lead U.S. industry to relocate in Mexico, especially in Maquiladora region of the country, where environmental regulations are weak (Stewart, 1993). But, Grossman and Krueger (1991) fail to find a significant positive relationship between the size of pollution abatement costs (as a fraction of value added) in the U.S. manufacturing industry and the scale of sectoral activity in Mexico. Xu and Song (2000) also states that there is no systematic structural changes occurred in patterns of the pollution content of USA and Canada's trade to Mexico and Chile despite the introduction of higher environmental regulations in the 1970s and 1980s. As the last word, Goodstein (1994) underlines that in the early 1990's average hourly wage in Los Angeles was $8.92; it was $0.77 in Maquiladora. This low labor cost is the main reason why U.S industry moves to Mexixo. He also states that based on sketchy evidence, it was estimated that four to five plants per year moved to the Maquiladora region from 1988 to 1990 as a result of environmental regulations. This movement accounted for a loss of about 350 jobs per year.

Mani et all (1996) investigate the relationship between environmental regulation and FDI in India. They also conclude that businesses don't choose locations in response to differences in the stringency of environmental regulation and thus the likelihood of an environmental "race to the bottom" in the Indian context is low. Consequently, these studies show that other factor like labor cost rather than environmental policies affect the flow of FDI.

But there are also opposite results. Xing and Kolstad (2001) focus on several industries, including two of the most polluting industries, chemicals and primary metals in order to understand the relationship between environmental regulations and FDI. They suggest that suggests that there exists a significant negative linear relationship between FDI of the US chemical and metal industries and the stringency of environmental regulation in a foreign host country. Consequently, lax environmental regulation tends to attract more capital inflow from the US for pollution intensive industries.

As we mention in above, environmental policies will also have positive impacts on financial positions of firms. There are some evidences about this. UK Environment Agency (2004) identifies 60 separate studies which examined the impact of environmental governance like environmental strategy, climate change strategy, eco-efficiency, environmental accounting, reporting or training, on financial performance. In 51 of the 60 studies reviewed, a positive correlation was found between environmental governance and financial performance. For example, Companies in forest and paper products industry with above average environmental governance standards and above average environmental track record financially outperformed companies with below average ratings by more than 43% over four years from March 1999 to March 2003. The stock prices of EU electric utilities with above

average environmental governance standards outperformed those of below average companies by 39,3% over 3 years from July 2000 to July 2003. Companies in the water services sector (predominantly from Europe) that demonstrate strong environmental policy and management outperformed laggard companies by 4,5 percentage points over the three year period 1997 to 2000.

In order to understand the effects of environmental policies on competitiveness and technology improvements, policy makers should consider the advantages and disadvantages of environmental policy instruments. In the literature, there are also discussions about which policy instruments are beneficial for competitiveness and technology improvements. It is generally accepted that market-based instruments like tax, charges or tradable permits will tend to be more cost-effective than command and control instruments. Thus market based instruments is more beneficial for competitiveness and technology improvements because such instruments allow flexibility, improve resource productivity and create incentives for innovation by using new techniques (Stewart, (1993), Jaffe et all, (1995), Porter and van der Linde, (1995)). They also promote financial recycling to the firms in order to compensate their losses.

Since technological innovations and the rise in productivity are a major driving force for economic development of countries, environmental polices can also be a win-win-process for developing countries to the extent that they provide the opportunity to develop new export markets and involve improved resource efficiency, reduced pollution intensity and improved public health, thereby also contributing to sustainable development.(Hesse, 2007). But, in order to take advantages in competitiveness, environmental policies whether market based or

command and control instruments, should aim at promoting the private firm's technological innovations and financial recycling.

5.4. Income Distribution Effects of Environmental Policies

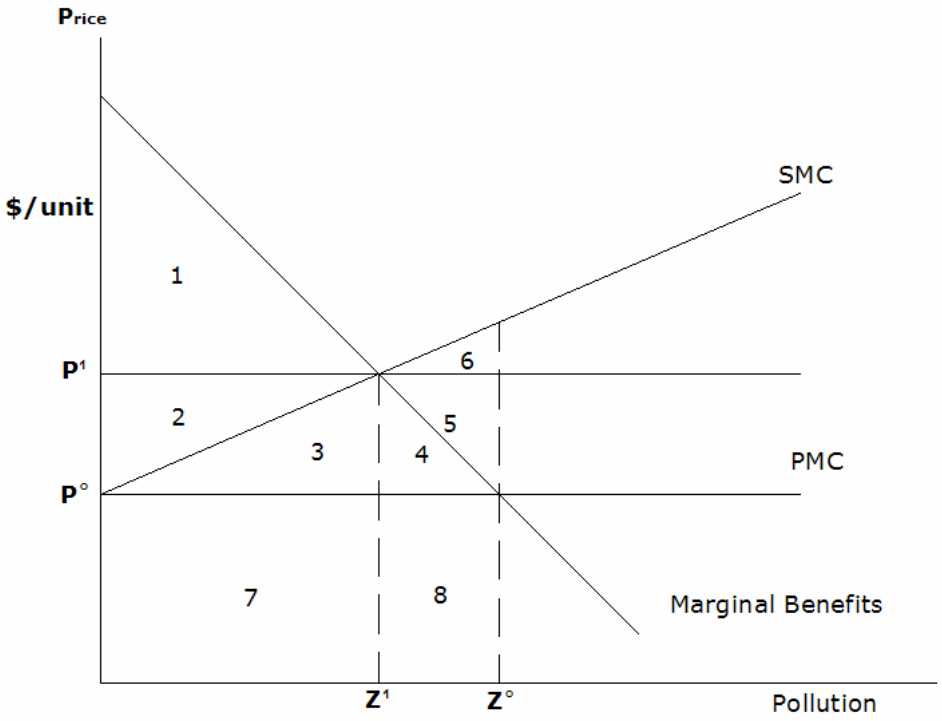
Since the main purpose of environmental policies is to change consumption and patterns' of environmentally harmful goods or services, it is very nature that environmental policies have distributional effects. Environmental policies affect the consumers directly and indirectly through prices on goods that they consume. Environmental policies also affect the firm through prices on inputs and output. Now let's consider the distributional effects of different environmental policies.

