Int. J. Environ. Res., 6(1):71-80, Winter 2012
ISSN: 1735-6865

Evaluating the Developed Countries Policy Making Toward Environmental Cases

Mossalanejad, A.

Department of political sciences, Faculty of law and political sciences, University of Tehran, Iran

Received 16 March 2011; Revised 12 Aug. 2011; Accepted 22 Aug. 2011

ABSTRACT: Today, Economic and environmental performance are tightly closed to each other. The natural environment plays an important role in supporting economic activity; directly, by providing resources and raw materials such as water, timber and minerals that are required as inputs for the production of goods and services; and indirectly, through services provided by ecosystems including carbon sequestration, water purification, managing flood risks, and nutrient cycling. Natural resources are, therefore, vital for securing economic growth and development, not just today but for future generations. Economic growth has also provided developing countries the opportunity to improve the quality of life of their citizens, and to balance the environmental challenges they face. Investment, aid and demand for imports from advanced economies all have an important role in supporting economic growth and development through the world. The main objective of this paper is to highlight the role of the natural environment in supporting and contributing to economic growth, and the role of environmental policy in achieving improved environmental outcomes in ways that are compatible with the long-term health and stability of the economy. It does not try to answer the question of what the sustainable level of economic growth might be, but instead reviews the evidence and sets out an approach for securing environmentally sustainable economic growth for current and future generations.

Key words: Developed Countries, Environment, Policy Making, Productivity Growth, Ecosystem

INTRODUCTION

Achieving the sustainable economic growth will require absolute decoupling in production of goods and services from their environmental impacts (Ezebilo, 2010; Dehghani *et al.*, 2010; Ehsani and Quiel, 2010; Monavari *et al.*, 2010; Vicente and Crezo, 2010; Zagas *et al.*, 2010). This means consuming environmental resources in a sustainable manner– whether by improving the efficiency of resource consumption or by adopting new production techniques and product designs. It also means avoiding breaches in critical thresholds beyond which natural assets cannot be replaced and can no longer support the desired level of economic activity. Existing commitments to avoid dangerous climate change exemplify the need for absolute decoupling, requiring a reduction in greenhouse gas emissions, even in the face of an expanding global economy. While empirical evidence suggests that the Developed Countries is achieving absolute decoupling for many air pollutants and carbon emissions, this does not hold true for all environmental resources and across all developed economies. Moreover, evidence shows that the decoupling in the Developed Countries is partly explained by shifts in the location of production, with many of the goods and services consumed in the Developed Countries now being produced in other countries. This highlights the importance of technology and innovation in reducing environmental impacts, not just in the Developed Countries but through the world.

*Corresponding author E-mail: abbassmossalanejad@gmail.com

Environment and Economic Growth

Economic growth involves the combination of different types of capital to produce goods and services. These include:

- produced capital, such as machinery, buildings and roads;
- Human capital, such as skills and knowledge;
- Natural capital, for example, raw materials we extract from the earth, carbon sequestration services provided by forests and soils; and
- Social capital, including institutions and ties within communities.

The formation of Economic Growth – whether produced, human, social or natural – is vital for economic growth. Declining levels of some natural assets – for example, the use of minerals and metals in manufacturing – can be acceptable as long as the decision to deplete them reflects the real costs of environmental resources, taking into account their scarcity and how substitutable they are, and only if adequate investments are made in other types of capital.

Environmenta and Sustaining Growth

The role of environmental policy is to manage the provision and use of environmental resources in a way that supports improvements in prosperity and wellbeing, for current and future generations. There are a number of reasons why government intervention is needed to achieve this. In particular, market failures in the provision and use of environmental resources mean that natural assets would be over-used in the absence of government intervention. These market failures arise from the public good characteristics of the natural environment; 'external' costs and benefits where the use of a resource by one party has impacts on others; difficulties in capturing the full benefits of business investment in environmental R&D; and information failures.

Environmental policy, including infrastructure and other investments, can reduce how vulnerable the economy and enterprises are to adverse environmental events – both by reducing environmental risk and by increasing the economy's resilience to these risks. For example, not just investments that facilitate emissions reductions to avoid dangerous climate change, but also those investments that help the economy adapt to climate impacts already locked-in by past and current emissions.

Environmental Policy and Economic Impacts

Policies that improve the efficiency with which enterprises use resources, such as energy, water and materials, produce not just environmental benefits but also financial savings for enterprises. For example, it was estimated in 2007 that businesses in the Developed Countries could save up to £6.4 billion per year by taking no- or low-cost measures to improve their resource-efficiency – by reducing energy and water use and volumes of waste generated.