Fullerton (2001) analyzes distributional effects of environmental policies theoretically. There is an environmentally harmful goods whose externalities (i.e. emissions) directly affect society. Fullerton assumes that the private cost per unit of a particular type of emissions is fixed at a price P^0. This price reflects the cost of resources necessary for removal and disposable of waste. He also assumes that the demand curve for these emissions is fixed. This demand reflects the marginal benefit of this pollution to production. The horizontal axis represents the amount of this pollution and vertical axis represents a price of cost (in dollars per unit of emissions). Since the private cost per unit of emissions P^0 is fixed, the firms face a flat private marginal cost (PMC). The demand for pollution (labeled marginal benefits) starts out high, because some minimal level of pollution is crucial to production.

In the absence of any regulations or taxes, firms and consumers would keep polluting as long as the marginal benefits exceed the private cost and they would stop where marginal

benefits of pollutions intersects the private marginal cost. Thus unregulated pollution is at point Z^0. When we look at the graph, we see that there is a consumer surplus. Consumer surplus is defined as the benefits in excess of the cost (1+2+3+4). The total social cost of pollution is the area under social marginal cost (3+4+5+6+7+8). Some of the this private cost is incurred by firms (7+8). Fullerton also assumes that firms received no profits because they paid sales revenue (7+8) to the factors of production.

Figure 5.6. Distributional Impacts of Environmental Policies



Source: Fullerton 2001

Now we assume that government impose Pigouvian tax in order to reduce pollution. The Pigouvian tax raises the private cost of pollution from P^0 to $P^{'}$. Then firms face costs P' and stop at Z'. The tax revenue would be the tax rate times the amount of pollution subject to tax. (2+3). The fall in the consumer surplus is 2+3+4. Firms reduce its production

but they still earn zero profit. So there is nothing change for them. Victims gain from environmental policies (4+5+6). So, overall net gain is the area 5+6.

This theoretically explanation shows that environmental taxes like Pigou tax, affect consumers, government and firms. How will this effect occur? OECD (2004b) and Kriström (2006) underline the distributional effects of environmentally related taxes that can arise from a variety of channels. The broad categories of distributional effects are:

- the direct distribution effects on households arising from the payment of the tax. For example, a carbon tax will raise the price of fossil fuels. Thus, transportation and heating costs are directly affected;
- the indirect distributional effects. Goods and services which are taxed directly are purchased by other firms in other sectors as inputs into the production of other goods and services. So this will also increase price of other goods. For instance, a fuel tax would have effects not only on fuel consumption expenditures directly, but also indirect effects on expenditures for goods or services whose production processes are intensive in the use of fuel;
- the effects of income. Environmental policy may lead to significant losses of income, at least in the short run, as some firms are shut down.
- the effects arising from the expenditure/use of environmental tax revenues. Households and firms may be compensated. Revenues from environmental taxes may be returned to the economy. Several options have been scrutinized, for example, reduced payroll taxes, VAT and lump-sum returns. Each choice maps into different distributional consequences;

After considering different channels, the main question should be this: "whether environmental taxes are regressive or progressive?" A tax is said to be regressive if the average tax rate falls with income. It is proportional if the average tax rate is constant and it is progressive if the average tax rate rises with income. Low income people pay a higher (lower) fraction of their income in taxes if the tax is regressive (progressive). Thus, the distributional effects of environmentally-motivated taxes will depend upon how important taxed goods consumption is in the total basket of expenditures for low income and high-income households. Examples of such goods and services might include electricity, potable water services and food. We know that the weight of these goods on total basket of expenditures for low income people is generally high. Thus, environmental taxes will be regressive in the absence of redistributive compensations.

While studies like Brännlund and Nordström (2003) and Cornwell and Creedy (1997) for Sweden and Australia show that carbon taxes would be regressive, Klinge- Jacobsen et al. (2001) find for Denmark that gasoline taxation as well as registration duties for cars may be progressive (OECD, 2004b). Moreover, studies like Symons et all (1994) shows environmental taxes would be less regressive and improve income distribution under some cases.

Symons et all (1994) analyze distributional effects of carbon tax in UK under different scenario with simulation techniques. Reform 1 is a simple carbon tax, with no other tax or benefit alterations. The carbon tax is set at a level that reduces CO2 emissions attributable to household consumption of goods, including fuels, by approximately 20 per cent. Reform 2 aims to achieve approximately the same reduction in CO2 emissions as Reform 1, without any

increase in the price of petrol. The carbon tax is higher than in Reform 1, and the petrol excise duty is more than halved from its present level. Reform 3 maintains the carbon tax of Reform 2, but to seek to maintain neutrality of government revenue, VAT is removed. There is a smaller reduction of CO2 emissions than in Reforms 1 and 2. In Reform 4 the neutrality of government income is approximately maintained by adjustments to various benefit payments, rather than VAT abolition[41].

In Reform 2 household energy, transportation and food prices increase more than in Reform 1. Thus Reform 2 is more regressive and its Gini coefficient is higher which indicates higher income inequality. When we compare Reform 3 and Reform 4, we see that even if prices of food, durables and transportation increase more in Reform 4 than in Reform 3, average weekly expenditure increase more in Reform 4 because of benefit payments. After all Symons et all (1994) concludes that distributional effects of Reform 4 is more beneficial than the other reforms because poorer households have a substantial increase in total expenditure, which more than compensates them for the increased tax rates. Only Reform 4 is beneficial for income distribution when we compare reforms with pre-reform conditions.

There are some other studies that focus on revenue recycling's effect on distribution. Baker and Köhler (1998) consider the distributional effects of imposing additional excise duties on energy products according to carbon content. The assumed duties escalate from 1999 to 2010 and achieve levels reducing CO2 emissions by 10 per cent below baseline by 2010 for 11 EU member states[42]. They concludes that the changes will be weakly regressive

[41] Reform 4 is a revenue-neutral change, which sets a minimum weekly expenditure per adult of £55, increases benefit to pensioner households by £7 per pensioner and to households with children by £7 per child

[42] 11 EU member states include Belgium, Denmark, France, Ireland, Italy, Luxemburg, Netherlands, Portugal, Spain, UK and West Germany

for nearly all the member states in the study if revenues are used to reduce employers' taxes and strongly progressive if they are given back lump-sum to households.

Bork (2006) also analyzes the German government's ecological tax reform[43] in order to understand revenue recycling's effect on distribution. He concludes that whole population loses on average because of the ecological tax reform, even when the reduced social security contributions are taken into account. In most cases, households experience a regressive effect of the reform because advantages arising from the reduction in social security contributions mostly favor the middle and upper-income classes and pensioners and some older people in lower-income brackets do not gain from child benefits. He proposes that government could take some other measures to compensate or mitigate the distributional impacts of the ecological taxes. For example, there are special regulations in the public transport or environment-related support programmes which are funded from the ecological tax revenue.

West and Williamson (2002) finds that the gas tax in USA is regressive, but that returning the revenue through a lump-sum transfer more than offsets this, yielding a net increase in progressivity. West and Williamson's findings show that the Suits index[44] for the gas tax is roughly 0.16. This shows that increasing the gas tax will be regressive. If the revenue is used to cut the labor tax, all households from different income quintiles are substantially better off than when the revenue is discarded. Even if cutting the labor tax reduces the deadweight loss in the labor market, the Suits index falls slightly. Thus, the pattern of regressivity of gas tax remains. However, when the revenue is used to provide a

[43] A new electricity tax was then introduced. Taxes on petroleum and gas have been gradually increased from 1999 to 2003 in five steps. The revenues from ecological taxes are transferred to the pension scheme and the contribution rates. In addition, the government increased child benefits from 112 euros per month in 1998 up to 154 euros per month in 2003 for first and second children.

[44] The Suits Index calculates a single number that measures tax progressivity. The Suits Index is a number ranging between –1 and +1. A negative Suits Index means that the tax is regressive while a positive index indicates a progressive tax

lump-sum transfer to households, the picture changes. Only the households in the bottom income quintile is actually better off as a result of the change and Suits index 0.14, indicating that this tax change is progressive overall.

In the literature, different criteria are applied as "proxy" for wealth such as household current income or life-time income. The literature suggests that the definition retained may affect the results regarding the regressivity of environmental policy. In general, studies indicate that the regressive impacts of taxes are more limited in a life-time context. For instance, taxes on gasoline appear less regressive when taken as a percentage of total consumption expenditures used as a proxy for life-time income (Porteba, 1991 as citied in OECD, 2004b).