More generally, policies aimed at pricing environmental resources correctly could raise costs in the near-term. There is also some evidence of short-term trade-offs between environmental regulation and growth (or productivity), but these effects have typically been found to be small or even insignificant. For example, economic modeling of the impacts of the EU Emissions Trading Scheme has found the macroeconomic effects to be almost negligible.

In the long-term, the cost to growth of acting now to ensure sustainable and efficient use of natural assets is likely to be smaller than the costs of not acting. For example, in the context of climate change, the costs of avoiding catastrophic climate change range from a 1% gain to a 3.5% reduction in global GDP in 2050, whereas the costs of not doing so are estimated to be much larger – between 5% and 20% of global GDP. Creating the right incentives now to shift to more environmentally sustainable production and consumption patterns reduces the need for more drastic and costly adjustments in the future.

Pardoxes of Economic Growth and the Environment

While economic growth has produced many benefits – raising standards of living and improving quality of life across the world – it has also resulted in the depletion of natural resources and the degradation of ecosystems. There has been much debate over whether or not it is possible to achieve economic growth without unsustainably degrading the environment, and a growing realization that economic growth at the current rate of depletion and degradation of environmental assets cannot continue indefinitely (Meadows *et al.*, 1972).

In the context of environmental resources more generally, the Millennium Ecosystem Assessment (2003) found that 15 out of the 24 ecosystems services it examined were being degraded or used unsustainably, and the use and consumption of natural resources such as minerals and metals continues at an increasing pace.

Some take the view that the finite resources of the Earth place limits on the extent to which economies can keep expanding in the long-term. Others believe that using environmental resources sustainably is consistent with continued economic growth, with the costs of inaction likely to be far greater than the cost of acting now (Treasury, 2009).

Policy Making on Environmental and the Economy

The ecosystems services framework provided by the Millennium Ecosystem Assessment (2005) suggests that the assets and services provided by the natural environment can be aggregated into four broad categories:

The OECD defines natural capital as "natural assets in their role of providing natural resource inputs and environmental services for economic

production". This ranges from clean air and water, to the soils we use to grow crops and the minerals and ores we extract from the earth (Choudhury and Jansen, 1997).

- **Provisioning Services** – products obtained from ecosystems, including fresh water, food, fiber, genetic resources, biochemical, natural medicines and pharmaceuticals.
- **Regulating Services** – benefits obtained from the regulation of natural processes, including air quality, climate, water/flood, erosion, water purification, disease and pest control, pollination, buffering pollution.
- **Cultural services** – non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic enjoyment.
- **Supporting Services** – services that are necessary for the production of all other ecosystem services, including soil formation, photosynthesis, primary production, nutrient cycling and water cycling.

Ecosystems have a wide range of impacts on both the quantity and quality of labor. The World Health Organization estimates that the apportioned burden of disease from water and air pollution accounts for the loss of over 100 million disability-adjusted life years globally each year. While the majority of global impacts occur in less developed countries, they also impose significant costs on the DEVELOPED COUNTRIES economy. The effects of outdoor air pollution on our respiratory and cardio-vascular systems are estimated to lead to between 12,000 and 24,000 premature deaths every year. It is estimated to reduce overall life expectancy by up to 7-8 months per person and cost the Developed Countries £20.5 billion per year.

The natural environment contributes to human capital in other ways too. For example, there is evidence to suggest that the availability of green spaces makes it more likely that people will undertake and sustain physical activity, a key factor in good physical and psychological wellbeing. It was recently estimated that the lack of physical activity costs England more than £8 billion a year, in addition to approximately £2.5 billion in obesity-related costs. The availability of wildlife-rich areas and green space could also have wider effects, for example, in treating stress, improving mental health, reducing crime, and improving the productivity of workers (Innovas, 2009).

The demand for a clean and healthy natural environment provides opportunities for employment and wealth creation; for example, organic agriculture and industries responsible for managing and protecting natural resources. Other industries aim to reduce the environmental impacts of economic activity; for example, through generating renewable energy, through waste management techniques, and through products and technologies that reduce air and noise pollution from production processes. Yet others aim to mitigate adverse environmental impacts and restore natural assets to their previous condition, such as water treatment services and land remediation.

Policy Making Where Environment is an Output

The load of environmental damage versus GDP is shown in Fig. 1. The shape of the curve can be explained as follows: As GDP per capita rises, so does environmental degradation. However, beyond a certain point, increases in GDP per capita lead to reductions in environmental damage (Lewis, 1954) specifically:

- At low incomes, pollution abatement is undesirable as individuals are better off using their limited income to meet their basic consumption needs;
- Once a certain level of income is achieved, individuals begin considering the trade-off between environmental quality and consumption, and environmental damage increases at a lower rate;
- After a certain point, spending on abatement dominates as individuals prefer improvements in environmental quality over further consumption, and environmental quality begins to improve alongside economic growth (Economides and Philippopoulos, 2008).