Metcalf (1998) also measures the distributional impact of green tax reforms using both annual income and lifetime income. He begin his analysis with a moderate shift in the income tax base in which he replace 10 percent of federal receipts with a cluster of environmental taxes like taxes on carbon emissions, gasoline consumption, air pollution, and the use of new (virgin) materials in production. He finds that the Suits Index for the environmental taxes is -0.248 indicating that this new tax levied would be a regressive tax. When he uses annualized lifetime income rather than annual income, tax reform look slightly more progressive. The Suit index is -0,056 in this case.

As we discussed above, environmental taxes will also affect employment via double dividend hypothesis and thus income distribution. The important point in here is how tax revenue (area 2+3) should be recycled. When we consider employment effects first, double dividend hypothesis mentions that cutting distortionary taxes will increase employment.

Increase in employment may improve income distribution. But when we consider distribution effects first, the studies that we surveyed show that lump-sum transfers rather than cutting distortionary taxes will be progressive and ameliorate income distribution. Beside employment effects via double dividend hypothesis, environmental taxes will have negative effects on employment. As we basically know that environmental taxes increase cost burden of firms, some of these firms will be shut down. Therefore some of the workers become unemployed. Consequently, policy makers should take into account all these factors when they decide whether they impose environmental taxes or not, if they impose how will tax revenues be recycled.

The distributional impact of environmental charges or fees seems to be same with environmental taxes because they have extra burden on producers and consumers. But there is no change to recycle revenues as in the case of environmental taxes. Thus, environmental charges are more regressive. There are limited studies which analyze distributional impacts of environmental charges or fees. One of the important study about this topic is Walls and Hanson (1996)'s one which compares standard vehicle registration fee (in USA) and alternative registration fee systems designed to reduce emissions. In this study, he analyzes three types of alternative registration fee systems designed to reduce emissions: (i) a fee based on annual vehicle-miles-traveled (VMT); (ii) a fee based on hydro carbon (HC) emissions rates, in grams per mile (g/mi); and (iii) a fee based on total HC emissions (g/mi multiplied by VMT). On the basis of annual income and lifetime income, the system appears weakly regressive. The Suits Index for Standard registration fees is -0.09, using annual income, and -0.03 using lifetime income. The Suits Indexes for the three fees are dramatically different from the Suits Index of -0.09 that we obtained above for the current registration fee. The VMT, emissions, and emissions rate fees have Suits Indexes of -0.15, -0.24, and -0.28,

respectively. The Suits Index, on a lifetime income basis, for the VMT fee is -0.06, compared to -0.03 for the existing registration fee (Walls and Hanson, 1996). But, it must be underlined that even if alternative registration fee systems designed to reduce emissions are more regressive than the standard one, long term impacts of alternative regulation fee systems will be more beneficial than the standard one.

Now we turn our attention to environmental subsidy's possible impacts on distribution. In the environmental subsidy case, policy states that each firm will be paid the difference between P'- P^o (=t) for every unit of pollution reduced from the initial point Z^0 in order no to pollute. Then for each unit of pollution, the firms bears a cost that is equal to the subsidy it must give up by not reducing that unit of pollution. The full cost of pollution is P', the PMC (P^0) plus the subsidy foregone. The firms pollutes as long as the marginal benefits exceed this cost. That is Z' In this case, instead of collecting 2+3 as revenue, government now pays t for each unit cut back from Z^0 to Z'. That is the area 4+5. The firms receive these payments. Consumers again pay higher for goods and lose their surplus (2+3+4) as in the case of tax. Since the firms receive the higher price. Thus firms also get the area 2+3. Victims again gain area 4+5+6 and the net gain is 5+6.

Firms become the winner in this case. While consumers lose its surplus, there is also another possible lost for them. Since government face with some burden, it tries to get rid of from this burden by increasing tax rates. In general, subsidies are paid by taxes. If it is financed in a non-lump sum manner, this creates additional social costs (Kriström, 2006). But in practically, there will be also some chances. For instance, firms will use these subsidies to find new techniques which are resource efficient and environment friendly. Thus this will

both increase production and reduce price level. This means that environmental subsidies also improve income inequality in some circumstances.

When we turn our attention to removing environmentally harmful subsidies, it seems that removing environmentally harmful subsidies in agriculture, transportation or energy would destroy income inequality because these kinds of subsidies aim to improve the employment opportunities, living conditions and comfort levels of poor people. Thus this would be a paradox between environmental quality and quality of life for poor. But, the truth of the matter is different. For instance, fuel subsidies are not an efficient way to improve poor people's life standard because rich owners of cars and energy and capital intensive industries benefit more from these subsidies (The Economist, 2008). Coady et al. (2006) analyze the distribution effects of fuel subsidies in Bolivia, Ghana, Jordan, Mali and Sri Lanka. They express that gasoline is used primarily by higher income household; the share of gasoline in low income household's budget is low. Thus, rich people benefits from fuel subsidies. The share of richest 60 percent of households in the total benefits from fuel subsidies ranges from 75-85 percent in these countries (Coady et al., 2006).

Agricultural subsidies encourage the production of environmentally harmful pollution, lead to the excessive use of natural resources and often impose high costs on consumers, taxpayers and government budgets. Even if income from agriculture is high in low income households, generally developed countries like USA, EU countries and Japan highly subsidize their farmer but these countries force developing countries not to subsidize farmers. Besides, developing countries mainly subsidize large farmers. Thus agricultural subsidies benefits developed countries and big farmers. Thus reforming agricultural subsidies is required for better environment and income inequality. This reform should include subsidies

based on low fertilizer, pesticides and energy use per production, production without hormone and high technology use.

It is generally accepted that the distributional effects of a tradable permits system, where the permits are auctioned, are similar to that of a tax. Assume that policy makers set up a tradable permits system which restricts firms to pollute at the level Z'. The firms know that the equilibrium output price will be P'. Their actual costs are P^0, so they are willing to pay an amount P'-P^0 for each permit. The government sells these permits at auction and provides revenue (area 2+3). So this shows that all effects of tradable permit system with auction are same as in the Pigouvian tax.

But, if the permits are grandfathered to the firm, this means that the scarcity rent (area 2+3) stays with the firm. Since any permit receipt can use the permit to produce and to sell output at higher output price and actual costs for firm are still Po firms make profits of area 2+3. In other words, the grandfathering of permits makes the owners of the firm wealthier, but does not change their marginal production costs (Cramton and Kerr, 1999). Thus they create windfall gains for firms and worsen income distribution. Alternatively, if the permits are auctioned, the rent will be captured by the governments, so that the revenues are returned to the taxpayers. So, from a distributional point of view, auctioned permits are equivalent to taxes (Kriström, 2006).

Available evidence on income distribution impacts of tradable permits is limited and some studies indicate a possible progressivity of the instrument like the survey by Markandya (1998) on permit markets in the U.S. Markandya (1998) states that the simulation analysis

carried out on US schemes have shown a net benefit to low income households in using marketable permits compared to conventional command and control instruments.

Dinan and Rogers (2002) examine the distributional effects of an allowance policy designed to achieve a 15 percent decrease in carbon emissions from a business-as-usual baseline under different mechanisms for allocating emissions permits. They assume that the government would use that additional revenue in one of three ways: to decrease corporate taxes, to decrease payroll taxes or to provide lump-sum rebates to households. Dinan and Rogers (2002) show that while households in the lowest income quintile would be worse off under grandfathered permits; households in the top income quintile would be better off. In contrast, average household income in the lowest quintile would increase if the government were to auction the permits off and use the revenue to issue lump-sum rebates. Household income in the higher quintile would be better off under auction with decrease in corporate taxes because the gains they receive directly (due to their stock holdings) and indirectly (due to the decrease in the corporate tax when revenue is recycled) is greater than their increase in cost due to the policy-induced price increases and associated deadweight losses in the carbon market and factor markets. Further, higher-income households benefit more when the government decreases corporate taxes than when it decreases payroll taxes.

Parry (2004) estimates the burden borne by different income groups when emissions permits are used to control power plant emissions of carbon, SO2, and NOx. He also compare the burden borne by poor households under permits with that under emissions taxes, performance standards, technology mandates, and input taxes. Grandfathered emissions permits are strongly regressive for all pollutants for emissions reductions below about 40-50%. The degree of regressivity is especially large at low amounts of abatement as permit

rents, and hence the windfall gains to the top income group, are a relatively large portion of the initial burden levels. He also shows that the top income quintile is always better off or not as worse off under grandfathered permits than other policies. Unlike grandfathered permits, the other policies do not transfer wealth in favor of the top quintile through higher profit income. The bottom income quintile receives more income compensation from the government under the emissions tax than under grandfathered permits. And under the performance standard and technology mandate bottom quintile bears a smaller initial burden as there are no permit rents reflected in higher product prices.

All these studies show that auctioned tradable permits are better, from a distributional point of view, than grandfathered one. As we see above, the result is same under the employment effect. While it is politically easy to use grandfathered tradable permits system, policy makers should take into account both these effects in order to make a right decision.

Both theoretically and practically, it is generally assumed that command and control programs are less efficient than market based instruments. Now we turn our graphical analysis in order to understand distributional effects of command and control instruments. Suppose that policy makers restrict pollution to no more than Z'. Consider the simple case where the production technology requires a fixed amount of pollution per unit of output and where the government requires every firm to set pollution to 80 percent of last year's level. In this case the price of output must rise to P' but actual production costs have not changed. The result is super-normal profits. Consumers lose surplus area 2+3+4. Firms earn scarcity rents ($P' - P^0$) for each of Z' units. Thus firms take area 2+3. Cutback in pollution reduces external damages (area 4+5+6). The net gain is area 5+6.

Command and control instruments will affect the cost of production and therefore the price households pay for the good or service. Indeed, sooner or later the costs for stringent environmental policy will be passed on to the households through higher market prices. Since there is no compensation opportunity in command and control instruments, household, especially in the lower income quintile, would be worse off.