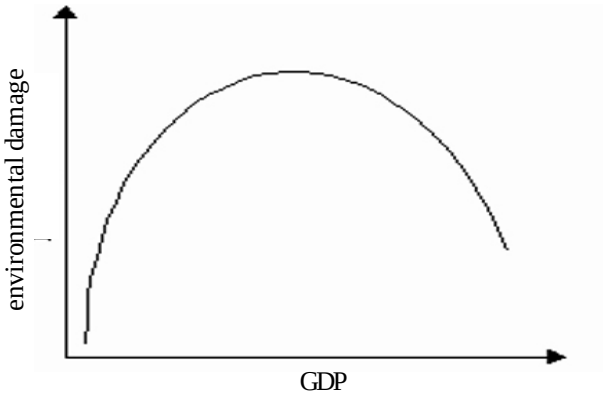

Fig. 1. Behaviour of environmental damage versus GDP

Other possible explanations for the shape of the Environmental Curve include:

- **Technological Progress:** firms initially concentrate on expanding production as quickly as possible, but as technology evolves production processes become cleaner and more resource efficient;
- **Behavior Change:** society is at first interested in higher levels of consumption, regardless of the means by which it is achieved, but after a certain

point greater consideration is given to other factors affecting quality of life, including the environment;

• **Lewis Growth Model:** the development pattern of any economy is characterized by the changing patterns of economic activity. Stage 1: society concentrates resources in the primary sector (i.e. extraction, agriculture) to satisfy necessary consumption; Stage 2: resources are switched to the secondary sector (i.e. manufacturing) as basic needs are satisfied and further consumption is concentrated on consumption goods; and Stage 3: society moves from the secondary to the tertiary sector (i.e. services) characterized by much lower levels of pollution. However, this model is less applicable in an increasingly globalised world where the move from stage 1 to 3 may happen as the result of a shift rather than a reduction in the levels of pollution.

The Environmental Curve relationship was initially observed for some elements of air pollution (suspended particles and NO_X), and the turning point – or the point beyond which increases in GDP per capita lead to reductions in emissions – was estimated to be $5,000. Subsequent studies have estimated the turning point to be generally higher, but have found evidence of the EC applying to a larger set of environmental variables (Dutt, 2009).

However, there are several reasons to question the relevance of the EC hypothesis to policy-making.

• First, the definitions of environmental quality normally used in EC analyses are based on a limited set of pollutants. As such, the conclusions reached by these analyses are not applicable to all types of environmental damage. For example, there was no evidence of an EC relationship in the Ecological Footprint – an aggregate measure of the pressure human beings place on the environment – unless energy use was removed from the measure (Caviglia-Harris *et al.,* 2009). The Environmental relationship appears strongest for pollutants with significant local impacts. For carbon and other greenhouse gases, on the other hand, where the impacts are global and diffuse, emissions have continued to rise with increases in income per capita – even in the richest countries (Ranjan and Shortle, 2007).

• Second, the econometric evidence put forward in support of the EC has been found to be less reliable and robust than previously thought. For example, the choice of model used to describe the relationship between income and pollution has a significant impact on the results of the analysis (Bimonte, 2009).

• Third, the existence of hysteresis may reduce the relevance of EC to environmental policy. Specifically, the costs of repairing damage and improving environmental quality once the economy is past its turning point may be drastically higher than the cost of preventing the damage or undertaking mitigation earlier; for example, cleaning up a polluted waterway, where the cost of avoiding the pollution in the first place is lower than the subsequent cost of the cleanup.

• Fourth, it has been shown that countries with similar levels of wealth perform differently, without any clear or systematic signs of convergence. Furthermore, it is been suggested that the decreasing part of the EC exists only for economies with less inequality and a relatively uniform distribution of wealth (Grossman and Krueger, 1993). Therefore, while there is some evidence of an EC relationship existing for certain countries and for certain local pollutants, it cannot be generalized to all types of environmental damage and across all countries and income levels. Moreover, it has limited use as a predictor of environmental performance as countries develop.

Policy Making When Environment is Input

There are other alternate theories describing the relationship between economic growth and environmental quality. Another theory questions the existence of turning points, and considers the possibility that environmental damage continues to increase as economies grow (see fig. 2.2b). This is similar to the new toxics view, where emissions of existing pollutants are decreasing with further economic growth, but the new pollutants substituting for them increase (Dietz, (2000).