The literature on the distributional effects of command and control instruments is scant compared to studies available on the impacts of market-based instruments. Robinson (1985) presents direct measurements of the distribution of industrial pollution abatement costs across twenty income classes, as a percentage of consumers' income and expenditures, for the years 1973 and 1977 in USA. Robinson (1985) finds that in 1977, 1.09% of income or 0.510% of personal consumption expenditures of the lowest income class paid indirectly for abatement costs implicit in purchased goods. For the highest income class, the corresponding figures were 0.218% and 0.423%, respectively. This figure shows that command and control instruments tend to be regressive.

Hee and Bae (2003) also analyze the distributional impacts of air quality regulations in Houston and Los Angeles, the two leaders among polluting cities in the United States. Bae (2002) concludes that the costs of air quality regulations tend to be regressive, but the benefits are progressively distributed. The high costs of air quality regulations are outweighed by the benefits in the form of favourable health effects and capitalized increases in house values.

In the voluntary approaches case, results will be same as command and control program because firms that use voluntary approaches windfall profits. As we mentioned above, voluntary approach may create a barrier to entry in terms of economies of scale or of

absolute cost advantages since voluntary target is reached through large R&D investments or by building a new large plant. The case of the German agreement on End of Life Vehicles[45] is a good example for competition effect. Competition in the car recycling industry would be in danger of being harmed to the detriment of small and medium-sized businesses owing to co-operation between large manufacturers and suppliers. This would happen because of the dominant influence of car manufacturers and suppliers on the licensing criteria for recyclers, leading to criteria erecting unnecessary barriers to entry and thereby favoring financially strong companies (Börkey and Leveque, 2000: 51-52). Therefore, if firms use this monopoly power and increase their price, this will hurt consumers and so income distribution.

5.5 Health Effects of Environmental Policies

Environmental pollution and degradation exert significant pressure on human health. Exposure to air, water and soil pollution, to chemicals in the environment, or to noise, can cause cancers, respiratory, cardiovascular, cerebrovascular and communicable diseases, as well as poisoning and neuropsychiatric disorders. A recent World Health Organization (WHO) study (Prüss-Üstün and Corvalán, 2006) suggests that 24% of the global burden of disease and 23% of all deaths are attributable to environmental factors. Diseases with the largest absolute burden attributable to modifiable environmental factors included: diarrhoea; lower respiratory infections; 'other' unintentional injuries; and malaria.

It must be also noted that low-income households are often more exposed to environmental pollution than middle- and high-income households and thus are also more vulnerable. For instance, at the global level, air pollution is estimated to be responsible each

[45] End of Life Vehicles is a project which aims at making vehicle dismantling and recycling more environmentally friendly, sets clear quantified targets for reuse, recycling and recovery of vehicles and their components and pushes producers to manufacture new vehicles also with a view to their recyclability.

year for approximately 800 000 premature deaths, or 1.4% of all deaths worldwide and 6.4 million years of life lost, or 0.7% of the world total. This burden of disease is most important in developing countries, causing an estimated 39% of years of life lost in south-east Asia (e.g. China, Malaysia, Viet Nam) and 20% in other Asian countries (e.g. India, Bangladesh) (OECD, 2008b).

Environmental degradation has increased mercurially for a long while. Because of this, the costs of healthcare from environmental degradation are likely to become greater in the years to come. If we don't take any serious steps to reduce environmental degradation, the costs of healthcare will gather exponentially. Therefore, efficient environmental policies should be implemented in order to address those environmental problems that have the strongest effects on human health. If efficient environmental policies are implemented, health will become one of the most important benefits of environmental policies.

As OECD (2008a) mentions, from an economic perspective, health effects are usually expressed in two forms: either as values of the costs of illness (*COI*) or as willingness-to-pay (WTP) values to avoid a given disease or risk. COI values include medical costs and productivity loss associated with illness, whereas WTP encompass direct and indirect costs of illness and intangible aspects (*e.g.* pain and suffering, time spent in taking care of sick people, impossibility of leisure or domestic activities when sick, etc.) as well..

OECD (2008a) summarizes a review of the literature on the valuing the health related costs of environmental degradation. For example, the World Bank (2007) used a WTP approach to estimate the health costs of air pollution in China. Total air pollution damages to health represented 3.8% of China's GDP (USD 69 billion). Muller and Mendelsohn (2007)

estimated the gross annual damages in the US associated with six different air pollutants: ammonia, nitrogen dioxide, PM10, PM2.5, sulphur dioxide and volatile organic compounds. Depending on the approach used for modelling the human health effects, the study estimated the gross annual damages to range between USD 71 billion (0.7% of GDP) and USD 277 billion (2.8% of GDP) per year.

Narayan and Narayan (2008) shows that sulphur oxide emissions and carbon monoxide emissions have a statistically significant positive impact on health expenditures' of eight OECD countries, namely Austria, Denmark, Iceland, Ireland, Norway, Spain, Switzerland, and the UK. They also conclude that countries with higher pollution have higher per capita health expenditures, and countries that spend more on defending environmental quality have lower expenditures on health care. These studies show that environmental problems will cause huge health costs. All these costs are burden for both government budget and consumer's pocket. Thus environmental policies should be implemented by governments in order to reduce or abolish these huge costs.

In the literature, cost-benefit analyses (CBA) are useful to assess the efficiency of environmental policies. Studies for Japan, France, Mexico and UK show that environmental policies are mostly efficient in the view of health effects (OECD, 2007). Economic studies have also demonstrated that environmental policies to improve the quality of drinking water and sanitation facilities can have significant health benefits, reducing mortality and morbidity-related health costs of waterborne diseases. For example, drinking water quality improvements in the US and recreational water quality improvements through sanitation (*i.e.* sewage treatment) in France, Portugal, the US and the UK show that huge health benefits can result from policies (OECD, 2008a).

As we mentions before, environmental policies will also have positive effects on economic growth if we consider health and life expectancy as the main channel of transmission. Since environmental policies have positive effects on health, it is accepted that these positive effects on health both increase individuals' productivity. For instance, Pautrel (2007) investigate the impact of environmental policy on growth in an *AK*-type growth model, when the link pollution, health and life expectancy is the main channel of transmission. Pautrel (2007) finds that environmental policy has an ambiguous effect on growth in the steady-state when the detrimental effect of pollution on health and lifetime is taken into account. For low levels of taxation, the environmental policy promotes growth because the positive effect of a lower net flow of pollution on health and life expectancy offsets the drag-down effect on the investment due to the increasing tax. Workers are compensated because of deleterious condition in some sectors like mining. Environmental polices that affect these sectors and improve conditions of these sectors will also cause to reduce wage. This will also reduce cost of firms in that sector and have positive effect on economic growth.

Consequently, in the case of health effects, environmental policies will directly affect health conditions and health costs and indirectly affect economic growth, productivity and wage levels. OECD (2007) gives some lessons in order to benefit more from health effects of environmental policies. First, the less stringent policies are rather effective. Second, simple. policies are sometimes the most efficient. Third, policies introduced recently benefit from the experience of countries which introduced similar policies few years before. Fourth, policies targeting several pollutants at the same time are more efficient than single pollutant-policies, meaning that there are economies of scope in abatement policies.

6. CONCLUSION

If we don't take steps, low lying coastal cities like New York, London will submerge. We think that this will only occur in films. But not, it will also occur in real life. We read from history books that some nations emigrated because of climate changes. We think that these kinds of emigrations could only occur in the past. But not, emigrations because of climate change can occur in the future. Environmental degradations like water and air pollution, global warming, deforestation, soil degradation severely threaten humankind. For instance, a new crisis is emerging; a global food shortage will be the most serious problem that the world has ever seen. World Bank President Robert Zoellick warned climbing food prices may have been pushed into poverty as a result of high prices over the last 2 years. The world will also suffer from water shortages which will lead to serious wars in the future. As if high tension is not enough in these days, social tensions will increase because of these struggles.

All of these will happen because of our misuse of environment. The world is exhausted as the day goes on. Thus, taking some steps is necessary and somehow inevitable. Environmental policies like tax, charges, subsidies, command and control approaches, tradable permits and voluntary approaches will be good step to tackle with environmental degradations.

In this thesis, environmental policies were analyzed into three categories: market based policies (environmental tax, charges, subsidies and tradable permits); command and control approaches and pure market based policies (the Coase Theorem and voluntary approaches). Command and control approaches were popular among environmental policies before 1980's. But, neoliberalism has come to dominate in public policies for nearly past

three decades. According to neoliberalism which is based on neoclassical-influenced economic theories, the power of state should be minimized because it is a source of inefficiency. Thus, countries quickly adopted the package of stabilization and adjustment measures based on liberalization, privatization and deregulation with neoliberalism trend. This trend also affected environmental policies. Trend in environmental policies shifted from command and control approaches to environmental taxes and charges. Compare to command and control approaches, taxes and charges are market based environmental policies. Rather than determining explicit directives as in the command and control approaches, market-based instruments are regulations that encourage behavior through market signals.

Even if it was used in 1970's, tradable permits became so popular especially after the Kyoto Protocol. The effects of green consumerism and desire of escaping other regulations channel firms to voluntary approaches which is a pure market based policy. All these policies have some advantages and disadvantages. They affect economic growth, employment, competitiveness & technology, income distribution and health through directly and indirectly. These are the most important pillars of economic development. Thus we focus on the effects of environmental policies on economic growth, employment, competitiveness & technology, income distribution and health in order to analyze the effects on economic development.

It is clear that environmental policies' main aim is to change consumption and/or production patterns by internalizing negative environmental externalities. Thus they increase the costs of production. According to some scholars, this extra cost reduces output, increases prices and finally reduces income growth and employment. They suggest that policies usually increase the price of goods whose share in the low income households' consumption basket are high, thus environmental policies, especially taxes and charges worsen income

distribution. They also suggest that tradable permits and voluntary approaches cause windfall profits for firms and thus they also deteriorate income distribution. It is also underlined that removing environmentally harmful subsidies will hurt poor people. Because removing agricultural subsidies cut farmer's income and removing energy subsidies increase the electricity and fuel bills of poor people. Thus governments fear that removing environmentally subsidies will hurt people and this will increase social tension. Thus governments are on the horns of a dilemma between protecting the environment through environmental policies and promoting economic development. Consequently, these scholars state that environmental policies will be harmful for economic development in a roundabout way and there is a trade-off between protecting the environment and promoting economic growth.