The limits theory considers the possibility of breaching environmental thresholds before the economy reaches the EKC turning point. Commentators, such as Arrow et al. (1996), suggest that the risk of small changes causing catastrophic damage means that solely focusing on economic growth to deliver environmental outcomes could be counter-productive. For example, in the context of biodiversity, increased spending on maintaining species diversity will not be able to recreate extinct species. The limits theory defines the economy-environment relationship in terms of environmental damage hitting a threshold beyond which production is so badly affected that the economy shrinks (Fig. 2). Stern (2004) discusses a further possible relationship between economic growth and the environment in the context of international competition. International competition initially leads to increasing environmental damage, up to the point when developed countries start reducing their environmental impact but also outsource polluting activities to poorer countries. The net effect is, in the best case scenario, a non-improving situation. This model is known as 'race to the bottom' (Stern, 2004).

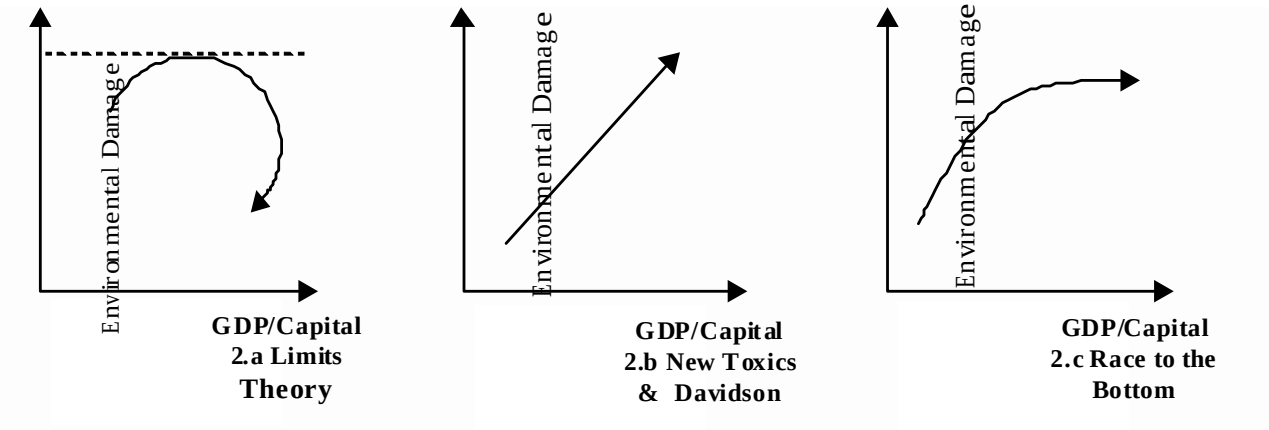

Fig. 2. Alternative views of the economic growth and environmental damage relationship

Relationship of the Economy-Environment

What these various theories demonstrate is that the relationship between economic growth and the environment is complex and multi-dimensional. While there may be no conclusive evidence on the shape of the economy-environment relationship, these theories provide a useful starting point for thinking about the factors that drive this relationship. These can broadly be divided into three effects (Fig. 3):

- **The Scale Effect** – economic growth has a negative effect on the environment, where increased production and consumption causes increased environmental damage;
- **The Composition Effect** – the composition of production changes along the growth path: initially economic growth leads to industrialization (and as the goods balance shifts from agriculture to manufactured products, environmental damage increases); but the balance then shifts from producing manufactured goods to producing services, due to both demand- and supply-side changes, reducing the level of domestic environmental damage;
- **The Technical Effect** – technological developments lead to a change in the environmental impacts of production. Whilst this often means reductions in environmental intensity, for example improvements in energy efficiency, it could also represent technological advances that lead to greater environmental damage (such as through increased energy use).

Changes in the preferences of society may also drive changes in environmental damage, for example through encouraging changes in the stringency of environmental regulation of industry. The relative size of these effects determines the relationship between economic growth and the environment (Ekins, 2000).