Their analyses seem static not dynamic because they don't take into account positive effects of new technologies and revenue recycling. Other scholars suggest that environmental policies will be a good chance for economic performance of firms and countries. Environmental policies force firms to use new technologies and clean production techniques in order to reduce the costs from these policies. These improvements in production process bring energy efficiency and waste reduction. We are in the time where energy prices skyrocket, innovation is so crucial and green consumerism ask for environmental-friendly products. Thus firms and countries which use environmental policies efficiently step forward and gain competitive advantage. For example, the technology company 3M began its pollution prevention programme in 1975 and is still profiting from it. 3M has saved over 740 million euros since then (NHEEPA, 2005).

Some scholars have assumed that investments to protect the environment provided

financial benefits to firms. Environmentally conscious investors want to invest environmentally friendly firms. Favorable environmental records show that this firm use its resources and recycle them efficiently. This will be a good indicator for financial investors. Well known financial institutions like Citigroup, Goldman Sachs and JPMorgan signed the Equator Principles encourage financing environmentally friendly firms. Thus, firms that use environmental policies efficiently will pay low interest and premium to banks and insurance companies. All these financial benefits will be competitive advantage for environmentally friendly firms and environmental policies will be triggering factor for firms.

From both theoretical and practical studies, two environmental policies – environmental taxes and tradable permits with auction- create extra revenues for government and if this revenue is used to cut distortionary taxes on labor and capital, it will both increase employment and income growth and ameliorate tax systems and income distribution. Thus revenue recycling is an important factor for efficiency of environmental policies. There are also some other positive effects of environmental policies on employment. As Goodstein (1994) mentions, demand for clean technologies such as photovoltaic, solar thermal and wind electricity, energy- and water-efficient technologies, efficient electric vehicles and clean battery storage, and high-speed trains for transportation will be the driving force behind industrial job creation in the 21st century.

But, we must underline an important point about technology as an aside in here. There are some controversies about technological improvements. The Club of Rome's report "Limits to Growth" (1972) state that humankind has compiled coped with limits to economic growth by developing technological advances. The report believe that many of the technological developments like recycling and pollution-control devices will be vital to the

future of human society if they are combined with deliberate checks on growth. But, as the report wasn't certain about whether technological improvements forestall limits to growth or not, it is also not certain whether technological improvements are enough in order to forestall environmental degradations.

First of all we have to underline that improvement in technologies doesn't mean that these new technologies will substitute for environmental goods. The main aim of new technologies is to not damage the environment anymore. Secondly, technological improvements play an important role in the development processes of countries. Countries cannot take competitive advantage without using new technologies. Consequently, new technologies are necessary in order to forestall environmental degradations and promote economic development. Thus environmental policies provide big opportunities for better environmental quality and economic development.

It is also clear that environmental policies improve health conditions. Environmental policies will be a good tool in order to deter some diseases like lung and skin cancers, respiratory, cardiovascular, cerebrovascular and communicable diseases, poisoning and neuropsychiatric disorders. Thus, labor will become more productivity and wage levels will reduce, thus employment will increase since improvement in health conditions of labor reduce health compensations in wages.

The thing what is definite that environmental policies have costs and benefits. According to UNDP (2007), the average annual cost of stabilizing emissions would amount to 1.6 percent of world GDP. It represents less than two-thirds of global military spending. Thus this is an affordable cost. Even if environmental policies distort economic performance in the

short run, it is necessary to use these kinds of policies in order to save our planet. Without these policies, we will exhaust our resources day by day, thus there will be nothing left to eat, drink and breathe. We start to face with the harmful effects of environmental degradations as in the last food crisis. If we don't take steps, the cost of environmental degradations will increase and the catastrophe will become unavoidable. We cannot achieve anything without pain. As Marxist belief mentions, capitalist style production and consumption patterns cause these degradations. Therefore we must think that where we make mistakes. The crucial point is to recover from mistakes quickly and try to minimize its cost efficiently.

It is not necessary to adopt anti-growth belief as dark greens and deep ecologist do because environmental polices has also some economic benefits. The important point is using environmental policies with a favorable way for economic development. Both theoretically and practically, it is clear that environmental taxes and tradable permits with auction are the most efficient policies in order to achieve better environmental quality and promote economic development. But governments should take into account their countries' social, political and economic conditions, when they select the environmental policies.

Consequently, governments must clearly determine environmental targets and policies, set institutions, impose penalties, encourage firms and households with using different incentives and pave the way for firms that want to use voluntary approaches. Governments also must choose their environmental policies with considering their social, political and economic conditions and secondary effects of these policies. Rather than using only one kind of environmental policy, environmental policies should be used in combination with one or more other environmental policies because it is hard to achieve better environmental quality with using one policy for all segments of country.

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