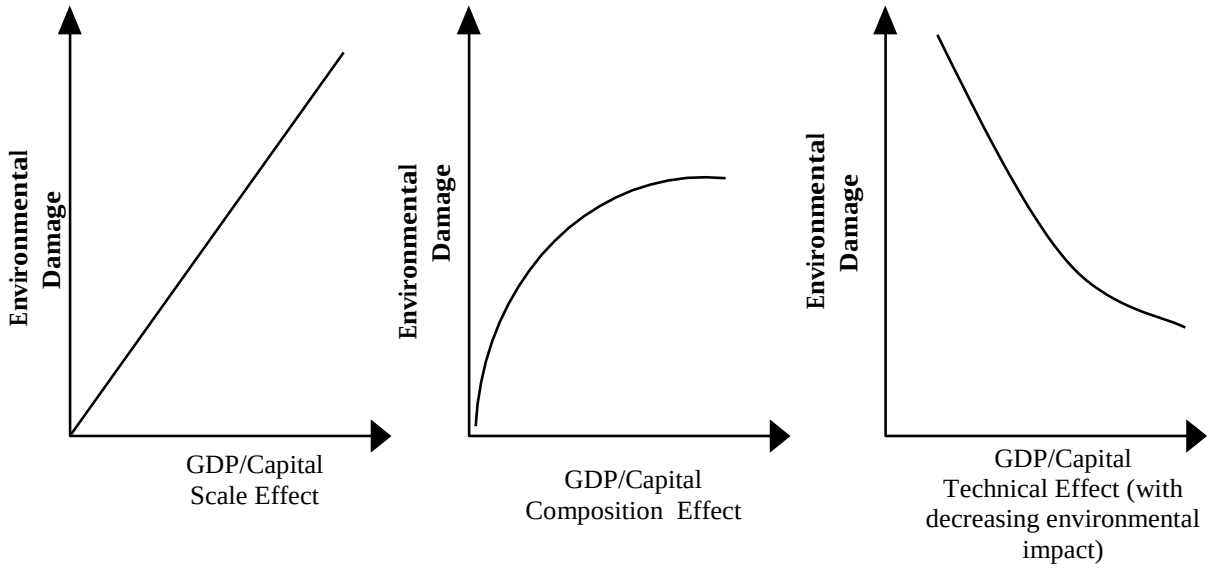

Fig. 3. Drivers of the domestic economic growth – environmental damage relationship

Updated analysis using OECD data up to 2005 indicates greater evidence of absolute decoupling in recent years; for example, Developed countries, Updated analysis using OECD data up to 2005 indicates greater evidence of absolute decoupling in recent years; for example Developed Countries, Germany, and France report absolute decoupling for all indicators. This is shown in Table1, which presents GDP and a selected set of emissions (indexed to their 1990 level). In most cases, emissions have declined in absolute terms, although some decoupling (notably for CO_2) still remains relative rather than absolute. As noted previously, the relationship between economic growth and levels of pollution would be expected to be different for global and local pollutants, which may go some way towards explaining this observation.

Looking specifically at CO_2 emissions, Germany has been the most successful in reducing emissions – by 18% over 1990 levels – but this has happened against a backdrop of relatively low GDP growth. Ireland, on the other hand, has demonstrated exceptional GDP growth – but while it has been successful in reducing the CO_2-intensity of GDP, it has not displayed absolute decoupling.

In terms of the Developed Countries decoupling performance, CO_2 emissions have fallen by 15% while other emissions have fallen by over 40%, all against a backdrop of steady economic growth. Figure below, uses official Developed Countries emissions data to illustrate the extent of absolute decoupling.

The Sustainable Development Indicators published by Defra show similar improvements for a wider set of environmental outcomes; for example, waste going to landfill fell 16% between 1998 and 2006, and Domestic Materials Consumption was 12% lower in 2007 than in 1990.

The Implication of Environmental Policy in the International Context

The globalised nature of the world economy means that decoupling needs to be discussed in the international context, rather than in terms of individual countries. For example, shifting manufacturing activities from advanced to developing countries without a significant change in patterns of domestic consumption simply results in environmental damage being exported from advanced to developing countries and, for global impacts, does not necessarily imply a reduction in overall levels of environmental damage – in some cases it has even led to an increase in environmental damage.

International trade allows greater specialization and leads to improved efficiency in production and consumption. For example, allowing production of goods and services to occur where it is relatively cheapest has economic efficiency and growth benefits; if country A is relatively better at manufacturing goods and country B is better at producing services, the combination of goods and services demanded by each country can be provided at a lower cost if each country produces according to its comparative advantage and engaged in trade, rather than meeting its domestic demand through domestic production.

However, if some of the comparative advantage arises from differences in the stringency of environmental regulation, this could reduce the overall efficiency and growth benefits from trade and specialization. The increasing focus across the world

Table 1. GDP and domestically produced emissions Indices, selected OECD Countries, 2005 (1990=100) (Defra, 2009)

Country	CO_2	VOC	CO	Particulates	NO_X	SO_X	GDP
France	98	52	50	67	66	35	132
Germany	82	35	33	10	50	10	123
Ireland	126	58	55	106	95	38	258
Japan	107	88	67	---	94	76	120
Portugal	143	94	70	133	104	69	135
Turkey	184	---	92	---	166	128	173
Developed countries	85	41	29	53	55	19	143
USA	116	69	62	81	74	63	155

on environmental sustainability also provides an opportunity for Developed Countries environmental and low carbon industries. For example, a recent study by the Department of Business, Innovation and Skills found that the Developed Countries had high revealed comparative advantage – a measure of the relative international strength in the production of that good or service – in industries such as environmental consultancy, wind power, building technologies, and recovery and recycling, amongst others.

The goods and services these industries produce enable reductions in the environmental impact of production, through greater use of low carbon and renewable energy, improvements in the resource-efficiency of production, and a reduction in the environmental impacts of manufacturing (such as air or water pollution).

A recent study estimated that this sector will grow by between 4.7% and 7.7% between 2009 and 2020, even factoring in the effects of the recent recession, suggesting an environmental goods and services sector worth between $1.2 and $1.9 trillion. With this international demand, Developed Countries businesses have an opportunity to become market leaders, and for this sector to be a potential driver of Developed Countries productivity and growth in the future.

Sustaining Economic Growth in the Long-term

Despite short-term downturns and setbacks, the long-term trend in economic output over the last 200 years has been unambiguously upward. New ideas and their transmission, in combination with the accumulation of labor and capital, have enabled sustained economic growth.

Average income has tripled over the last 60 years (with absolute increases in household income for even the lowest income groups) and people are more educated, healthier, and have a higher standard of living than ever before.

The benefits of economic growth have not been restricted to the Developed Countries or other advanced economies. As global GDP has multiplied 21-fold over the last 100 years, it has helped improve quality of life and pull countless millions out of poverty.

Economic growth remains essential to support continued improvements in factors that affect people's wellbeing, from health and employment to education and quality of life, and to help the government deliver on a range of policy objectives – economic, social, and environmental. It is vital for supporting continued improvements in material living standards, for example, by creating employment opportunities and by creating an attractive environment for private investment. Through the tax system, economic growth also supports other factors affecting wellbeing, for example, through continued improvements in the provision of public services and in support for lower income households that reduce poverty, improve health outcomes, and lead to greater educational attainment.

The shift to a low carbon and more resource-efficient economy will require fundamental changes in the structure of the economy. It will require investment in new technologies and innovation, and investments to replace aging infrastructure and reduce future risks from environmental change. Economic growth allows these demands to be met without necessarily reducing investments in other areas that matter to the wellbeing of individuals and society.

Looking beyond the Developed Countries, growth provides developing economies with the opportunity to improve the quality of life of their citizens, developing institutions and industries, raising incomes and providing the means by which they can meet the environmental challenges they face. Through trade, investment, aid and remittance flows, continued growth in advanced economies has an important role to play in reducing poverty and raising standards of living across the world.

Natural capital and sustainable economic growth

The process of wealth creation is generally described in terms of combining factors of production in order to produce goods and services. Some of these goods and services are consumed, while others are used to enhance the capital stock. However, this formulation of output does not fully account for the role of natural capital in the production process and provides an incomplete picture of the contribution of natural capital to economic growth and wealth creation.

The key factors of production to be considered in the context of economic growth are:

- **Produced Capital**– usually man-made capital such as machinery and infrastructure;
- **Human Capital**– such as labor effort, skills, education, experience;
- **Natural Capital** – the raw materials and services provided by the natural environment, such as wood, minerals, water, nutrient recycling; and
- **Social Capital** – whilst definitions of social capital differ, it generally includes institutions and ties within communities. An increase in the quantity of these factors of production increases economic output; for example, through an increase in the labor force or through the development of equipment and

built infrastructure. In addition, technological progress and improvements in the quality of these factors of production improve productivity and increase output; for example, technological progress and the accumulation and application of knowledge allow new and better ways of combining the various factors of production to produce output.

Specific characteristics of natural capital

There is a strong argument for treating natural capital as a significant factor of production in its own right, alongside produced capital, human capital and social capital, and to fully take account of it in production and consumption decisions.

Under traditional assumptions of wealth creation, there are assumed to be no limits to the availability of capital in the long run – it can either be replenished or substituted for by produced goods and services – and the objective of economic growth is consistent and aligned with the efficient use of resources.

However, there are a number of attributes that differentiate natural capital from other types of capital.

- **Environmental assets may have critical thresholds**

Changes to some renewable environmental assets beyond unknown thresholds may cause non-linear and irreversible changes to occur. These thresholds mark the boundary between alternate stable states. If these critical thresholds are breached, the asset may no longer be able to continue providing services or may no longer be adequately replenished, leading to eventual depletion of the asset. Ecosystems are often subject to these thresholds, including 'source limits' such as fish stocks and top soil (where breaching this threshold will lead to a change or collapse in the ecosystem) and 'sink' limits, such as limits to the degree that water and soil can absorb chemical outputs from production, and where breaching this limit can cause temporary or permanent disruption to ecological functioning. However, there is a great deal of scientific uncertainty around if and where critical thresholds might exist. In the absence of robust evidence, the precautionary principle would suggest preventing degradation or depletion well before these thresholds are reached.

- **Environmental assets may have finite limits**

Stocks of non-renewable environmental assets are limited not just in the short run, as traditionally assumed for capital assets, but also in the long run. For example, non-renewable assets such as metals and minerals are limited in the long-run and continued depletion will eventually lead to no virgin reserves remaining. However, identifying where and when these limits exist remains a challenge; for example, identifying which assets are non-renewable and face limits, and over what timescale.

- **Changes to environmental assets are potentially irreversible**

Depletion and degradation of natural assets can often be irreversible, at least within timescales of interest to human civilization. For example, whereas a degraded road can be repaired or worn-out machinery replaced, it is not as simple to replant an ancient woodland ecosystem, and not possible to recreate an extinct species. In many cases, these natural assets are not substitutable to the same degree as produced or human capital.

- **Changes to environmental assets have impacts that extend over many generations**

The present generation's actions will have an impact on the welfare and endowment of future generations. For example, damage to environmental capital not only affects people today, but its impact extends over several generations. Decisions regarding the use of environmental assets need to be evaluated over a similar time scale. Intergenerational impacts complicate the valuation and pricing of environmental assets into economic decisions. For example:

- Economic agents may not be able to accurately evaluate the costs and benefits of actions that far into the future;
- Individuals' discount rates may be higher than those displayed by society as a whole, and may vary over time such that individuals' short-run actions are inconsistent with their long-run preferences (Turner *et al.*, 2007).

CONCLUSION

The role of environmental policy is to manage the provision and use of environmental resources in a way that supports continued improvements in prosperity and wellbeing, for current and future generations.

There are a number of reasons why government intervention is needed to achieve this. In particular, market failures in the provision and use of natural resources mean that natural assets would be over-used in the absence of government intervention.

These market failures arise from the public good characteristics of the natural environment, 'external' costs and benefits where the use of a resource by one party has impacts on others, difficulties in capturing the full benefits of private investment in environmental R&D, and information failures. Each of

these market failures are discussed in greater detail below.

Public good characteristics of the natural environment

Many environmental goods and services are either public goods or partial public goods, and that is a key reason for their under-provision. The non-rival and non-excludable characteristics of public goods mean that markets alone will not be able to provide the socially optimum level – consumers can free-ride and providers are not able to capture or charge for all the benefits provided by the good. For example, use of farmland as a natural flood break provides flood defenses for an entire region. An individual benefiting from these defenses does not reduce its availability for others (non- rival) and individuals cannot be excluded from enjoying its benefits (non-excludable). As a result, individuals may not be willing to pay for the benefit and providers may not be willing to continue to supply it.

Existence of externalities

Externalities occur where the use of a resource by one party imposes costs or benefits on others, but these impacts are not factored into economic decisions. As a result, economic agents– individuals, firms or governments– do not face the full costs/ benefits of their actions on society. Externalities can be either positive or negative, depending on whether actions produce unpriced beneficial or detrimental effects – positive externalities will tend to result in under-provision of the good or service, whereas negative externalities will lead to over-provision.

For example, in the absence of regulation, sewage companies discharging effluent into waterways will not face the full social cost of their activities – in terms of recreational and other benefits foregone and/or the cost to society to remediate the damage – leading to degradation of the environment beyond the economically efficient level. Conversely, the pollination of plants by bees kept for their honey is a positive externality, which cannot necessarily be captured by beekeepers, leading to under-provision of this service compared to the economically efficient level.

Private under-investment in environmental R&D

The market alone does not provide the level of investment in R&D that is best for society as a whole. The private rate of return on investments in R&D does not capture the full benefits to society of this investment, leading to private investment in R&D below the optimal level. Environmental R&D will also be under- provided by the market because many of the environmental benefits are non-market – that is, not reflected in market prices – and therefore investors are not able to reap financial rewards for their investment.

Measures to price in the cost of environmental pollution (and address the externality) increase the private return to environmental investments and go some way in correcting for R&D under-investment. However, addressing this market failure requires additional government support to incentivize and encourage investment to the socially optimum level.

Information failures

Information failures occur when the necessary information for people or firms to make optimal decisions is incomplete, costly to acquire, unavailable or not readily comprehensible. This is especially true for environmental systems, which are inherently complex and non-linear, and reflect a wide range of interdependencies. Given these complexities, decision-makers may not always have the necessary information to deliver an efficient outcome. As a result, existing opportunities to improve both economic and environmental outcomes may not be realized. For instance, information failures are one of the reasons businesses and households frequently do not take-up resource efficiency measures that not just improve environmental outcomes, but provide them with financial cost savings.

REFERENCES

Arrow, K., Bolin, B., Costanza, R., Dasgupta, P., Folke, C., Holling, C.S., Jansson, B., Levin, S., Mäler, K., Perrings, C. and Pimentel, D. (1996). Economic growth, carrying capacity, and the environment. Environment and Development Economics, **1,** 104-110.

Bimonte, S. (2009). Growth and environmental quality: Testing the double convergence hypothesis. Ecological Economics, **68,** 2406–241.

Caviglia-Harris, J., Chambers, L., Dustin, K. and James, R. (2009). Taking the "U" out of Kuznets: A comprehensive analysis of the EKC and environmental degradation. Ecological Economics, Elsevier, **68(4),** 1149-1159.

Choudhury, K. and Jansen, L. (1997). Terminology for integrated resources planning and management. Rome, FAO, Soils Resources Management and Conservation, 59.

Dehghani, M., Farshchi, P., Danekar, A., Karami, M. and Aleshikh, A.A. (2010). Recreation Value of Hara Biosphere Reserve using Willingness-to-pay method, Int. J. Environ. Res., **4(2),** 271-280.

Department for the Environment, Food and Rural Affairs. (2009). Government Economics Service: Review of the Economics of Sustainable Development. Defra.

Dietz, S. (2000). Does an environmental Kuznets curve exist for biodiversity? Institut für Wirtschaftsforschung, Eidgenössische Technische Hochschule Zürich.

Dutt, K. (2009). Governance, institutions and the environment-income relationship: a cross-country study. Environment, Development and Sustainability, **11 (4),** 705-723.

Economides, G. and Philippopoulos, A. (2008). Growth enhancing policy is the means to sustain the environment. Review of Economic Dynamics, Elsevier for the Society for Economic Dynamics, **11(1),** 207-219.

Ehsani, A. H. and Quiel, F. (2010). Efficiency of Landsat ETM+ Thermal Band for Land Cover Classification of the Biosphere Reserve "Eastern Carpathians" (Central Europe) Using SMAP and ML Algorithms, Int. J. Environ. Res., **4(4),** 741-750.

Ekins, P. (2000). Economic Growth and Environmental Sustainability: The Prospects for Green Growth. Routledge, London.

Ezebilo, E. E. (2010). Community-Based Preferences for Economic Incentives to Promote Biodiversity Conservation in a Tropical Rainforest, Int. J. Environ. Res., **4 (3),** 501-506.

Grossman, G.M., and Krueger, A.B. (1993). Environmental Impacts of a North American Free Trade Agreement. In The Mexico-U.S. Free Trade Agreement, P. Garber, ed. Cambridge, Mass. MIT Press.

Innovas, P. (2009). Low Carbon and Environmental Goods and Services: an industry analysis. Report for BERR.

Lewis, W.A. (1954). Economic Development with Unlimited Supply of Labour. The Manchester School, **22 (2),** 139-91.

Meadows, D.H., Meadows, D.L., Randers, J. and Behrens, W.W. (1972). The Limits to Growth. Universe Books.

Millennium Ecosystem Assessment. (2003). Ecosystems and Human Wellbeing: Current State and Trends Assessment. Island Press, Washington DC.

Millennium Ecosystem Assessment. (2005). Ecosystems and Human Wellbeing: Synthesis. Island Press, Washington DC.

Monavari , S. M. and Momen Bellah Fard, S . (2010). A GIS Based Assessment Tool for Biodiversity Conservation, Int. J. Environ. Res., **4(4),**701-712.

Ranjan, R. and Shortle, J. (2007). The environmental Kuznets curve when the environment exhibits hysteresis. Ecological Economics, Elsevier, **64(1),** 204-215.

Stern, D. (2004). The Rise and Fall of the Environmental Kuznets Curve. World Development, Elsevier, **32(8),** 1419-1439.

Treasury, H.M. (2009). The Green Book – Appraisal and Evaluation in Central Government. HMT. Institute for Fiscal Studies, Poverty and Inequality in the Developed Countries, IFS Commentary 109.

Turner, R.K., Morse-Jones, S. and Fisher, B. (2007). Perspectives on the Environmental Limits concept: A report to the Department for the Environment, Food and Rural Affairs, CSERGE, Norwich.

Vicente, J. A. and Cerezo, R. B. (2010). The Socio-Economic Contributions of Marine Protected Areas to the Fisherfolk of Lingayen Gulf, Northwestern Philippines, Int. J. Environ. Res., **4(3),**479-490.

Zagas, T., Tsitsoni, T., Ganatsas, P., Tsakaldimi, M., Skotidakis, T. and Zagas, D. (2010). Land Reclamation and Ecological Restoration in a Marine Area, Int. J. Environ. Res., **4(4),**673-680.